

SOIL SURVEY

Fairbanks Area Alaska



UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
ALASKA AGRICULTURAL EXPERIMENT STATION

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of the Fairbanks Area, Alaska, will serve several groups of readers. It will help farmers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; add to our knowledge of soil science; and provide general information about this part of Alaska.

Soil scientists studied and described the soils and made a map that shows the kind of soil everywhere in the Area. The base for the soil map is a set of aerial photographs that show roads, streams, houses, forests, and many other landmarks.

Locating Soils

Use the index to map sheets at the back of this report to locate areas on the large map. The index is a small map of the county on which numbered rectangles have been drawn to show where each sheet of the large map is located. When the correct sheet of the large map has been found, it will be seen that boundaries of the soils are outlined, and that there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, wherever they occur on the map. The symbol is inside the area if there is enough room; otherwise, it is outside the area and a pointer shows where the symbol belongs.

Finding Information

This report contains sections that will interest different groups of readers, as well as some sections that may be of interest to all readers.

Farmers and those who work with farmers can learn about the soils in the section "Descriptions of the Soils" and then turn to the section "Use and Management of the Soils." In this way, they first

identify the soils on their farm and then learn how these soils can be managed and what yields can be expected. The "Guide to Mapping Units and Management Groups" at the back of the report will simplify use of the map and report. This guide lists each soil and land type mapped in the county, and the page where each is described. It also lists, for each soil and land type, the management group and the page where each group is described.

Engineers will want to refer to the section "Engineering Applications." Tables in that section show characteristics of the soils that affect engineering.

Scientists and others who are interested will find information about how the soils were formed and how they were classified in the section "Formation, Classification, and Morphology of the Soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

Newcomers in the Fairbanks Area will be especially interested in the section "General Characteristics of the Area," which gives additional information about the climate and other features.

* * * * *

Fieldwork for this survey was completed in 1959. Unless otherwise indicated, all statements in the report refer to conditions in the Fairbanks Area at that time. The soil survey of the Fairbanks Area is part of the technical assistance furnished by the Soil Conservation Service to the Fairbanks Soil Conservation Subdistrict. Help in farm planning can be obtained from the staff of the Soil Conservation Service assisting the subdistrict. Help in other agricultural problems can be obtained from the extension agent, the State Agricultural Experiment Station, and other agencies in the Area.

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SOIL SURVEY OF FAIRBANKS AREA, ALASKA

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REPORT BASED IN PART ON EARLIER SURVEYS BY THOMAS H. DAY, THEODORE W. ANDERSON, ROBERT A. BOWEN, WILLARD A. CALL, M. GRANT LINDSAY, H. DALE MUNK, FRANK B. TAYLOR, GEORGE A. WOODRUFF, SOIL CONSERVATION SERVICE, AND NEIL MICHAELSON, ALASKA AGRICULTURAL EXPERIMENT STATION

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH ALASKA AGRICULTURAL EXPERIMENT STATION

THE FAIRBANKS AREA is the most densely populated and most intensively farmed part of central Alaska. Its center is the city of Fairbanks, which is the commercial hub of interior and northern Alaska and the second largest city in the State. The Area includes all but a small part of the Fairbanks Soil Conservation Sub-district. It extends from a line 12 miles west of the Fairbanks meridian to a point on the Chena River 36 miles east of the meridian. It is bounded on the south by the Tanana River and on the north by a line 6 miles north of the Fairbanks base line. In all, 255,536 acres of land are in the Area. Streams and lakes amount to an additional 2,167 acres. The boundaries and the location of the Fairbanks Area are shown on the map on the back cover of this report.

General Characteristics of the Area

A broad, level flood plain borders the Tanana River and its main tributary in this Area, the Chena River. A narrower flood plain borders Goldstream Creek in the northwestern part of the Area. Adjoining the flood plains of these streams are the hills and ridges of the Yukon-Tanana upland. As a rule, gently sloping alluvial fans lie between the flood plains and the hills, but in many places, the transition between level land and steep hills is abrupt. At Fairbanks, the flood plain is less than 450 feet above sea level, whereas the summits of some hills in the Area are more than 1,800 feet above sea level.

Geology

Part of the Fairbanks Area is on the Yukon-Tanana upland, and part is on the flood plains of the Tanana River and a major tributary, the Chena River.

The country rock of the uplands near Fairbanks is Birch Creek schist, a Precambrian formation made up mainly of folded and strongly jointed quartz-mica and quartzite schist (5, 9, 14, 15).¹ Many veins of quartz in the schist contain gold. A few masses of granite, quartz diorite, and basalt are exposed locally.

On the lowlands along the Tanana River, large quantities of glacial outwash have been deposited. The Fairbanks Area has never been glaciated, but the Tanana River carries large quantities of outwash material from glaciers in the Alaska Range to the south. When glaciation was at its maximum, several hundred feet of gravel and sand was deposited in the flood plain of the Tanana River. This deposit was later covered by layers of finer alluvial sand and silt, a few inches to many feet thick.

The uplands are almost everywhere covered by a mantle of micaceous loess that blew in from the outwash plains of the Tanana Valley (8). On the high ridges, the loess is about 1 foot thick; on the low hills near the Tanana River, it is up to 200 feet thick. The loess consists of silt-size particles of quartz, feldspar, and muscovite from 0.002 to 0.05 millimeter in diameter. Much of the loess has moved from the hillsides and has accumulated on the lower slopes and in the narrow upland valleys. As a result, the lower ends of the valleys along streams that flow into the Tanana River now have more than 300 feet of colluvial silt. Lenses of organic material occur throughout the redeposited silt, which is known locally as muck.

Minor earthquakes are fairly common. They are caused by movement deep in the earth related to the continuing upthrust of the Alaska Range to the south.

Permafrost underlies most of the flood plains. It is also under the alluvial fans, the bottoms of drainageways in uplands, and the north-facing slopes. The upper limit of perennially frozen ground ranges from less than 2 feet from the surface in the silty alluvium on the older parts of the flood plains to more than 40 feet where the native vegetation has been cleared for a long time. Permafrost is absent on moderately to steeply sloping south-facing hillsides and in places on the flood plain along the Tanana and Chena Rivers and their tributaries.

On the flood plains, ice occurs in the forms of fine lenses and "cement" between mineral grains. On colluvial slopes, however, it occurs commonly as large ice masses under the redeposited loess (7). In shallow loess on steep, north-facing slopes, only a thin layer above and in the weathered bedrock is perennially frozen.

The permafrost table is lowered when the natural vegetation and the insulating mat of moss on the soil surface are removed by fire or in clearing.

¹ Italicized figures in parentheses refer to Literature Cited, p. 40.

Thermokarst topography is caused by the melting of large masses of underground ice on colluvial slopes. This type of topography is characterized by steep-walled sink-holes or an extremely hummocky soil surface. Cultivation may have to be abandoned on some cleared fields where this condition is severe (?).

Climate ²

The Fairbanks Area is near the center of the Climatological Division known as the Interior Basin of Alaska. This part of Alaska has extreme seasonal variations in temperature. Nearly all of the extreme temperatures for Alaska have been recorded in the Interior Basin. Climatic data for three stations in the Fairbanks Area are shown in table 1.

The record high of 99 degrees, recorded in the Area at the University Experiment Station in July 1919, is just 1 degree less than Alaska's record high of 100 degrees, recorded at Fort Yukon in June 1915. The record low of 66 degrees below zero for the Area was recorded at the University Experiment Station and the Weather Bureau in Fairbanks in January 1934. Daily minimum readings drop to zero degrees or colder more than 75 percent of the days from November 1 to March 31. Daily maximum

² This section was prepared by C. E. WATSON, State climatologist, U.S. Weather Bureau, Anchorage, Alaska.

readings reach 70 degrees or higher about 56 percent of the days in July and August. Temperatures reach 90 degrees and higher at some time during about 20 percent of the days in the growing season.

The growing season is more sharply defined than in most agricultural areas, as there is a rapid change from the warm to the cold seasons. Terminal dates of the warm season fall rather dependably within narrow limits. The dates for freeze-free periods shown in table 2 are a fairly dependable guide for agriculture and other activities. Rapid growth of crops should be maintained, so that they can mature in the short growing season. However, the growth of crops is accelerated by the many hours of available sunshine. During the months of June, July, and August, possible sunshine averages slightly more than 19 hours per day. As a result, the growth and maturity of crops is extremely rapid, particularly if temperature and moisture conditions are favorable.

Temperature characteristics

Table 2 shows, for two weather stations, the terminal dates of the season and the number of days between terminal dates, at specified temperatures of 32, 28, 24, 20, and 16 degrees. Data in this table indicate that the University Experiment Station, situated on a slope near the boundary between the uplands and the alluvial plain, has an average freeze-free period of 88 days. The U.S. Weather Bureau Airport Station, situated on the alluvial plain, has a freeze-free period of 106 days.

TABLE 1.—Temperature and precipitation, Fairbanks Area, Alaska

Month	University Experiment Station, College, Alaska; elevation, 481 feet; data for period 1931 through 1960						U.S. Weather Bureau Airport Station (International Airport), Fairbanks, Alaska; elevation, 436 feet; data for period 1934 through 1960					College Magnetic Observatory, U.S. Coast and Geodetic Survey, College, Alaska; elevation, 621 feet; data for period 1949 through 1960				
	Temperature			Precipitation			Temperature			Precipitation		Temperature			Precipitation	
	Average	Average maximum	Average minimum	Average ¹	Average snowfall	Average pan evaporation	Average	Average maximum	Average minimum	Average ¹	Average snowfall	Average	Average maximum	Average minimum	Average ¹	Average snowfall
December	-6.8	1.5	-15.1	0.57	8.7	(³)	-8.9	-0.6	-17.2	0.49	9.0	-6.7	-0.1	-13.3	0.66	11.7
January	-7.3	1.6	-16.2	.83	13.1	(³)	-10.5	-1.2	-19.7	.90	14.0	-7.2	.2	-14.5	.91	15.2
February	.8	11.4	-9.8	.51	7.7	(³)	-2.4	9.2	-13.9	.47	7.7	-2.8	6.0	-11.5	.64	10.8
March	12.7	25.8	- .5	.42	5.5	(³)	8.7	22.8	-5.4	.43	7.0	12.3	23.4	1.2	.32	5.3
April	30.7	43.8	17.6	.24	2.3	(³)	29.9	41.8	17.9	.26	3.1	29.5	40.1	18.8	.13	1.2
May	47.0	60.5	33.5	.80	.3	4.21	47.4	59.1	35.7	.72	.4	47.0	58.2	35.8	.67	.5
June	58.0	72.0	43.9	1.48	0	5.02	58.9	70.9	46.8	1.36	(⁴)	57.4	69.2	45.8	1.57	0
July	59.8	72.9	46.6	2.10	0	4.31	60.2	71.5	48.9	1.86	0	59.5	70.4	48.6	2.37	0
August	54.8	66.7	42.8	2.44	(⁴)	2.71	54.8	65.5	44.1	2.12	(⁴)	55.4	65.9	44.9	1.80	(⁴)
September	44.3	55.2	33.3	1.36	.4	1.31	44.1	54.0	34.2	1.12	.6	43.9	53.2	34.6	1.34	.8
October	27.2	36.1	18.2	.93	9.3	(³)	26.6	34.6	18.5	.86	9.5	25.3	32.8	17.7	.66	7.5
November	5.5	13.7	-2.7	.63	8.8	(³)	3.5	11.6	-4.7	.62	9.3	7.2	14.1	.4	.53	8.4
Year	27.2	38.4	16.0	12.31	56.1	(³)	26.0	36.6	15.4	11.21	60.6	26.7	36.1	17.4	11.60	61.4

¹ Inches of water.

² Inches of water. Length of record ranges from 12 to 26 years.

³ Data not available.

⁴ Trace.

TABLE 2.—Average dates, for beginning and end of season, at which temperature is equal to or above the °F. indicated

Temperature limit	University Experiment Station, College ¹		U.S. Weather Bureau Airport Station, Fairbanks ²	
	Terminal dates	Number of days	Terminal dates	Number of days
32.....°F.	May 29 to Aug. 24.	88	May 19 to Sept. 2.	106
28.....	May 18 to Sept. 9.	114	May 7 to Sept. 13.	129
24.....	May 9 to Sept. 20.	134	Apr. 29 to Sept. 24.	148
20.....	Apr. 26 to Oct. 1.	158	Apr. 22 to Oct. 1.	162
16.....	Apr. 24 to Oct. 6.	165	Apr. 19 to Oct. 7.	171

¹ Data period, 1931 through 1960.
² Data period, 1934 through 1960.

For concurrent periods, the average minimum air temperatures at the University Experiment Station are generally lower than those observed at the lower lying U.S. Weather Bureau Airport Station.

There is little recorded evidence that cold-air drainage has a pronounced general effect in the vicinity of Fairbanks or College, Alaska. This does not mean that cold-air drainage does not affect local areas. The lowland along Goldstream Creek, for example, is rimmed by high ridges and doubtless has pronounced downslope air drainage. This air drainage is capable of producing colder temperatures and a shorter growing season on the lowland than at either the University Experiment Station or the U.S. Weather Bureau Airport Station.

The probability of having seasons of various lengths in which the temperature will not fall below stated limits is shown in figures 1 and 2. This information is valuable to farmers and others who need favorable temperatures to operate outdoor enterprises. A farmer in the vicinity of the University Experiment Station (fig. 1) can expect, for example, about half the time, or 5 years out of 10, a growing season of 88 days in which the temperature will not fall below 32 degrees. In only 2 years in 10 can he expect a season of 110 days in which the temperature will not fall below 32 degrees, but in 9 years out of 10 he can expect a season of 56 days in which the temperature will not fall below 32 degrees. A farmer near the U.S. Weather Bureau Airport Station can expect slightly longer seasons than one near the University Experiment Station, and he can determine similar probabilities for his area by referring to figure 2.

Precipitation characteristics

Precipitation in the early part of the growing season, or in June, averages considerably less than that received in the eastern parts of Wyoming and Colorado, or in the western parts of the Dakotas. The relatively short growing season makes it imperative that plants grow rapidly all season if they are to mature. Although precipitation

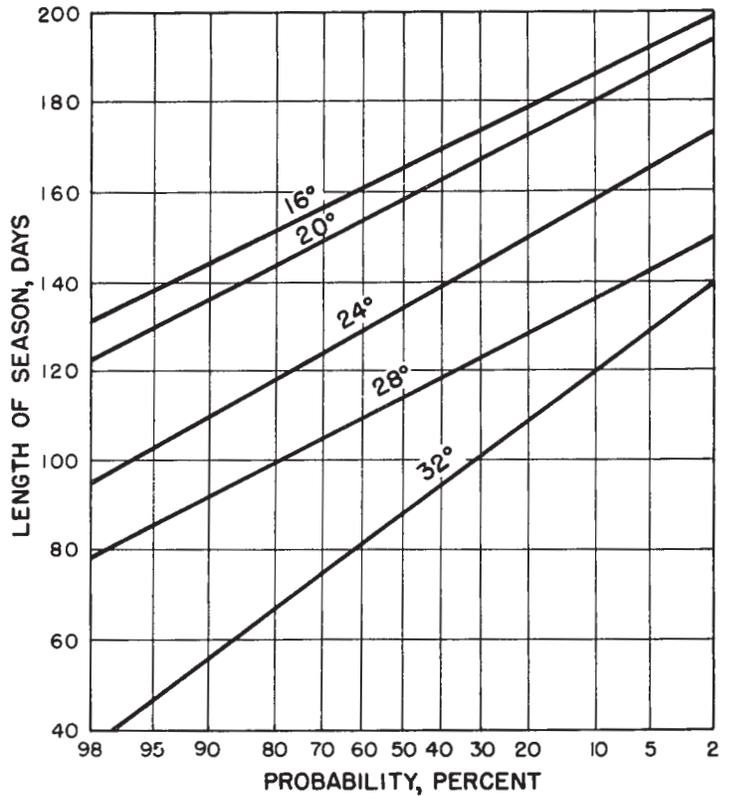


Figure 1.—Probable number of days per year that temperature will not drop below 16, 20, 24, 28, or 32 degrees F. at the University Experiment Station, College, Alaska. Based on records for period 1931 through 1960. Elevation 481 feet.

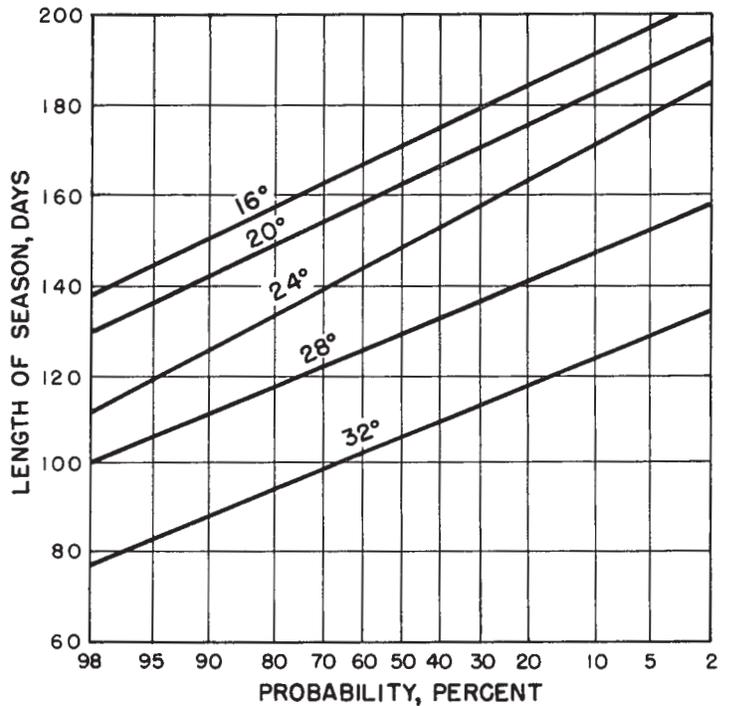


Figure 2.—Probable number of days per year that temperature will not drop below 16, 20, 24, 28, or 32 degrees F. at the U.S. Weather Bureau Airport Station, Fairbanks, Alaska. Based on records for period 1934 through 1960. Elevation 436 feet.

is apparently deficient in the early part of the growing season, crops generally grow fast enough to mature. This growth indicates that there is enough early spring moisture in the soil to allow crops to grow rapidly. Frost melting in the subsoil is also a source of moisture for growing crops in the first part of the season.

Potential evapotranspiration in this Area has not been accurately determined, but preliminary computations by use of the Thornthwaite (11) method indicate that the potential (maximum) evapotranspiration is about 4½ inches per month in June and July and slightly less than 4 inches in August. Table 3 shows probable monthly precipitation at the University Experiment Station for May to September, inclusive.

Most of the rain in this Area falls during the growing season, and the amount may vary greatly within short distances. It is believed that most of the summer rain originates as moisture vapor in the Interior Basin. The frequency and intensity of showers tend to increase as the summer season progresses. The average monthly precipitation is less than one-fourth inch in April but increases to slightly more than 2¼ inches in August. Data on precipitation intensity are limited, but reliable, unofficial measurements indicate that rates of about 2 inches per hour have occurred in the Fairbanks Area for a period of 30 minutes. An average of about eight thunderstorms occur during the summer. Hailstorms occur almost every summer, but the hailstones are seldom large enough to cause extensive damage. Tornadoes are practically unknown. Snowfall averages about 50 inches per year at the University Experiment Station, and about 60 inches at the U.S. Weather Bureau Airport Station. However, total snow was 126 inches at the University Experiment Station and 135 inches at the U.S. Weather Bureau Airport Station during the winter of 1936-37. Snow is usually on the ground from mid-October to mid-April. The maximum depth of snow on the ground during the winter averages between 25 and 30 inches.

Wind velocity is usually low. The U.S. Weather Bureau Airport Station records an average annual wind velocity of 5 miles per hour. Winds are seldom strong enough to erode the soil severely. Winds are mainly from the north and northwest, but in June, July, and August they are mostly from the southwest.

TABLE 3.—Monthly precipitation probability, University Experiment Station
[1906 through 1960]

Month	1 year in 10 years will have—		Median ¹	2 years in 10 years will have—	
	Less than—	More than—		Less than—	More than—
	Inches	Inches	Inches	Inches	Inches
May.....	0.2	1.4	0.7	0.3	1.1
June.....	.5	2.5	1.4	.8	2.2
July.....	.6	3.8	1.9	.9	2.8
August.....	.9	3.6	2.0	1.1	3.1
September.....	.4	2.5	1.3	.6	1.8

¹ The midpoint of total monthly precipitation. Half the time the total monthly precipitation can be expected to be above this figure, and half the time, less.

Vegetation³

Most of the Fairbanks Area is forested. Well-drained soils of the uplands and alluvial plains are covered mainly by white spruce, paper birch, and quaking aspen. Balsam poplar is common near streams. Imperfectly drained soils of the alluvial plains are generally covered by a dense growth of scrubby white spruce, black spruce, paper birch, willow, and tamarack. Poorly drained soils of uplands and plains support a sparse stand of black spruce and a dense undergrowth of shrubs. Imperfectly and poorly drained areas normally are covered by a thick mat of moss.

The climax forest on all well-drained soils in the Area is the white spruce type. It is believed that this forest type, once established, will reproduce itself and not change unless the stand is destroyed by fire or cutting. Immediately following fire, most areas are invaded by the pioneer species—paper birch and quaking aspen. Areas that have been repeatedly burned by severe fire, however, may be occupied mainly by black spruce. Other plants that are abundant immediately after fire are Sitka alder, willows, bunchberry dogwood, wild rose, lingenberry, bluejoint, and fireweed. In stands more than 80 to 100 years old, birch and aspen begin to decay and are frequently replaced by white spruce. Although birch and aspen are relatively short lived, nearly pure stands of these trees, or of mixtures of birch, aspen, and white spruce, are dominant in the Fairbanks Area. Most of the Area has been burned or cut over within the past 75 years.

As a rule, tree seedlings will survive only where mineral soil is exposed. This fact suggests that without seedbed preparation regeneration is apt to be a problem after logging. Aspen and willow, however, may reproduce by sprouts from stumps or by suckers from roots.

Trees in a mature stand of white spruce may be more than 200 years old, more than 90 feet tall, and more than 20 inches in diameter, measured at breast height. Fully stocked stands of old white spruce may have a gross merchantable volume of more than 15,000 board feet per acre.

Dominant and codominant trees in stands of pure birch at the rotation age of 90 years average 65 feet tall and 6 to 7 inches in diameter, measured at breast height. In a well-stocked stand of birch, the gross merchantable volume is 2,000 to 2,500 cubic feet per acre at rotation age.

The ground cover in forests is essentially the same in all established stands. The principal shrubs in the subordinate vegetation are lowbush cranberry or lingenberry (*Vaccinium vitis-idaea*), highbush cranberry or mooseberry (*Viburnum edule*), wild rose (*Rosa acicularis*), bunchberry dogwood (*Cornus canadensis*), and crowberry (*Empetrum nigrum*). The forbs are mainly bristly clubmoss (*Lycopodium annotinum*), American twinflower (*Linnaea borealis* var. *americana*), northern comandra (*Comandra livida*), creeping rattlesnake-plantain (*Goodyera repens* var. *ophioides*), horsetail (*Equisetum* spp.), and fireweed (*Epilobium angustifolium*). Grasses and

³ This section is based largely on the work of H. J. LUTZ (4) and on information supplied by R. A. GREGORY, Alaska Forest Research Center, U.S. Forest Service, Fairbanks.

grasslike plants occur in places. These include bluejoint (*Calamagrostis canadensis*), altai fescue (*Festuca altaica*), bluegrass (*Poa* spp.), and Bigelow sedge (*Carex bigelowii*). The most common mosses on the forest floor are *Hylocomium splendens*, *Pleurozium schreberi*, and *Hypnum crista-castrensis*. Lichens include *Peltigera* spp. and *Cladonia* spp.

Most plant roots, including those of trees, are in the mat of decomposing organic material on the soil surface. Despite the shallow rooting habit of most trees, windthrow is only a slight hazard.

Moderately well drained and imperfectly drained soils may support forests similar to those on the well-drained soils, but more often they support a scrubby noncommercial stand of trees consisting of black spruce and willow. Mosses cover the ground. Horsetail and grasses are commonly the principal plants in the subordinate vegetation, but shrubs like those on well-drained soils are also present.

Poorly drained soils with a high permafrost table generally support a sparse, noncommercial stand of black spruce mixed with some willows and alder and an occasional paper birch. A thick mat of moss, mostly *Sphagnum* spp., makes up the upper part of the soil. Many lichens, including *Cladonia* spp. and *Peltigera* spp., grow in the mat of moss. This mat also supports a dense cover of shrubs, mainly bog birch (*Betula glandulosa*), spirea (*Spirea beauverdiana*), Labrador-tea (*Ledum palustre* spp. *groenlandicum*), lingenberry (*Vaccinium vitis-idaea*), bog bilberry (*Vaccinium uliginosum*), cloudberry (*Rubus chamaemorus*), and crowberry (*Empetrum nigrum*). Tussocks of cottonsedge (*Eriophorum vaginatum*) are also common. In many places, especially in low level areas on the alluvial plain, trees are virtually absent. In these areas, mosses, shrubs, and tussocks of cottonsedge are the vegetation.

On the whole, little use is made of forests in the Area. Although four small sawmills are in operation, and many houses and barns have been built of logs, the production of usable lumber is small. Almost no use is made of trees other than white spruce. It seems likely, however, that the forests in the Fairbanks Area and in other parts of interior Alaska may be an important future source of pulpwood.

Wildlife

Most of the Fairbanks Area is still forested, and wildlife is plentiful. Moose and black bear are the big game animals. Smaller animals in the Area are rabbit, mink, muskrat, beaver, fox, lynx, marten, land otter, weasel, porcupine, squirrel, marmot, and wolverine. Ducks, geese, ptarmigan, spruce hen, and many other birds are seen in the Area. Many salmon are taken from the Tanana River in midsummer, and there is much fishing for grayling in tributary streams.

History, Settlement, and Industry

Prospectors first entered the Tanana Valley in the 1870's and 1880's, after gold had been discovered in adjoining districts. The search for gold was intensified after the discovery of gold in the Klondike region in 1896.

Felix Pedro, a prospector, was the first to discover gold in the Area in 1898. During a return trip to the Area, he persuaded Barnette, captain of a small river steamer, to erect a trading post on the Chena River. This is the present site of Fairbanks. The town was named for Senator Charles W. Fairbanks of Indiana, who later became Vice President of the United States.

Another gold strike by Pedro, north of Fairbanks in 1902, started a stampede to the Area. By 1904, Fairbanks had over 500 houses and a population of about 1,200; the Fairbanks district had a population of more than 3,000. In 1910, the population of the district had grown to 11,000 persons. As easily accessible deposits of gold were exhausted, the number of people rapidly declined. By 1920, the population was only one-third as large as in 1910. The introduction of heavy equipment and efficient mining methods, in the decade following 1930, made gold mining a profitable and stable industry. As a result, Fairbanks changed from a mining camp to a modern city with a steadily growing population.

Ladd Air Force Base (now Fort Wainwright), the first permanent military establishment in the Area, was built near Fairbanks in 1939. Since that time, military activity and construction at this base and at nearby Eielson Air Force Base, established a few years later, have been dominant in the local economy. Fairbanks is also the commercial and transportation center for all of central and northern Alaska.

In the early years, all supplies for Fairbanks were sent by riverboat from St. Michael on the Bering Sea or from Whitehorse in Yukon Territory. In 1913, a wagon road was constructed to Fairbanks from Valdez, on Prince William Sound. Year-round freight and passenger service to Fairbanks from Seattle was established in 1923 with the completion of the Alaska Railroad. The railroad also provided access to the Healy coalfields, and it was a major factor in the development of the modern gold-mining industry. The Alaska Highway, constructed in 1942, connects Fairbanks with Dawson Creek, B.C., and with the roads of Canada and the United States. Roads also extend north from Fairbanks to the Yukon River and south to Anchorage and Valdez. Commercial airlines connect Fairbanks with Seattle and with all principal points in Alaska.

In 1960, the population of the city of Fairbanks was 13,311; about 38,000 people, excluding military personnel, lived in the greater Fairbanks district.

Agriculture

The growth of agriculture in the Fairbanks Area has always been directly related to the growth of nonfarm activities. Agricultural settlement first started during the gold rush in the first decade of the 20th century. The principal agricultural products at that time were hay and grain for horses. Crop production declined as the population declined after 1910. It increased again after 1918, during construction of the Alaska Railroad. By 1920, 107 farms were in the Area. These farms had 1,764 acres under cultivation. A flour mill that processed local wheat operated successfully until the completion of the railroad. After that, it was cheaper to buy flour shipped from Seattle. Since the railroad was built, potatoes, vegetables, and milk have been the principal farm products.

The demand for local farm products increased sharply after construction of the military bases in 1939, but the breaking of new land for crops was restricted by the high cost of clearing land and of purchasing farm machinery. However, more than 7,000 acres are now cultivated in the Fairbanks Area, and it is expected that 500 to 1,000 acres will be added to this total each year.

The principal crops are brome grass, oats, peas, barley, potatoes, cabbage, and carrots. Some wheat and lettuce are grown commercially. Beets, broccoli, cabbage, cauliflower, celery, carrots, kale, lettuce, onions, peas, radishes, rutabagas, and turnips grow well in the Area.

Two small creameries are in the Fairbanks Area, but to satisfy the demand, additional milk and other dairy products must be shipped in. Eggs and some beef and pork are produced in the Area.

How Soils Are Named, Mapped, and Classified

Soil scientists made this survey to learn what kinds of soils are in the Fairbanks Area, where they are located, and how they can be used.

As they traveled over the area, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug or bored many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down to the underlying material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in nearby areas and those in places more distant. They classified and named the soils according to uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Fairbanks and Chena, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in natural characteristics.

Many soil series contain soils that are alike except for texture of their surface layer. According to this difference in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Fairbanks silt loam and Chena very fine sandy loam are soil types in the Fairbanks and Chena series.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that

affects management. For example, Fairbanks silt loam, 3 to 7 percent slopes, is one of several phases of Fairbanks silt loam, a soil type that ranges from nearly level to steep.

After a fairly detailed guide for classifying and naming the soils had been worked out, the soil scientists drew soil boundaries on aerial photographs. They used photos for their base map because these show woodlands, buildings, field borders, trees, and similar detail that greatly help in drawing boundaries accurately. The soil map in the back of this report was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. The nature of the mapping unit depends on the kind of map prepared. The three common kinds of maps are the detailed, reconnaissance, and detailed-reconnaissance.

On a detailed map, the mapping units are precise enough to allow the planning of management for farms and fields. Such mapping units are nearly equivalent to a soil type or phase of a soil type. They are not exactly equivalent because it is not practical to show, even on a detailed map, all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly a recognized soil type or soil phase.

On a reconnaissance map, one or more soil phases, types, or even series may be placed in one mapping unit. A reconnaissance map is not suitable for planning of farms and fields, but it is useful to those who need to appraise the potential of broad areas for agriculture, forestry, or similar uses.

On a detailed-reconnaissance map, some of the mapping units are detailed enough for planning of farms and fields, and some are suitable only for judging broader uses.

The map of the Fairbanks Area is detailed-reconnaissance. Over most of the Area, the soils were examined and mapped in detail. But along the Chena River, in the eastern part of the Area (see back cover), the soils were mapped in less detail, or reconnaissance. In this eastern part of the Area not all the soil boundaries shown on the map were determined, throughout their length, by examination. Parts of these boundaries were inferred by observing topographic features.

The reconnaissance mapping units in the eastern part of the Fairbanks Area are called soil associations. These units contain one or more soil types and are readily recognized by their names; for example, Goldstream-Lemeta association.

In some places in the Fairbanks Area, materials have recently been deposited or exposed and have little plant cover; these materials cannot be called soils, but they are shown on the map like other mapping units. Mapping units consisting of such materials are called miscellaneous land types and are given descriptive names, such as Alluvial land, Gravel pits, and Mine tailings.

Soil Groups

According to position on the landscape, the soils of the Fairbanks Area can be placed in two broad geographic groups: (a) Soils of the uplands, and (b) soils of the alluvial plains (fig. 3). A grouping of this kind brings out relationships among soils not easily made evident in other ways, and it provides a background desirable for study of individual soils.

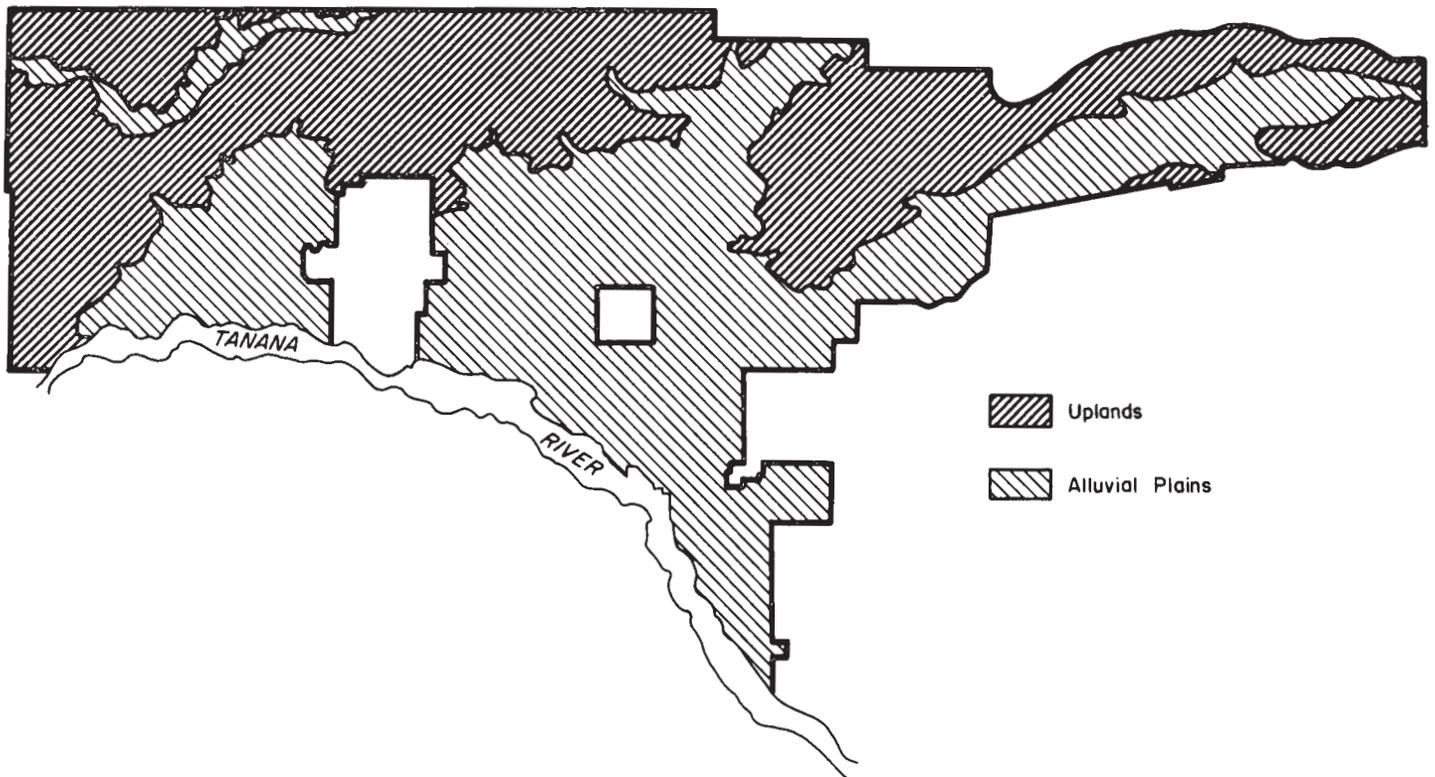


Figure 3.—Distribution of uplands and alluvial plains in the Fairbanks Area.

In each of the two broad geographic groups there is a fairly consistent pattern of soils. The soils in the pattern differ from one another in a number of ways, including kind and degree of profile development, degree of wetness, nature of the material from which formed, and depth to underlying bedrock or gravel. Study of figure 4 will disclose some of the relationships between soil series and position on the landscape, and between soil series and nature of the underlying material and occurrence of permafrost.

Soils of the Uplands. All soils of the uplands have developed in micaceous silty material laid down by wind when glacial activity was at its maximum. After deposition, some of this silty material (loess) moved down the slopes of ridges and accumulated on foot slopes or in narrow drainageways in the uplands. This process was most pronounced on south-facing slopes, and, as a result, the lower parts of these slopes generally have more gentle gradients than the lower parts of north-facing slopes. The loess covering the bedrock is generally thicker in the low parts than in high parts of the uplands.

In the latitude of the Fairbanks Area, south-facing slopes get much more heat from the sun than north-facing slopes. Soil and vegetation reflect this difference in received heat, especially at the higher elevations in the uplands.

Soils on south-facing slopes have developed under forests of white spruce, paper birch, and quaking aspen, and they are generally well drained and free of permafrost. Soils on north-facing slopes have formed under a forest of spindly black spruce and a thick carpet of moss. They

are underlain by permafrost and are poorly drained. As a rule, the boundary between soils on north- and south-facing slopes is abrupt at the ridgetops (2).

The most extensive soils of the uplands are those of the Fairbanks series. These deep, well-drained, moderately sloping to steep soils are mainly on low hills near the alluvial plain, and on south-facing middle slopes of high ridges farther from the plains. The shallow, well-drained Gilmore soils are also extensive in the uplands but occur mostly on the higher parts of ridges. The deep, moderately well drained Minto soils are dominant on long gentle slopes at the bases of hills below the Fairbanks soils.

On north-facing slopes, the Ester soils occupy steep areas near the tops of ridges where the cover of loess is normally thin. The less steep Saulich soils are on the lower slopes that are covered by a thicker mantle of loess. The Goldstream soils occupy sloping upland valleys between ridges.

In the uplands, the Fairbanks and Minto soils on gentle to moderate slopes are best suited to agriculture. If given adequate fertilizer and other good management, these soils can produce excellent crops of grasses, small grains, potatoes, and other vegetables. Sloping areas, however, are highly erodible. In addition, some areas of the Minto soils are subject to thermokarst pitting after they have been cleared of vegetation. Soils of north slopes and of upland drainageways are generally too wet for cropping, but the gently to moderately sloping soils in these positions may be productive after the surface moss has been removed and artificial drainage provided.

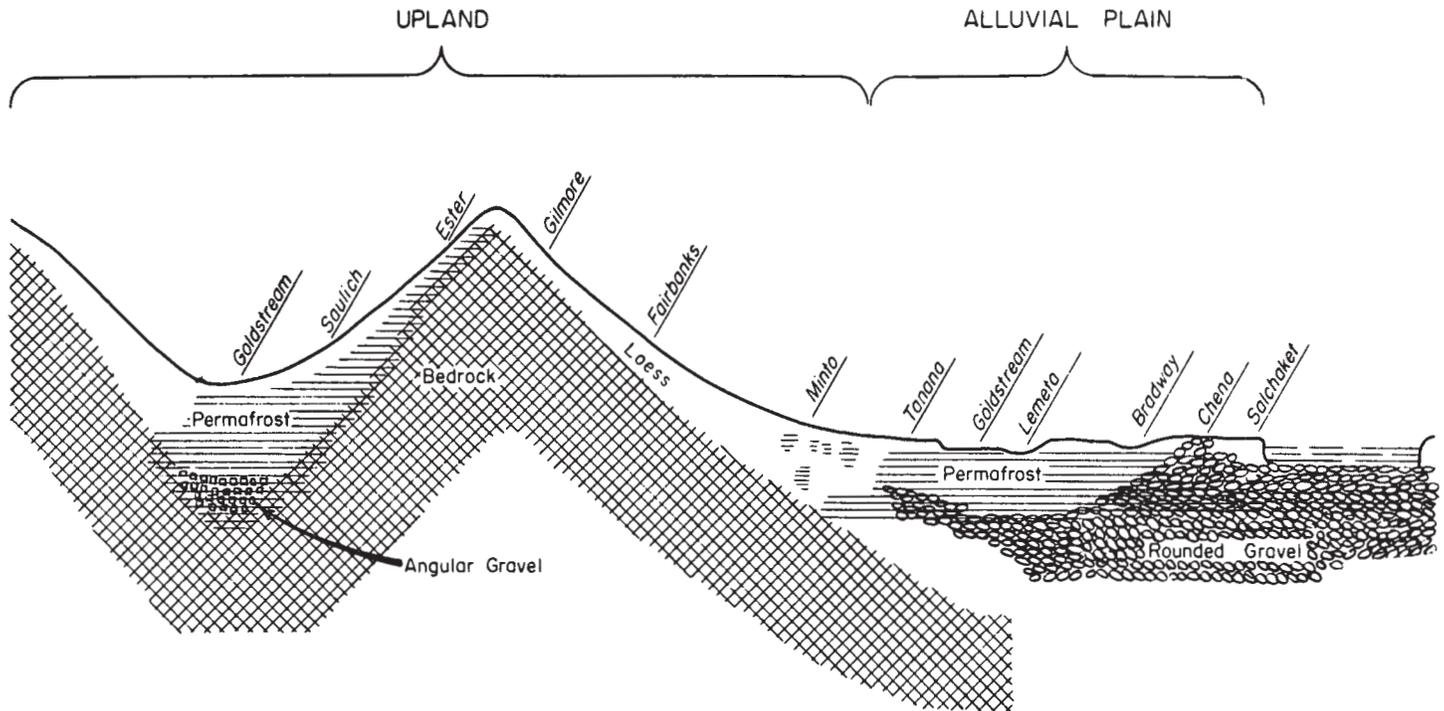


Figure 4.—Diagram of a landscape showing relationship of soil series, underlying material, and permafrost. Adapted from Péwé (7).

Soils of the alluvial plains. Soils on alluvial plains have developed in sandy or silty, water-deposited material. Most of this soil material is of glacial origin, but some originated from the loess and underlying bedrock of adjacent uplands.

Soils near the course of the main streams are generally sandy, and permafrost in them is deep or is absent. Those away from the streams are silty and have a high permafrost table. Deposits of perennially frozen peat occupy shallow depressions on the alluvial plains. Gravel underlies all alluvial soils at a depth ranging from less than 1 foot to more than 50 feet. Near the Tanana River, the gravel is mostly rounded pebbles and cobbles laid down by glacial outflow water. In the alluvial plains of the tributary streams, the gravel is mostly angular and subangular fragments of schist or quartzite.

The well-drained, sandy Salchaket soils border the principal rivers in the area and are the most extensive soils of the alluvial plains. The silty, imperfectly drained Tanana soils and the silty, poorly drained Goldstream soils occupy large areas between the streams and the uplands. The poorly drained, sandy Bradway soils, which mainly occupy old stream channels and other low areas near the principal rivers, and the very poorly drained Lemeta peat, which occupies broad, shallow depressions, are also fairly extensive on the alluvial plains.

The Salchaket and Tanana soils are best suited to agriculture. Because of their coarse texture, however, the Salchaket soils may be droughty in dry years. Water perched above permafrost in the Tanana soils may prevent cropping the first year after clearing, but after that it will not be a serious problem. Many areas of the Goldstream and Bradway soils probably can be cultivated if they are artificially drained. However, wetness early in

the spring restricts the choice of crops. Lemeta peat is not suitable for cropping. If fertilized and properly managed, the better soils of the alluvial plains can produce crop yields that are comparable to those obtained from soils of the uplands.

Descriptions of the Soils

The soils of the Fairbanks Area, Alaska, are described in the following pages. Their acreage and proportionate extent are shown in table 4. Their location can be seen on the detailed map at the end of the report. The soils mapped, their map symbols, and the management group in which each soil has been placed, are listed in the "Guide to Mapping Units and Management Groups" at the end of the report.

The method used in this section is that of first describing the soil series, and then all the mapping units that belong to that series. The series are described in alphabetical sequence.

An important part of each series description is the soil profile, a record of what the soil scientist saw and learned when he dug into the ground. It is to be assumed that all the mapping units of one series have essentially the same kind of profile. The differences, if any, are explained in the description of the mapping unit or are indicated in the name of the mapping unit.

The name of each mapping unit is followed by a set of symbols in parentheses. These symbols identify the mapping unit on the detailed soil map. At the end of the description for each mapping unit, the management group for that unit is shown. The management groups are described in the section "Use and Management of the Soils."

Some of the terms used in describing the characteristics of soil series and mapping units, and the significance of these characteristics, are explained in the following paragraphs.

The color of a soil can be described in words alone, or by symbols called Munsell color notations, or by both. In this section, words alone are used to describe color. In the section "Formation, Classification, and Morphology of the Soils," however, both words and notations are used, since the descriptions of soil profiles in that part are the technical, more detailed kind that scientists need for study and classification of soils. The color of a soil is a clue to its drainage. Well-drained soils have brown, yellow, and red colors throughout their profiles.

The terms for drainage have specific meaning. A well-drained soil, for example, commonly retains optimum amounts of moisture for plant growth after rains or after irrigation water has been added. Roots can grow deep in such a soil. In contrast, a poorly drained soil is wet most of the time; the water table is at or near the surface

a considerable part of the year. The large quantity of water in such a soil prohibits the growing of field crops. Only moisture-tolerant plants can grow on poorly drained soils.

The terms used to describe texture of soils indicate proportionate content of sand, silt, and clay. Soils with textures near either extreme, all sand or all clay, are the most difficult to manage; those near midpoint in the textural range, the loam soils, are considered best for most kinds of agriculture.

The terms used for structure describe how the individual soil particles are arranged in larger grains, or aggregates, and indicate the amount of pore space between the grains. In describing structure, separate terms are normally used to indicate strength, or grade, of the aggregate; size of the aggregate; and shape of the aggregate. For example, a soil horizon may have "weak, fine, blocky structure." Descriptions of structure help in identifying soils and aid in making inferences concerning their behavior under management.

TABLE 4.—*Acres and proportionate extent of soils of the Fairbanks Area, Alaska*

Mapping unit	Area	Extent	Mapping unit	Area	Extent
Detailed survey:	<i>Acres</i>	<i>Percent</i>	Detailed survey—Continued	<i>Acres</i>	<i>Percent</i>
Alluvial land.....	1, 356	0. 5	Goldstream silt loam, 0 to 3 percent slopes.....	28, 919	11. 4
Bradway very fine sandy loam.....	12, 182	4. 8	Goldstream silt loam, 3 to 7 percent slopes.....	8, 374	3. 3
Chena very fine sandy loam.....	776	. 3	Goldstream silt loam, 7 to 12 percent slopes.....	330	. 1
Ester silt loam, 12 to 20 percent slopes.....	773	. 3	Total Goldstream silt loam.....	37, 623	14. 8
Ester silt loam, 20 to 30 percent slopes.....	3, 543	1. 4	Gravel pits.....	244	. 1
Ester silt loam, 30 to 45 percent slopes.....	3, 469	1. 4	Lemeta peat.....	3, 074	1. 2
Total Ester silt loam.....	7, 785	3. 1	Mine tailings.....	2, 185	. 9
Fairbanks silt loam, 0 to 3 percent slopes.....	175	. 1	Minto silt loam, 0 to 3 percent slopes.....	3, 285	1. 3
Fairbanks silt loam, 3 to 7 percent slopes.....	1, 350	. 5	Minto silt loam, 3 to 7 percent slopes.....	16, 420	6. 4
Fairbanks silt loam, 7 to 12 percent slopes.....	10, 660	4. 2	Minto silt loam, 7 to 12 percent slopes.....	2, 415	. 9
Fairbanks silt loam, 12 to 20 percent slopes.....	9, 606	3. 8	Total Minto silt loam.....	22, 120	8. 6
Fairbanks silt loam, 20 to 30 percent slopes.....	3, 454	1. 3	Salchaket very fine sandy loam.....	40, 736	16. 0
Fairbanks silt loam, 30 to 45 percent slopes.....	600	. 2	Salchaket very fine sandy loam, moderately deep.....	13, 352	5. 2
Fairbanks silt loam, moderately deep, 3 to 7 percent slopes.....	400	. 2	Salchaket very fine sandy loam, shallow.....	649	. 2
Fairbanks silt loam, moderately deep, 7 to 12 percent slopes.....	840	. 3	Total Salchaket very fine sandy loam.....	54, 737	21. 4
Fairbanks silt loam, moderately deep, 12 to 20 percent slopes.....	2, 442	1. 0	Saulich silt loam, 3 to 7 percent slopes.....	2, 700	1. 1
Fairbanks silt loam, moderately deep, 20 to 30 percent slopes.....	5, 472	2. 1	Saulich silt loam, 7 to 12 percent slopes.....	1, 845	. 7
Fairbanks silt loam, moderately deep, 30 to 45 percent slopes.....	676	. 3	Saulich silt loam, 12 to 20 percent slopes.....	1, 745	. 7
Total Fairbanks silt loam.....	35, 675	14. 0	Total Saulich silt loam.....	6, 290	2. 5
Gilmore silt loam, 3 to 7 percent slopes.....	740	. 3	Tanana silt loam.....	16, 525	6. 5
Gilmore silt loam, 7 to 12 percent slopes.....	1, 257	. 5	Total detailed survey.....	216, 471	85. 0
Gilmore silt loam, 12 to 20 percent slopes.....	2, 554	1. 0	Reconnaissance survey:		
Gilmore silt loam, 20 to 30 percent slopes.....	6, 856	2. 7	Alluvial land.....	680	. 3
Gilmore silt loam, 30 to 45 percent slopes.....	1, 010	. 4	Ester silt loam, steep.....	420	. 2
Gilmore silt loam, very shallow, 3 to 7 percent slopes.....	710	. 3	Fairbanks association, moderately sloping to moderately steep.....	1, 415	. 5
Gilmore silt loam, very shallow, 7 to 12 percent slopes.....	160	. 1	Fairbanks-Ester association, steep to very steep.....	4, 990	2. 0
Gilmore silt loam, very shallow, 12 to 20 percent slopes.....	395	. 1	Gilmore-Ester association, moderately steep to very steep.....	8, 820	3. 5
Gilmore silt loam, very shallow, 20 to 30 percent slopes.....	1, 225	. 5	Goldstream-Lemeta association.....	3, 930	1. 5
Gilmore silt loam, very shallow, 30 to 45 percent slopes.....	992	. 4	Goldstream-Saulich association.....	4, 205	1. 6
Total Gilmore silt loam.....	15, 899	6. 3	Minto-Saulich association.....	1, 320	. 5
			Salchaket association.....	8, 340	3. 3
			Tanana-Goldstream association.....	3, 980	1. 6
			Total reconnaissance survey.....	38, 100	15. 0
			Total (detailed and reconnaissance survey).....	254, 571	100. 0

¹ Does not include 965 acres in urban and industrial uses and 2,167 acres of streams and lakes; total extent of the Fairbanks Area is 257,703 acres.

Alluvial Land

Alluvial land (Ad).—This land type consists of frequently flooded areas adjacent to the rivers and sloughs. It is only slightly higher than the normal level of streams, and it is dissected by many small channels.

Alluvial land is mainly loose, coarse sand and gravel, but in places it is covered by a thin mantle of gray silty material. It supports a fairly dense cover of shrubs, mosses, sedges, and black spruce. A few isolated areas on higher elevations that support a thick stand of black spruce are included. (Management group 23.)

Bradway Series

The Bradway series consists of poorly drained sandy soils that occupy former stream channels in the alluvial plain. These old channels range from less than 100 feet to more than a mile in width. The narrow channels wind through many areas of the Salchaket and Tanana soils and generally support a dense stand of sedges and grasses. The broad channels are mainly in the southeastern part of the Fairbanks Area and are covered by low shrubs and clumps of black spruce. Fire has destroyed the trees in many areas of Bradway soils.

Typical profile (Bradway very fine sandy loam) :

- 4 inches to 0, black mat of roots, moss, and partially decomposed organic material mixed with small amounts of silt; medium acid; layer may be as much as 12 inches thick in places.
- 0 to 2 inches, black, mucky silt loam; weak, granular structure; friable; slightly acid.
- 2 to 36 inches +, dark-gray very fine sandy loam mottled with dark brown; weak, platy structure; very friable; mildly alkaline; thin lenses of silt loam and fine sand, mostly below a depth of 24 inches.

In many places Bradway soils are greenish or bluish in the lower part. Under the native vegetation, they are perennially frozen below a depth of 3 to 4 feet. Above permafrost, these soils are always wet, except for the upper few inches in some places. In narrow channels near the Tanana and Chena Rivers, these soils are subject to flooding in spring or other times of the year.

The Bradway soils are similar to the Salchaket soils in texture but are much more poorly drained because of their lower topographic position. The Bradway soils differ from the Goldstream soils in that they are sandy rather than silty and have a deeper permafrost table.

Bradway very fine sandy loam (Br).—This soil is extensive in the alluvial plains of the Tanana and Chena Rivers. In most places, it borders Salchaket very fine sandy loams, but in other places it adjoins Tanana silt loam. A few areas of soil similar to the Goldstream silt loams are included. (Management group 14.)

Chena Series

The Chena series consists of very shallow, excessively drained sandy soils that have formed in recently deposited material along the Tanana River. These soils are from 3 to 10 inches deep over thick deposits of gravel. They support a forest dominated by white spruce, paper birch, and quaking aspen.

Typical profile (Chena very fine sandy loam) :

- 2½ inches to 0, mat of roots and partially decomposed organic material; very strongly acid.
- 0 to 1 inch, very dark grayish-brown and grayish-brown silt loam; weak, granular structure; friable; very strongly acid; layer is absent in many places.
- 1 to 4 inches, dark yellowish-brown very fine sandy loam; very weak, blocky structure; very friable; medium acid.
- 4 to 7 inches, grayish-brown fine sand; lighter in color with depth; structureless; loose; slightly acid.
- 7 to 18 inches +, rounded gravel and coarse sand.

Depth to the underlying gravel ranges from 3 to 10 inches. Permafrost is deep or absent.

The Chena soils are similar to the Salchaket soils in origin and profile characteristics but are shallower. Because of this shallowness, they are much more droughty than the Salchaket soils.

Chena very fine sandy loam (Ch).—This soil occurs only in the southeastern part of the Fairbanks Area. Small areas of the shallow Salchaket very fine sandy loam are commonly included. (Management group 13.)

Ester Series

The Ester series consists of poorly drained soils with perennially frozen subsoil. The soils have developed in shallow deposits of micaceous silt on north-facing slopes of high ridges. In most places, the Ester soils support a forest of spindly black spruce mixed with scattered alder and willow. A few areas support a stand of paper birch. The surface is generally covered by a thick mat of moss and lichen and a dense growth of low shrubs.

Typical profile (Ester silt loam) :

- 13 to 10 inches, live sphagnum moss.
- 10 inches to 0, mat of roots and slightly decomposed moss; extremely acid.
- 0 to 4 inches, very dark grayish-brown silt loam with lenses and pockets of black, decomposed organic matter; usually frozen; very strongly acid.
- 4 to 10 inches +, olive-gray silt loam with mottles of olive brown and many streaks of dark color; usually frozen; strongly acid.

Depth to the underlying schist bedrock ranges from less than 10 inches to 24 inches. Where the profile is shallow or where the cover of moss has been removed, the soil may not be frozen in summer. The unfrozen soil is always wet.

Near the tops of steep ridges and where slopes change in aspect, the boundary between the Ester and the Gilmore or, less commonly, the Fairbanks soils is abrupt. At elevations below the steepest parts of north-facing slopes, the Ester soils generally grade to the deeper Saulich soils. Small areas of Saulich soils may be included in the mapping units of Ester soils.

Ester silt loam, 12 to 20 percent slopes (EsD).—This soil occurs mostly on moderately steep ridges near upland drainageways. On the lower slopes of ridges, it commonly borders the Saulich silt loams, small areas of which may be included. In most places the Saulich silt loams are at elevations below this steeper Ester silt loam. (Management group 20.)

Ester silt loam, 20 to 30 percent slopes (EsE).—This soil is on steep slopes near the tops of high ridges. Fewer areas of Saulich silt loams are included with this soil than with Ester silt loam, 12 to 20 percent slopes. (Management group 20.)

Ester silt loam, 30 to 45 percent slopes (EsF).—This very steep soil is near the tops of high ridges. It differs from Ester silt loam, 20 to 30 percent slopes, only in gradient. (Management group 20.)

Ester silt loam, steep (ERE).—This soil is mapped on the high ridges in the eastern part of the Fairbanks Area. Slopes range from 20 to 45 percent. Small areas of Saulich silt loams are included.

This soil is shallow, should not be cleared of vegetation, and is not suitable for cultivation. The sedges and grasses can be grazed, but forage yields are low.

Fairbanks Series

The Fairbanks series consists of well-drained soils of the uplands that have developed in moderately deep to deep deposits of micaceous silt. These soils occur mainly near the middle of long, south-facing slopes and on low hills near the alluvial plains. Fairbanks soils can support good stands of white spruce and paper birch. However, many areas of these soils have been burned or cut over and are now covered by young stands of aspen and, in places, alder.

Typical profile (Fairbanks silt loam) :

- 2 inches to 0, dark reddish-brown mat of partially decomposed organic material; many roots; slightly acid.
- 0 to 4 inches, dark-brown silt loam; very weak, crumb structure; very friable; slightly acid.
- 4 to 7 inches, brown to yellowish-brown silt loam; moderate, very thin, platy structure breaking easily to very fine, granular structure; very friable; strongly acid.
- 7 to 12 inches, dark-brown silt loam that contains thin, roughly horizontal bands of dark yellowish-brown, heavy silt loam or silty clay loam; moderate, very thin, platy structure; very friable; strongly acid.
- 12 to 16 inches, dark yellowish-brown silt loam; moderate, very thin, platy structure; very friable; strongly acid.
- 16 to 26 inches, olive silt streaked with dark brown; moderate, very thin, platy structure; very friable; medium acid.
- 26 inches +, olive silt; moderate, very thin, platy structure; very friable; slightly acid.

The thin bands of heavy silt loam or silty clay loam in the 7- to 12-inch layer range from less than $\frac{1}{8}$ inch to almost $\frac{1}{2}$ inch in thickness. These bands are roughly horizontal, but they fork and merge in an irregular pattern. They occur immediately below the surface soil and apparently are the result of soil development rather than of deposition.

Near the bases of slopes, the Fairbanks soils are generally bordered by the moderately well drained Minto soils. The boundary between soils of these two series generally is gradual, and patches of Minto soils may be included in areas mapped as the Fairbanks soils. At the higher elevations on steep slopes, the Fairbanks soils grade to shallower Gilmore soils. Gilmore soils are commonly included with the Fairbanks soils on the higher slopes. Along very narrow drainageways, strips of soil similar to the Minto soils may occur within areas of Fairbanks soils.

Cleared areas of the more sloping Fairbanks soils are highly susceptible to sheet and gully erosion. Control of erosion is essential in managing these soils.

Fairbanks silt loam, 0 to 3 percent slopes (FaA).—The few areas of this nearly level soil are at the tops of low ridges or hills. These areas are generally very gently

undulating rather than flat. There are few or no inclusions of other soils. (Management group 2.)

Fairbanks silt loam, 3 to 7 percent slopes (FaB).—Nearly all areas of this gently sloping soil are on or near the tops of low ridges or hills. Most of them are not extensive. They differ from Fairbanks silt loam, 0 to 3 percent slopes, only in gradient. (Management group 4.)

Fairbanks silt loam, 7 to 12 percent slopes (FaC).—This moderately sloping soil occurs on the middle and lower parts of long, concave, south-facing slopes; on slopes of low hills near the flood plains; and on the tops of low ridges. At its lower boundary, this soil commonly grades to the Minto soils; at the upper boundary, it grades to the steeper members of its own series. Patches of these bordering soils are included. As a rule, the slopes of Fairbanks silt loam, 7 to 12 percent slopes, are fairly smooth, but in places they are dissected by minor drainageways. Narrow strips of the Minto soils, too small to delineate separately, occupy these dissected areas. (Management group 7.)

Fairbanks silt loam, 12 to 20 percent slopes (FaD).—This moderately steep soil occupies topographic positions that are similar to those occupied by Fairbanks silt loam, 7 to 12 percent slopes. It is much more dissected by minor drainageways and includes more strips of the Minto soils. Patches of the moderately deep Fairbanks silt loams have also been included, especially higher on the slopes. (Management group 12.)

Fairbanks silt loam, 20 to 30 percent slopes (FaE).—This steep soil generally is on the higher parts of long, south-facing slopes. Here the thickness of silt over bedrock is normally not as great as on lower slopes. Patches of the moderately deep Fairbanks silt loams are commonly included. Minor drainageways and strips of Minto soils are less numerous than in the moderately steep Fairbanks soils. (Management group 16.)

Fairbanks silt loam, 30 to 45 percent slopes (FaF).—This very steep soil differs from Fairbanks silt loam, 20 to 30 percent slopes, only in steepness of slope. Patches of Minto soils are rarely included. (Management group 19.)

Fairbanks silt loam, moderately deep, 3 to 7 percent slopes (FmB).—This moderately deep soil has formed in a silty deposit that is 20 to 36 inches thick over bedrock. This soil occurs in only a few places, mostly on ridgetops. These areas are on higher elevations than those of the gently sloping, deep Fairbanks silt loams. Patches of Gilmore silt loams are included in places. (Management group 4.)

Fairbanks silt loam, moderately deep, 7 to 12 percent slopes (FmC).—This moderately sloping soil occupies positions that are similar to those occupied by Fairbanks silt loam, moderately deep, 3 to 7 percent slopes. It differs only in gradient. (Management group 7.)

Fairbanks silt loam, moderately deep, 12 to 20 percent slopes (FmD).—This soil occurs mostly on the higher parts of ridges. Except for the thickness (20 to 36 inches) of the silty deposit in which this soil has developed, it is like Fairbanks silt loam, 12 to 20 percent slopes.

The areas of Fairbanks silt loam, moderately deep, 12 to 20 percent slopes, are only slightly dissected by minor drainageways, and very few patches of the Minto soils are

included. Small areas of the Gilmore silt loams and the deep Fairbanks silt loams are commonly included. (Management group 12.)

Fairbanks silt loam, moderately deep, 20 to 30 percent slopes (FmE).—This steep soil occurs on the slopes of high ridges in the northern part of the Fairbanks Area. Except for depth to bedrock, it is similar to Fairbanks silt loam, 20 to 30 percent slopes. Included are small patches of steep Fairbanks silt loams and of Gilmore silt loams. (Management group 16.)

Fairbanks silt loam, moderately deep, 30 to 45 percent slopes (FmF).—This very steep soil differs from Fairbanks silt loam, moderately deep, 20 to 30 percent slopes, mainly in gradient. In addition, included patches of Gilmore silt loams are somewhat more numerous, and there are a few outcrops of rock. (Management group 19.)

Fairbanks association, moderately sloping to moderately steep (FBD).—This mapping unit is in the eastern part of the Fairbanks Area. Soils in this part were mapped in less detail than in the western part of the Area. The deep and moderately deep Fairbanks soils on southerly slopes of high ridges were mapped as a unit. More than three-fourths of this unit has slopes of 12 and 20 percent; about half of this area consists of the deep Fairbanks silt loams. Inclusions of other soils are like those described for the Fairbanks soils.

When these soils are cleared of trees, the risk of erosion is severe. Cleared areas should be kept more than half the time in hay meadow, or in pasture if grazing is controlled. Small grains or row crops should be grown in strips. Diversion ditches and grassed waterways should be built to dispose of excess water safely.

Fairbanks-Ester association, steep to very steep (FEF).—This mapping unit is on high ridges in the eastern part of the Fairbanks Area. In this part, the soils on southerly and northerly slopes were mapped as one unit. Fairbanks silt loams, mostly moderately deep, make up more than 75 percent of this mapping unit. As in other parts of the Area, Ester silt loams are on north-facing slopes. Also included in this mapping unit are many areas of Gilmore silt loams on southerly slopes and of Goldstream silt loams along small streams. The soils in this mapping unit should be left in forest.

Gilmore Series

The Gilmore series consists of well-drained soils of uplands. The soils have developed in shallow to very shallow deposits of micaceous silt. They occur on south-facing slopes of high ridges in the northern part of the Fairbanks Area. Marketable stands of white spruce, aspen, and paper birch are available, but most areas of Gilmore soils have been burned over or cut over. Present stands consist mainly of quaking aspen and, in places, alder.

Typical profile (Gilmore silt loam) :

- 4 inches to 0, mat of moss and other organic material; partially decomposed in the upper part but well decomposed in the lower part; medium to slightly acid.
- 0 to 2 inches, very dark grayish-brown silt loam; very weak, very thin, platy structure; very friable; strongly acid.
- 2 to 5 inches, brown silt loam with a few angular pebbles; weak, very thin, platy structure; very friable; strongly acid.
- 5 to 8 inches, dark-brown silt loam with a few angular pebbles; moderate, very thin, platy structure; very friable; thin, un-

undulating band of heavy silt loam or silty clay loam near bottom of layer; strongly acid.

8 to 17 inches, dark grayish-brown silt loam with a few angular pebbles; moderate, very thin, platy structure; very friable; very thin, irregular band of heavy silt loam or silty clay loam in middle of layer; strongly acid.

17 to 24 inches +, weathered mica schist.

Depth to the underlying rock ranges from 6 to 20 inches. In soils that have developed in thin silty deposits, the brown subsoil may extend into the schist, and the undulating bands of finer material may be absent. At high elevations, a gray or grayish-brown layer may be near the surface. In many places, the mat of organic material on the surface has been partially or wholly destroyed by fire.

The Gilmore soils have developed in much the same way as the Fairbanks soils but differ from them in their shallowness to bedrock and in the absence of a layer of unweathered silty material beneath the brown soil material. In general, the Gilmore soils grade downslope to the Fairbanks soils.

Like the Fairbanks soils, the Gilmore soils are highly susceptible to erosion after clearing.

Gilmore silt loam, 3 to 7 percent slopes (GmB).—This gently sloping soil occurs principally on the tops of high, narrow ridges. The silty mantle over the bedrock is normally 10 to 20 inches thick. Areas mapped as this soil may include patches of Fairbanks silt loams, moderately deep, and of Gilmore silt loams, very shallow. (Management group 10.)

Gilmore silt loam, 7 to 12 percent slopes (GmC).—This soil is mainly on high ridges. It differs from Gilmore silt loam, 3 to 7 percent slopes, only in gradient. (Management group 13.)

Gilmore silt loam, 12 to 20 percent slopes (GmD).—This moderately steep soil is mainly on high ridges. Down the slope it grades to the moderately deep Fairbanks silt loams, and up the slope, it may grade to the steeper, very shallow Gilmore silt loams. Patches of both these soil types may be included. As a rule, the slopes of Gilmore silt loam, 12 to 20 percent slopes, are fairly smooth, but they are dissected in a few places by shallow drainageways. (Management group 17.)

Gilmore silt loam, 20 to 30 percent slopes (GmE).—This steep soil is mostly near the tops of high ridges. It contains fewer inclusions of the moderately deep Fairbanks silt loams than of the moderately steep Gilmore silt loams. However, patches of very shallow Gilmore silt loams are more numerous. In these patches there are a few outcrops of rock. (Management group 19.)

Gilmore silt loam, 30 to 45 percent slopes (GmF).—This very steep soil is similar to Gilmore silt loam, 20 to 30 percent slopes, except that it has steeper slopes and occupies higher positions on the ridges. In addition, the patches of the very shallow Gilmore silt loams and of rock outcrops are somewhat more numerous. (Management group 19.)

Gilmore silt loam, very shallow, 3 to 7 percent slopes (GrB).—This soil has formed in a deposit of micaceous loess that is less than 10 inches thick over bedrock. In most places, the soil-forming processes have modified a few inches of the underlying rock. The content of clay in this weathered bedrock is slightly higher than in weathered bedrock elsewhere in the Fairbanks Area. Gilmore silt loam, very shallow, 3 to 7 percent slopes,

occurs on gentle slopes on a few high ridgetops. Patches of the deeper Gilmore silt loams may be included with this soil. (Management group 13.)

Gilmore silt loam, very shallow, 7 to 12 percent slopes (GrC).—Except for slopes, this soil is like Gilmore silt loam, very shallow, 3 to 7 percent slopes, and it occurs in the same topographic position. (Management group 17.)

Gilmore silt loam, very shallow, 12 to 20 percent slopes (GrD).—This soil occurs on the slopes and tops of high ridges. Rock outcrops are more numerous than in the gently sloping, very shallow Gilmore silt loams. A few patches of the deeper Gilmore silt loams have been included. (Management group 17.)

Gilmore silt loam, very shallow, 20 to 30 percent slopes (GrE).—This steep soil generally is on the high parts of ridges. Rock outcrops are fairly common on these steep slopes, but in general, the slopes are smooth and only slightly dissected. A few patches of the deeper Gilmore silt loams are included. (Management group 19.)

Gilmore silt loam, very shallow, 30 to 45 percent slopes (GrF).—Except for gradient, this very steep soil is like Gilmore silt loam, very shallow, 20 to 30 percent slopes. (Management group 19.)

Gilmore-Ester association, moderately steep to very steep (GEF).—This mapping unit is in the eastern part of the Fairbanks Area, where the shallow soils on high ridges were mapped as a unit. Gilmore silt loam, 30 to 45 percent slopes, makes up more than half the area of these soils, and Gilmore silt loam, 20 to 30 percent slopes, makes up most of the rest. Ester silt loam, which is on north-facing slopes, covers about 20 percent of the mapping unit. Areas of the very shallow Gilmore silt loams are common. Patches of the moderately deep Fairbanks silt loams also occur. The soils in this association should be kept in forest.

Goldstream Series

The Goldstream series consists of poorly drained silty soils with perennially frozen subsoil. These soils occur in broad, low areas of the alluvial plain along principal rivers and in relatively narrow strips along upland drainageways. The native vegetation is a dense growth of shrubs and a few clumps of spindly black spruce, tamarack, and willow. Numerous closely spaced tussocks of sedge, some as much as 18 inches high and 12 inches wide, give the soil surface a hummocky appearance. Between the tussocks, the soil is covered by moss.

Typical profile (Goldstream silt loam) :

- 5 inches to 0, mat of moss and roots; upper part of moss is undecomposed, but the lower part is black and finely divided; strongly acid.
- 0 to 4 inches, black silt loam; weak, fine, blocky structure; slightly sticky when wet; strongly acid.
- 4 to 19 inches, gray silt loam; many mottles of olive brown and few irregular streaks of black; massive; sticky; neutral; frozen below depth of 19 inches late in summer.

Lenses of fine sand may occur in the lower part of the profile, especially in soils on the broad alluvial plain. Under native vegetation, the depth to permafrost ranges from 10 to about 24 inches. The soil above permafrost is always semifluid.

The Goldstream soils occur in slightly lower areas of the alluvial plain than the Tanana soils, and they are more

poorly drained and finer textured. The Goldstream soils are finer textured than the sandy Bradway soils, which are also in low areas on the alluvial plain. They are generally somewhat wetter than the poorly drained Saulich soils on north-facing slopes bordering upland drainageways.

Goldstream silt loam, 0 to 3 percent slopes (GtA).—This nearly level soil occurs mostly on alluvial plains of the Tanana and Chena Rivers and Goldstream Creek, and along the lower parts of the main tributaries of these streams. Layers of sand and sandy loam in the subsoil are more common in this soil than in Goldstream silt loams in upland drainageways. Included are patches of soil that resemble Tanana silt loam. Lemeta peat occurs in depressions too small to map separately. (Management group 14.)

Goldstream silt loam, 3 to 7 percent slopes (GtB).—This gently sloping soil occurs in fairly narrow strips in upland drainageways and at the bases of hills that border the alluvial plain. It has formed mainly in silty material that washed from adjoining slopes. This silty material is many feet thick and contains almost no lenses of sand. Because many black organic streaks occur in the profile, even at great depths, the soil is known locally as muck. Trees grow mainly on very narrow strips of sandy soils along small streams flowing through the centers of some areas. These included sandy soils resemble those of the Salchaket series. (Management group 15.)

Goldstream silt loam, 7 to 12 percent slopes (GtC).—Except for slopes, this soil is like Goldstream silt loam, 3 to 7 percent slopes. (Management group 15.)

Goldstream-Lemeta association (GL).—This mapping unit occupies nearly level, low areas on the alluvial plain of the Chena River in the eastern part of the Fairbanks Area. It consists of Goldstream silt loam and Lemeta peat that were mapped together in a reconnaissance survey.

Goldstream silt loams comprise about 80 percent of the mapping unit; Lemeta peat is in shallow depressions surrounded by Goldstream silt loams. Small patches of Tanana silt loam are also included in this association.

These poorly drained soils are underlain by permafrost. Open ditches are needed to remove excess moisture from cleared fields of Goldstream silt loams. Even if drained, these soils dry out slowly in spring. As a result, planting dates are late, and only short-season crops, such as grains, grasses, and some vegetables, can be grown. Lemeta peat will not be productive, even if it is drained.

Goldstream-Saulich association (GS).—This mapping unit is in the eastern part of the Fairbanks Area. It consists of Goldstream silt loams on flood plains and Saulich silt loams on foot slopes adjacent to tributaries of the Chena River. Slopes are mainly 3 to 7 percent, but there are also nearly level areas and slopes as steep as 12 percent in this mapping unit. Goldstream silt loams are the dominant soils. On south-facing slopes, patches of Minto silt loams are included in the association.

The soils in this association are poorly drained and need open ditches to remove excess water if they are to be cultivated. Tilth can be maintained in most fields by occasionally adding organic matter and by avoiding tillage when the soil is wet. Fertilizer should be applied according to needs determined by soil tests. Some areas are in low places for which suitable drainage outlets are not available. These areas cannot be drained successfully.

Even if drained, the soils of this association dry out slowly and only short-season crops can be grown. Grasses, some vegetables, and grains are most suitable. Grasses should not be grown more than 4 years in succession, because they produce an insulating effect that encourages the return of permafrost.

Gravel Pits

Gravel pits (Gv).—This is a land type that occurs on the alluvial plain and, less commonly, along roads in the uplands. On the alluvial plain, Gravel pits are generally surrounded by Salchaket or Tanana soils, and in the uplands, by the Gilmore or the moderately deep Fairbanks soils. Most Gravel pits on the alluvial plain have been excavated to a depth of several feet below the water table. (Management group 22.)

Lemeta Series

The Lemeta series consists of peat soils that have formed in depressions in the alluvial plain. The peat consists mostly of undecomposed sphagnum moss, but it also contains layers of slightly decomposed sedge. The lower part of the peat and the underlying mineral soil are perennially frozen. In addition to mosses and sedges, Lemeta peat supports a dense growth of shrubs and clumps of spindly black spruce, tamarack, and other trees. Tussocks of sedge are common, especially near the edges of the peat bogs.

Typical profile (Lemeta peat) :

- 0 to 13 inches, dark-brown (when moist) moss peat arranged in thin horizontal layers; light brown when squeezed dry; few, thin layers of black sedge peat; strongly acid.
- 13 to 25 inches, moss peat similar to that in 0- to 13-inch layer, but with many layers of black sedge peat; very strongly acid; frozen below depth of 25 inches.

Woody particles may occur at any depth in the peat. Free water occurs immediately below the surface throughout the summer. Depth to permafrost ranges from 1 foot to about 2½ feet.

Lemeta peat (lp).—This soil is generally surrounded by broad areas of Goldstream silt loams and may include patches of those soils near its boundary. Ponds, or small lakes, are common in the peat bogs. Some lakes, or ponds, are open, but others are filled with sedge and horsetail. (Management group 21.)

Mine Tailings

Mine tailings (Me).—This is a land type that consists of mounds of coarse rubble left by gold dredges in several of the tributary valleys of the Tanana River and Goldstream Creek. The silty overburden above the gold-bearing gravel was usually many feet thick. This was removed hydraulically before dredging operations started. (Management group 22.)

Minto Series

The Minto series consists of nearly level to moderately sloping, moderately well drained soils that have developed in micaceous silty material. This material is many feet thick over bedrock. The Minto soils occupy the bases of

hills that are dominated by the well-drained Fairbanks soils. In most places, they support forests of white spruce, paper birch, and quaking aspen, like those on the Fairbanks soils, but some areas are covered by black spruce. The forest floor is generally covered by moss, grass, and horsetail.

Typical profile (Minto silt loam) :

- 4 inches to 0, mat of roots, moss, and partially decomposed organic material; extremely acid.
- 0 to 3 inches, very dark grayish-brown silt loam; weak, fine, granular structure; friable; very strongly acid.
- 3 to 7 inches, dark grayish-brown silt loam with dark yellowish-brown mottles and dark streaks; weak, blocky structure breaking to very thin, platy; very friable; strongly acid.
- 7 to 15 inches, dark grayish-brown silt loam mottled with faint olive brown; moderate, very thin, platy structure; very friable; slightly acid.
- 15 to 30 inches +, dark grayish-brown silt that contains many horizontal streaks of olive brown; moderate, very thin, platy structure; very friable; mildly alkaline.

The Minto soils differ from the Fairbanks soils in having grayish rather than brown or yellowish-brown subsoil, in lacking the thin bands of fine material characteristic of the Fairbanks soils, and in having mottles throughout the profile. The Minto soils are not so highly mottled as the imperfectly drained Tanana soils of the river flood plains, and they are browner.

The Minto soils grade to the Fairbanks soils on higher slopes, and to the Tanana or the Goldstream soils on the bordering flood plains. Inclusions of small patches of these soils are common in areas mapped as the Minto soils.

Many areas of Minto soils are underlain at a depth of 6 feet or more by irregular, discontinuous masses of ice. After clearing of vegetation and subsequent warming of the soil, this ice may melt. Soil subsidence resulting from the melting of ice and tunneling in the subsurface may result in the formation of deep, steep-walled pits or in a very hummocky microrelief. These conditions may become severe enough in fields to prevent their further agricultural use (?).

Cleared areas of the sloping Minto soils are subject to sheet and gully erosion.

Minto silt loam, 0 to 3 percent slopes (MnA).—This nearly level soil occurs at the bases of long, concave upland slopes that have a southerly exposure. Small patches of Tanana silt loam, and of Goldstream silt loams, which are soils of the flood plains, may be included with this Minto soil.

Minto silt loam, 0 to 3 percent slopes, is somewhat more highly mottled than the Minto soils on higher areas. Under natural conditions, this soil generally has a thicker cover of moss. (Management group 3.)

Minto silt loam, 3 to 7 percent slopes (MnB).—This soil occupies the lower parts of long, southerly upland slopes and a few low, isolated hills adjacent to flood plains. On hillsides, there is a gradual boundary between this soil and the higher lying, steeper Fairbanks silt loams. Consequently, near the boundary, patches of Fairbanks silt loams are included with this soil. In addition, narrow strips of the Goldstream soils, which occur along some of the minor drainageways, have been included. (Management group 5.)

Minto silt loam, 7 to 12 percent slopes (MnC).—This moderately sloping soil is mostly on low hills near the river flood plains. Some of the slopes face north, and on these, a few areas resembling the Saulich silt loams are

included. On the south-facing slopes, patches of Fairbanks silt loams are included. In the minor drainageways on all slopes, narrow strips of Goldstream silt loams were mapped with Minto silt loam, 7 to 12 percent slopes. (Management group 8.)

Minto-Saulich association (MS).—This association was mapped on the foot slopes of hills in the eastern part of the Fairbanks Area. The gently sloping to moderately sloping Minto silt loams are dominant in this association. They occur mostly on south-facing slopes having a gradient in the range of 3 to 12 percent. Saulich silt loams are on north-facing slopes. Small areas of Goldstream silt loams that occur along drainageways are included in the association.

If cleared of vegetation, these soils are subject to subsidence because of the melting of subsurface ice. This causes uneven settling and pitting of the surface and may make cultivation difficult or impossible. In addition, these soils are subject to severe erosion and should be cultivated only if adequate precaution is taken to control accelerated erosion.

Salchaket Series

The Salchaket series consists of nearly level, well-drained soils that have developed in recently deposited water-laid material along the Tanana and Chena Rivers. These soils are dominantly sandy but commonly contain layers of silty material. They are underlain by thick deposits of coarse sand and gravel.

The Salchaket soils support a forest of white spruce, paper birch, and quaking aspen. Near streams, these forests contain some balsam poplar. Most forested areas have been burned or cut over, and many areas have been cleared for farming and homesites.

Typical profile (Salchaket very fine sandy loam) :

- 7 inches to 0, mat of roots, moss, and partially decomposed organic material; very strongly acid.
- 0 to 3 inches, olive-brown and grayish-brown silt loam with black lenses of decomposed organic matter; weak, granular structure; very friable; very strongly acid.
- 3 to 10 inches, gray and brown very fine sandy loam with few black lenses; very weak, blocky structure; very friable; slightly acid.
- 10 to 26 inches, gray fine sand with mottles of strong brown; structureless; loose; mildly alkaline.
- 26 inches +, gravel and coarse sand; all pebbles are rounded.

Depth to the gravelly underlying material ranges from 10 inches to 6 feet or more. Thin silty lenses or seams of coarse sand may occur at any depth in the profile, especially in areas far from the present river courses. The silty surface layer is absent in some places, but in a few places it may be more than 12 inches thick. As a rule, the soil above gravel is not perennially frozen, but under the native vegetation, silty lenses may stay frozen well into the summer.

Salchaket very fine sandy loam (Sc).—This level to nearly level soil is generally more than 36 inches deep over the underlying gravel. The surface is dissected in places by sloughs and by the scars of old streams. Included are many small areas of the moderately deep Salchaket very fine sandy loam and strips of the poorly drained Bradway very fine sandy loam, which occupy former sloughs that are too narrow to delineate separately. (Management group 1.)

Salchaket very fine sandy loam, moderately deep (Sm).—This soil is 20 to 36 inches deep over gravel. Small areas may be thicker or thinner, because of the variations in the depth to underlying gravel. As a rule, this moderately deep soil has fewer silty lenses than Salchaket very fine sandy loam, and there are fewer strips of Bradway very fine sandy loam included. (Management group 6.)

Salchaket very fine sandy loam, shallow (Ss).—This soil is generally 10 to 20 inches thick over gravel. It is shallower than Salchaket very fine sandy loam, moderately deep, but otherwise is like it. Many patches of the moderately deep Salchaket very fine sandy loam and a few of the even shallower Chena soils are included. (Management group 9.)

Salchaket association (SA).—This association was mapped along the Chena River in the eastern part of the Fairbanks Area. It consists of the deep and moderately deep Salchaket very fine sandy loams. Most of the soil in this association is thicker than 36 inches, but the depth to the underlying gravel varies considerably. Included with this mapping unit are patches of the shallow Salchaket soils, and in former stream channels, strips of the poorly drained Bradway very fine sandy loam. These soils warm up and can be worked earlier in the season than the silty soils of the Area. Droughtiness may reduce yields, but crops will respond to supplemental irrigation. Crops that are suited to the climate will produce good yields if seeded early and fertilized according to needs determined by soil tests. Crop residue or manure should be applied regularly to maintain tilth and soil structure. Serious erosion hazards do not exist on these nearly level soils.

Saulich Series

The Saulich series consists of poorly drained soils that occupy mainly the lower parts of north-facing slopes. The soils have developed in fairly thick deposits of silty material. The subsoil is perennially frozen. The soil surface is covered by a thick mat of moss and a dense growth of low shrubs. In most places the Saulich soils support a sparse stand of spindly black spruce, mixed with scattered alders and willows.

Typical profile (Saulich silt loam) :

- 7 inches to 0, mat of roots and moss; extremely acid.
- 0 to 4 inches, dark olive-gray silt loam streaked with black; very weak, platy structure; very friable when moist, non-sticky when wet; very strongly acid.
- 4 to 7 inches, dark grayish-brown and very dark grayish-brown silt loam with a few, thin streaks of black; weak, platy structure; very friable when moist, nonsticky when wet; strongly acid.
- 7 to 15 inches +, dark grayish-brown silt loam with many mottles of olive brown and a few streaks of black; weak, platy structure; very friable when moist, nonsticky when wet; frozen below a depth of 15 inches; medium acid.

Depth to permafrost ranges from 12 to 30 inches, but it may be more where the natural cover of moss has been removed. In their natural condition, these soils are always saturated above the permafrost.

At the higher elevations on the slope, the Saulich soils generally border the steeper, shallow, and poorly drained Ester soils; at lower elevations on the slope, adjacent to

upland drainageways, they border the more gently sloping Goldstream soils. Areas of Saulich soils may include patches of either of these two soils.

Saulich silt loam, 3 to 7 percent slopes (SuB).—This gently sloping soil is on north-facing slopes in positions that are comparable to those the Minto soils occupy on southerly slopes. At lower elevations on the slope, this soil grades to areas of Goldstream silt loams, patches of which may be included. (Management group 15.)

Saulich silt loam, 7 to 12 percent slopes (SuC).—This soil is on the middle and low parts of north-facing slopes. These slopes are generally smooth and undissected. At lower elevations along the drainageways, this soil grades to areas of Goldstream silt loams. Up the slope, it may border Ester silt loams. A few patches of either of these soils may be included with this soil. (Management group 15.)

Saulich silt loam, 12 to 20 percent slopes (SuD).—This soil is on the middle slopes of high ridges. It commonly borders the steep Ester silt loams higher on the slope and the more gently sloping Saulich silt loams lower on the slope. Saulich silt loam, 12 to 20 percent slopes, has developed in somewhat thinner deposits of silty material than the more gently sloping Saulich silt loams. Small areas of Ester silt loams are commonly included. (Management group 18.)

Tanana Series

The Tanana series consists of nearly level, imperfectly drained soils that have developed in silty materials on alluvial plains. These soils occur farther from the principal streams than the Salchaket soils and in slightly higher positions than the Goldstream soils. In many places, the Tanana soils border the Minto soils on the foot slopes of uplands.

The Tanana soils support a scrubby forest of black and white spruce, paper birch, tamarack, and willow. A fairly smooth mat of mosses and low shrubs generally covers the surface. Under the native vegetation, the soil is perennially frozen at a depth of 30 inches or less. After the mat of moss has been cleared, the depth to permafrost generally increases to more than 6 feet. When this occurs, excess moisture can percolate through the soil.

Typical profile (Tanana silt loam) :

- 5 inches to 0, mat of roots, moss, and lichen; color grades from dark brown at surface to black at bottom of horizon; strongly acid.
- 0 to 4 inches, olive-gray silt loam with many streaks and patches of black and grayish brown; massive; friable; neutral.
- 4 to 20 inches, olive-brown silt loam with streaks and patches of black and grayish brown and mottles of dark brown; massive; friable; mildly alkaline; perennially frozen below depth of 20 inches under native vegetation.

Lenses of very fine sandy loam or fine sand are common. Gravel underlies most areas at a depth of 4 to 10 feet.

Tanana silt loam (Tc).—This nearly level soil is extensive on the alluvial plains. Near the uplands, it grades to the moderately well drained Minto silt loams. Elsewhere on the plains, it borders the well-drained Salchaket very fine sandy loams or the poorly drained Goldstream silt loams and the Bradway very fine sandy loam. Included with this soil are many small patches of Minto and Goldstream silt loams. These included areas occur most

often where this soil borders the Minto or Goldstream soils. Bradway very fine sandy loam has been included where it occupies winding, narrow channels within areas of Tanana silt loam. Small areas of Salchaket very fine sandy loams and Lemeta peat are also included but are rare. (Management group 11.)

Tanana-Goldstream association (TG).—This association was mapped in the eastern part of the Fairbanks Area, along the Chena River. Tanana silt loam is the dominant soil, but Goldstream silt loams occupy large areas in slightly lower positions. Inclusions of other soils of the alluvial plains, as described for Tanana silt loam, are common.

These soils are almost always wet before clearing because the ground water perched above the permafrost cannot escape. After the vegetation and ground cover of moss have been cleared, the soil will be dry enough to cultivate in 1 or 2 years without the need of artificial drainage. Shallow ditches are needed in some fields to carry off excess moisture in the spring. The removal of excess water allows earlier seeding and reduces the chances of frost damage to crops late in summer.

All crops that are suited to local conditions can be grown but require fertilizer in quantities determined by soil tests. Crop residue and manure should be applied to maintain tilth and soil structure. Grasses should be grown part of the time in the cropping systems.

Use and Management of the Soils

This section consists of three parts. The first discusses methods of clearing vegetation from land intended for farming; the second discusses crop yields and fertilization in the Area; and the third explains how soils are grouped for management.

Clearing Land

The well drained and moderately well drained soils can be cleared any time after the marketable trees have been harvested. However, clearing is most efficiently done when the soil is not frozen. The underbrush and trees left after logging are pushed over by a bulldozer equipped with a scarifier blade. This material, together with large roots, is then pushed into windrows.

If clearing is done on frozen ground, trees are sheared off above the ground and moved into windrows. They are allowed to dry and are then burned. Large roots and stumps are later moved to the windrows with a scarifier blade or a heavy breaking plow.

On sloping land, windrows should be made diagonally across the slopes to keep runoff from ponding on the upper sides and, at the same time, to control runoff from newly cleared soil. Natural drainageways should not be blocked. Windrowed material should be allowed to dry and then burned. Precautions must be taken to prevent the spread of fire to surrounding forests. In most well-drained soils, the organic material is concentrated in a mat at the soil surface. This mat should not be removed in clearing.

The imperfectly drained and poorly drained soils are generally underlain by permafrost, and the removal of most of the surface mat of organic matter is necessary. Most of this mat is undecomposed moss or sedge, and if

it is not removed, it will prevent the soil from drying and reduce the effectiveness of some fertilizers. Some of the organic matter, however, should be left as an aid to good tilth.

The excess moss should be turned up by using an angle blade or a comparable implement. After the moss has dried, it should be burned in place. It should not be piled in windrows, as it dries slowly and will be very difficult to burn. The moss not turned up will stay wet for at least a year, so there is little danger of complete loss of organic matter.

The tussocks of sedge on wet soils are most easily sheared off when the soil is frozen. They can be burned with the excess moss.

On alluvial plains the clearing of the imperfectly drained and poorly drained soils should start next to a stream or other natural drainageway. On slopes, however, it should start at the upper end and progress down the hill. In both situations, small pockets should not be cleared in undisturbed areas, as runoff and water from melting ice will collect in the cleared pockets and prevent the soil from drying. Diversion ditches may be necessary along the upper end of cleared slopes to divert melt water and runoff from the cleared soil.

After land has been cleared and the debris or moss burned, the remaining mat of moss and fine roots should be broken up by use of a breaking plow or a heavy disk. This should be followed by several harrowings. Rototilling may be adequate in fields that had only a light cover of brush. Oats grown for hay is the most widely used crop for newly cleared land. The second year, the land is plowed and disked in the spring and then generally seeded to brome grass or to oats and peas.

Crop Yields and Fertilization

Although the freeze-free season in the Fairbanks Area is short, the almost continuous daylight in the summer months effectively reduces the number of days required for crops to mature. Gains in weight are rapid, and plant tissues are high in sugar and protein. Some plants, however, are unable to adapt to the long hours of light in this subarctic environment. For example, leafy vegetables like spinach and chard may bloom before vegetative development is completed. In addition, some legumes that are normally winter-hardy do not build up enough reserves before freezing weather to survive their first winter (6). Most of these problems will gradually be solved through the development of plant varieties that are better adapted to the growing conditions of this latitude.

Crop yields in the Fairbanks Area depend considerably on the intensity of fertilization. Heavy applications of a complete fertilizer—one that contains nitrogen, phosphate, and potash—are needed for production of good yields on all soils in the Area, including those newly cleared. Newly cleared soil needs large quantities of nitrogen because much of this element is used by bacteria in decomposing the native organic material. Application of fertilizer in excess of the minimum rate established by the University of Alaska (12) usually results in higher yields. Continuous cultivation has the tendency to break down the natural structure of the soil; consequently, periodic applications of manure or other organic matter are needed to help maintain good tilth.

In most years, midsummer moisture levels in the well-drained soils of the Area are less than optimum. Preliminary experiments indicate that yields can be increased through use of sprinkler irrigation, but data on the effects of irrigation are not yet available.

In this relatively new agricultural area, yields from soils suitable for cultivation appear to be more strongly influenced by management than by differences in soils. However, as more land is cultivated, and as farming procedures become more standardized, yields and adaptabilities of crops will reflect soil differences to a greater extent. At present there are not enough data to establish quantitative differences in productivity of the soils.

The estimated yields per acre of principal crops in the Fairbanks Area are shown in table 5. These estimates are based on yields from soils now in cultivation. Most cultivated soils are the nearly level to moderately sloping, deep to moderately deep Salchaket, Fairbanks, and Minto soils. There is but little cultivation of the poorly drained, very shallow, or steep soils. On these soils it is likely that some of the crops listed cannot be grown and that yields of most crops will be lower than stated.

Yield estimates are made for soils under two levels of management, average and improved. Average management includes the use of only the minimum recommended amounts of fertilizer, the return of little or no organic matter to the soil, and the use of only a few or no erosion control practices. Improved management includes the use of fertilizer at the rates determined by soil tests, the use of manure or green manure every 3 or 4 years, the growing of grass at fairly regular intervals, and the use of simple erosion control practices where necessary. Because of the small acreage per farm in crops, few farmers in the Area use a standard or systematic rotation of crops.

Yields shown in table 5 are averages over periods of several years. Abnormal crop seasons, past management, and the possible effects of irrigation were not considered.

TABLE 5.—*Estimated average yields per acre of principal crops under two levels of management*

Crop	Average management	Improved management
Potatoes..... tons..	6-7	10-12
Barley..... bushels..	30-35	50-60
Oats..... bushels..	40-45	60-70
Brome grass hay..... tons..	1½-2	2½-3
Brome grass silage..... tons..	5-6	7-9
Oat-pea silage..... tons..	4-5	8-10

Capability Groups of Soils

The capability classification is a grouping of soils that shows, in a general way, how suitable they are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be up to four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony, and *c*, used in only some parts of the country, indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it have little or no erosion hazard but have other limitations that limit their use largely to pasture, range, woodland, or wildlife. There are no class I nor class V soils in the Fairbanks Area.

Within the subclasses are the capability units, which are called management groups. The soils in one management group are enough alike to be suited to the same crops or other plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit or management group is a convenient grouping for making many statements about management of soils. Capability units are generally identified by numbers assigned locally.

Soils are classified in capability classes and subclasses and management groups in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

The six classes and the subclasses and management groups in the Fairbanks Area, are described in the list that follows. In this list, the capability unit designation is given in parentheses following the management group number.

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.

Subclass IIc.—Soils for which the choice of crops is limited only by climatic factors.

Management group 1 (IIc-1): Deep, medium- to coarse-textured, well-drained, alluvial soils; permafrost deep or absent.

Management group 2 (IIc-2): Deep, medium-textured, well-drained, nearly level soils of uplands; not susceptible to thermokarst pitting after clearing.

Management group 3 (IIc-3): Deep, medium-textured, moderately well drained, nearly level soils of uplands; susceptible to thermokarst pitting after clearing.

Subclass IIe.—Soils subject to moderate erosion if not protected.

Management group 4 (IIe-1): Deep and moderately deep, medium-textured, well-drained, gently sloping soils; not susceptible to thermokarst pitting after clearing.

Management group 5 (IIe-2): Deep, medium-textured, moderately well drained, gently sloping soils of uplands; susceptible to thermokarst pitting after clearing.

Subclass IIs.—Soils that have moderate limitations because of shallowness to excessively permeable substrata.

Management group 6 (IIs-1): Moderately deep, well-drained, medium- to coarse-textured, alluvial soils; permafrost deep or absent.

Class III. Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

Subclass IIIe.—Soils subject to severe erosion if they are cultivated and not protected.

Management group 7 (IIIe-1): Deep and moderately deep, medium-textured, well-drained, moderately sloping soils; normally not susceptible to thermokarst pitting after clearing.

Management group 8 (IIIe-2): Deep, medium-textured, moderately well drained, moderately sloping soils; susceptible to thermokarst pitting after clearing.

Subclass IIIs.—Soils that have severe limitations caused by shallowness to excessively permeable substrata or bedrock.

Management group 9 (IIIs-1): Shallow, medium- to coarse-textured, well-drained, alluvial soils; permafrost deep or absent.

Management group 10 (IIIs-2): Shallow, medium-textured, well-drained, gently sloping soils.

Subclass IIIw.—Soils that have severe limitations because of excess water.

Management group 11 (IIIw-1): Deep, medium-textured soils of the alluvial plain; imperfectly drained because of permafrost within 30 inches of soil surface.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe.—Soils subject to very severe erosion if they are cultivated and not protected.

Management group 12 (IVe-1): Deep and moderately deep, medium-textured, well-drained, moderately steep soils.

Subclass IVs.—Soils that have very severe limitations caused by shallowness to excessively permeable substrata or to bedrock.

Management group 13 (IVs-1): Shallow to very shallow, medium- to coarse-textured, well-drained to excessively drained, level to moderately sloping soils.

Subclass IVw.—Soils that have very severe limitations for cultivation because of excess water.

Management group 14 (IVw-1): Deep, medium-textured, poorly drained, level to sloping, alluvial soils that are underlain by permafrost.

Management group 15 (IVw-2): Deep, medium-textured, gently sloping to moderately sloping soils in upland drainageways and on north-facing hillsides; poorly drained because of high permafrost table.

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture or range.

Subclass VIe.—Soils severely limited, chiefly by risk of erosion if protection is not maintained.

Management group 16 (VIe-1): Deep and moderately deep, medium-textured, well-drained, steep soils.

Subclass VIIs.—Soils generally unsuitable for cultivation and severely limited for other uses by shallowness to bedrock.

Management group 17 (VIIs-1): Shallow to very shallow, medium-textured, well-drained, moderately sloping to moderately steep soils.

Subclass VIw.—Soils severely limited by excess water and unsuitable for cultivation.

Management group 18 (VIw-1): Deep, medium-textured, moderately steep soils on north-facing hillsides; poorly drained because of high permafrost table.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation and restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe.—Soils unsuited to cultivation and severely limited by risk of erosion if cover is not maintained.

Management group 19 (VIIe-1): Medium-textured, well-drained, steep to very steep soils.

Subclass VIIw.—Soils unsuited to cultivation and very severely limited by excess water.

Management group 20 (VIIw-1): Shallow, medium-textured, moderately steep to very steep soils on north-facing slopes; poorly drained because of a high permafrost table.

Management group 21 (VIIw-2): Peat soils with a high permafrost table.

Class VIII. Soils and land types that have limitations that preclude their use for commercial production of plants and restrict their use to recreation, wildlife, or esthetic purposes.

Subclass VIIIs.—Land types that are too stony to support commercial plants.

Management group 22 (VIIIs-1): Nonsoil areas.

Subclass VIIIw.—Land types that are too wet to support commercial plants.

Management group 23 (VIIIw-1): Annually flooded areas.

of fertilizer, crop varieties, or seeding rates, since recommendations change as new information is obtained and new crop varieties are developed. Up-to-date information and recommendations on farming in this Area are available in publications of the Alaska Agricultural Experiment Station. Soil samples may be mailed to the Agricultural Experiment Station in Palmer for testing and for specific fertilizer recommendations.

MANAGEMENT GROUP 1

This management group consists of a deep, medium- to coarse-textured, well-drained, alluvial soil, in which permafrost is deep or absent. The soil is—

Salchaket very fine sandy loam.

If adequately fertilized, this sandy soil will produce good yields of all crops suited to the climate. It warms more quickly and can be worked somewhat earlier in spring than the silty soils of the Area. Droughtiness reduces yields in dry summers, but the soil would respond to irrigation.

To obtain good yields, fertilize crops regularly according to the needs determined by soil tests. In addition, apply manure or crop residue regularly to maintain soil structure and tilth. Favorable tilth allows rapid infiltration of surface water and more efficient utilization of moisture and plant nutrients.

This nearly level soil has no serious erosion hazard. Crops should be seeded as early as possible in spring to reduce the chance of loss from early frosts.

MANAGEMENT GROUP 2

This management group consists of a deep, medium-textured, well-drained, nearly level soil of the uplands that is not susceptible to thermokarst pitting after clearing. The soil is—

Fairbanks silt loam, 0 to 3 percent slopes.

This soil is well suited to all crops that can be grown in the Area. For good yields, crops should be fertilized according to needs determined by soil tests. In addition, manure or crop residue should be added to maintain good tilth. If the supply of organic matter is depleted, the soil becomes firm when dry, and it may form a slowly permeable crust on the surface.

This soil has a moderate water-holding capacity, but it may be dry in midsummer. In most years, irrigation would increase yields. Special erosion control measures are not needed, because the hazard of erosion is low.

MANAGEMENT GROUP 3

This management group consists of a deep, medium-textured, moderately well drained, nearly level soil of uplands that is susceptible to thermokarst pitting after clearing. The soil is—

Minto silt loam, 0 to 3 percent slopes.

This soil is among the most productive in the Area, primarily because it is not likely to be droughty in dry summers. All crops common in the Area can be grown. If good yields are to be obtained, crops should be fertilized according to needs determined by soil tests. Additions of organic matter are needed periodically for good tilth.

Management by Groups of Soils

Information is given in this section about the principal management and conservation practices. Specific recommendations are not made concerning kinds and amounts

There is no serious risk of erosion from runoff. However, fields may become hummocky or badly pitted because of subsidence caused by the melting of subsurface masses of ice. In most places where this occurs, leveling followed by application of fertilizer and organic matter will help restore the field to its original condition. In rare instances all or part of a field may have to be abandoned because of pitting.

MANAGEMENT GROUP 4

This management group consists of deep and moderately deep, medium-textured, well-drained, gently sloping soils that are not susceptible to thermokarst pitting after clearing. The soils are—

Fairbanks silt loam, 3 to 7 percent slopes.

Fairbanks silt loam, moderately deep, 3 to 7 percent slopes.

The physical properties of these soils are like those of the soil in management group 2. If the same kind of management is applied, yields of crops from these soils can be expected to be comparable to those from the soil in management group 2.

The sloping soils of this management group, however, are subject to sheet and gully erosion unless simple conservation practices are used. These practices consist of cultivating along the contour, growing row crops in strips, and using grass in the cropping sequence. Organic matter should be applied regularly to maintain soil structure and tilth and to reduce the hazard of erosion.

MANAGEMENT GROUP 5

This management group consists of a deep, medium-textured, moderately well drained, gently sloping soil of the uplands that is susceptible to thermokarst pitting after clearing. The soil is—

Minto silt loam, 3 to 7 percent slopes.

This soil, like the one in management group 3, is capable of producing good yields of all crops that can be grown in the area, if adequate fertilizer is applied. It is subject to uneven subsidence, caused by the melting of subsurface ice, and to moderate sheet and gully erosion. Erosion can be controlled by cultivating along the contour, growing row crops in strips, and including grass in the regular cropping sequence.

MANAGEMENT GROUP 6

This management group consists of a moderately deep, medium- to coarse-textured, well-drained, alluvial soil, in which permafrost is deep or absent. This soil is—

Salchaket very fine sandy loam, moderately deep.

This soil is like the one in management group 1, except that it has gravel within 3 feet of the surface and is droughty in dry summers. All crops suited to the area can be grown, but they are more likely to be damaged by drought than those growing on the deeper sandy soil of the alluvial plain. Irrigation will probably make this soil as productive as the one in management group 1.

MANAGEMENT GROUP 7

This management group consists of deep and moderately deep, medium-textured, well-drained, moderately sloping soils that are normally not susceptible to thermokarst pitting after clearing. The soils are—

Fairbanks silt loam, 7 to 12 percent slopes.

Fairbanks silt loam, moderately deep, 7 to 12 percent slopes.

These soils are suitable for all crops adapted to the area and will yield well if fertilized according to needs determined by soil tests. However, they are subject to severe erosion. The soils should be in grass crops at least half of the time, and crop residues should be returned to the soils. This will help to maintain good soil structure, allow water to soak in, and reduce erosion. Contour cultivation is always necessary; strip-cropping is desirable if small grains or row crops are grown.

Many fields, especially those on long slopes below high ridges and those that are irrigated, should be protected by diversion ditches, grassed waterways, and other simple erosion control structures.

On the lower slopes where these soils grade to the Minto soils, the melting of subsurface ice may cause tunneling. This is most likely to occur where large volumes of water are concentrated.

MANAGEMENT GROUP 8

This management group consists of a deep, medium-textured, moderately well drained, moderately sloping soil that is susceptible to thermokarst pitting after clearing. The soil is—

Minto silt loam, 7 to 12 percent slopes.

Like the soils in management group 7, this soil is subject to severe erosion. It may also be subject to uneven settling and pitting after clearing. It is normally moister than the soils in management group 7, and crops probably will not need irrigation.

Erosion control practices on this soil should include maintaining good soil structure, cultivating on the contour, and strip-cropping. If possible, concentrations of water in ditches or waterways should be avoided, as this may result in soil pitting.

MANAGEMENT GROUP 9

This management group consists of a shallow, medium- to coarse-textured, well-drained, alluvial soil in which permafrost is deep or absent. This soil is—

Salchaket very fine sandy loam, shallow.

This sandy soil has a gravel substratum 10 to 20 inches below the surface. All crops suited to the Area can be grown, but shallowness to gravel may interfere with the production of potatoes and other root crops. In most summers, drought reduces yields unless the soil is irrigated. Suitable management for this soil is essentially the same as that for the soil in management group 1.

MANAGEMENT GROUP 10

This management group consists of a shallow, medium-textured, well-drained, gently sloping soil. The soil is—

Gilmore silt loam, 3 to 7 percent slopes.

All crops suited to the Area can be grown on the soil. Management needs are similar to those of management group 4, but shallowness to bedrock may interfere with the cultivation of potatoes and other root crops. Crops on this soil may be damaged by drought. In addition, the soil is on high ridges, and the danger to crops from frost is greater than on most other upland soils.

MANAGEMENT GROUP 11

In this management group is a deep, medium-textured soil of the alluvial plain that is imperfectly drained because permafrost is within 30 inches of the soil surface. The soil is—

Tanana silt loam.

Ground water perched above the permafrost keeps uncleared areas of this soil permanently wet. After the native vegetation and mossy ground cover have been removed, the soil thaws to greater depths. As a result it becomes dry enough in a year or two to allow cultivation without artificial drainage. Shallow ditches are needed in some fields to carry off excess water early in spring. The removal of this water allows crops to be seeded earlier and reduces the hazard of frost late in summer.

All crops suited to the Area can be grown on this soil. Good yields can be obtained by applying fertilizer in amounts indicated by soil tests. Good tilth can be maintained by periodically adding manure or crop residue and by including grass in the cropping sequence.

MANAGEMENT GROUP 12

This management group consists of deep and moderately deep, medium-textured, well-drained soils that are moderately steep. These soils are—

Fairbanks silt loam, 12 to 20 percent slopes.

Fairbanks silt loam, moderately deep, 12 to 20 percent slopes.

If cleared of trees, these soils are subject to severe erosion. They can be cultivated with reasonable safety, however, if suitable precautions are taken. More than half the time, fields should be in grass crops or used for pasture in which grazing is controlled. Small grains and row crops should be grown in strips. Diversion ditches and permanently grassed waterways are desirable in many places. An irregular surface, caused by shallow swales and low ridges running up and down slope, makes many areas suitable only for grass.

If crops other than grass are to be grown regularly, these soils should receive regular additions of manure or of crop residue to maintain structure and control erosion.

MANAGEMENT GROUP 13

This management group consists of shallow to very shallow, medium- to coarse-textured, level to moderately sloping soils that are well drained to excessively drained. These soils are—

Chena very fine sandy loam.

Gilmore silt loam, 7 to 12 percent slopes.

Gilmore silt loam, very shallow, 3 to 7 percent slopes.

If cleared, these soils can be used only for grass crops, pasture, garden vegetables, and, possibly, small grains. They are too shallow, as a rule, for the production of potatoes and other root crops. They are subject to mid-summer drought. Where feasible, irrigation will increase crop yields, but it is doubtful if yields will be as high as the average for the Fairbanks Area.

On the sloping soils, contour cultivation and strip-cropping are essential if crops other than grass are grown. The amounts and kinds of fertilizers needed for crops should be determined by soil tests. Organic matter should be added to cultivated fields to help maintain tilth and to increase the moisture-supplying capacity of these soils.

MANAGEMENT GROUP 14

This management group consists of deep, medium-textured, poorly drained, level to sloping, alluvial soils that are underlain by permafrost. These soils are—

Bradway very fine sandy loam.

Goldstream silt loam, 0 to 3 percent slopes.

Under natural conditions, these soils contain water far in excess of field capacity. The removal of most of the surface mat of moss and the construction of open ditches are needed to reduce the water level enough to make cultivation possible.

Ditches must be deep enough to allow for subsidence, which accompanies the melting of permafrost following the removal of the surface moss. Some areas of these soils are in depressions or in narrow channels of old streams and have no suitable outlet for ditches. These areas cannot be drained and are comparable to the soil in management group 21.

Even if drained, the soils of this management group dry out more slowly in spring than other soils in the Area. As a result, planting dates are late and only grains, grasses, some vegetables, and other short-season crops can be grown. Even these may be damaged by frost late in summer.

Grasses should not be grown consecutively for more than 4 years, because they insulate the soil and encourage the return of permafrost to its former high level.

Good tilth is essential for proper moisture relations in these soils. Tilth can be maintained in most fields by occasionally adding organic matter and not working the soil when it is wet. Fertilizers should be applied according to needs determined by soil tests.

MANAGEMENT GROUP 15

This management group consists of deep, medium-textured, gently sloping to moderately sloping soils in upland drainageways and on north-facing hillsides. These soils are poorly drained because the permafrost table is near the surface. Soils in this group are—

Goldstream silt loam, 3 to 7 percent slopes.

Goldstream silt loam, 7 to 12 percent slopes.

Saulich silt loam, 3 to 7 percent slopes.

Saulich silt loam, 7 to 12 percent slopes.

These soils are much wetter than those in comparable positions on south-facing slopes. Wetness is caused by the permafrost and by the constant inflow of seep water from the poorly drained soils on higher slopes. Removing the surface moss and diverting the seep water from cleared fields will reduce the moisture and allow the soils to warm. Open ditches are needed to remove water in spring, because these soils get less direct sunlight than other soils and are naturally slower in warming.

Low soil temperatures and the necessity of late planting limit the choice of crops to grains, grasses, and some vegetables. Good tilth can be maintained by occasionally adding organic matter and by not tilling the soils when wet. Fertilizer is needed in amounts shown by soil tests.

MANAGEMENT GROUP 16

This management group consists of deep and moderately deep, medium-textured, steep soils that are well drained. Soils in this group are—

Fairbanks silt loam, 20 to 30 percent slopes.

Fairbanks silt loam, moderately deep, 20 to 30 percent slopes.

Deep gullies will form in these soils if they are used for crops other than grass. If the native forest is removed, the soils should be kept in permanent meadow or pasture. Overcutting or overgrazing of grass should be avoided, as a continuous, firm sod is necessary to hold these soils in place.

Renovation of meadow or pasture should be accomplished by disking and reseeding without turning under the old sod. New seedings and established grass require fertilizer in amounts determined by soil tests.

MANAGEMENT GROUP 17

This management group consists of shallow to very shallow, medium-textured, well-drained, moderately sloping to moderately steep soils. These soils are—

- Gilmore silt loam, 12 to 20 percent slopes.
- Gilmore silt loam, very shallow, 7 to 12 percent slopes.
- Gilmore silt loam, very shallow, 12 to 20 percent slopes.

Even a small amount of erosion may expose bare rock and result in permanent loss of productivity of these soils. Consequently, the soils should have a permanent cover of vegetation consisting of either grass or trees. Grass should not be overcut or overgrazed. Seedings are more difficult to establish on these soils than on the deeper soils because stones interfere with tillage. Fertilization, including topdressing, is needed. Apply fertilizer in amounts indicated by soil tests.

MANAGEMENT GROUP 18

This management group consists of a deep, medium-textured, moderately steep soil on north-facing slopes that is poorly drained because of a high permafrost table. The soil is—

- Saulich silt loam, 12 to 20 percent slopes.

Because of the permafrost, the constant inflow of seep water from poorly drained soils on higher slopes, and the low amount of direct sunlight, this soil is much wetter than those in comparable positions on south-facing slopes.

Diversion ditches for intercepting seep water are needed to make the soil suitable for agriculture. Even though seep water is diverted, this soil is too limited by low soil temperatures and steepness of slope to be used for hay and pasture grasses. Fertilization, as determined by soil tests, will be necessary for sustained good yields of forage. Overgrazing must be avoided if gullying is to be prevented.

MANAGEMENT GROUP 19

This management group consists of medium-textured, well-drained, steep to very steep soils. These soils are—

- Fairbanks silt loam, 30 to 45 percent slopes.
- Fairbanks silt loam, moderately deep, 30 to 45 percent slopes.
- Gilmore silt loam, 20 to 30 percent slopes.
- Gilmore silt loam, 30 to 45 percent slopes.
- Gilmore silt loam, very shallow, 20 to 30 percent slopes.
- Gilmore silt loam, very shallow, 30 to 45 percent slopes.

The removal of the native forest would create a very severe erosion hazard. Consequently, forest is by far the best use of these soils. The soils can be used for pasture if a vigorous stand of grass is maintained and grazing is carefully regulated. In addition, nitrogen and other fertilizer must be applied to obtain high yields of forage.

MANAGEMENT GROUP 20

This management group consists of shallow, medium-textured, moderately steep to very steep soils on north-facing slopes that are poorly drained because of a high permafrost table. The soils are—

- Ester silt loam, 12 to 20 percent slopes.
- Ester silt loam, 20 to 30 percent slopes.
- Ester silt loam, 30 to 45 percent slopes.

These soils are not suitable for cultivation and should not be cleared of their native vegetation. They receive little direct sunlight. Controlled burning on these soils may create conditions that favor the establishment of paper birch. Stands of birch may have commercial value. The native sedges and grasses that grow on these wet, moss-covered soils can be grazed. Forage yield is very low.

MANAGEMENT GROUP 21

This management group consists of a peat soil that has a high permafrost table. The soil is—

- Lemeta peat.

This soil is always waterlogged and cannot be drained. Some of the surface is covered by small ponds and sloughs. Sedges and grasses growing on the bogs can be grazed, but the amounts of forage available to farm livestock is small.

MANAGEMENT GROUP 22

This management group consists of nonsoil areas. These areas, or land types, are—

- Gravel pits.
- Mine tailings.

The areas are bare gravel that have no value for agriculture or forestry. They support only a few bushes of alder and willow.

MANAGEMENT GROUP 23

This management group consists of areas flooded annually. The land type is—

- Alluvial land.

This land type is along the large rivers and is frequently flooded. It is not suitable for agriculture or forestry. It supports some vegetation that is of benefit to wildlife.

Engineering Applications

This section is for engineers and others who want information about use of soils in structures. Most of the information is presented in three tables. Table 6, on physical properties of soils that affect engineering, and table 7, on features affecting use of soil materials for highways or agricultural structures, are based partly on the tests of soil samples shown in table 8. These tables, with the soil map and the information on soils given elsewhere in the report, can be used by engineers to—

1. Make soil and land-use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in planning drainage and irri-

gation systems and other structures for soil and water conservation.

3. Make preliminary evaluations of soil conditions that will aid in selecting highway and airport locations and in planning detailed investigations of the selected sites.
4. Locate sources of sand and gravel.
5. Correlate performance of existing structures with soil types and thus develop information that can be useful in designing and maintaining future structures.
6. Determine the suitability of soils for off-road movement of vehicles and construction equipment.

It must be emphasized, however, that the soil map and the descriptions of the soils in this report are generalized. The report therefore should be used only in planning the more detailed field surveys that will need to be made to determine the in-place condition of the soil at the site proposed for construction.

Some of the terms used in this report have special meanings to soil scientists that do not correspond with the meanings assigned to the same terms by engineers or others concerned with soil mechanics. The following commonly used terms are defined according to their special meaning in soil science.

Soil.—The natural, three-dimensional medium for the growth of land plants, on the earth's surface, that has properties resulting from the combined effect of climate and living matter acting on parent material, as conditioned by relief, over periods of time. Deep, unconsolidated materials not affected by soil-forming processes other than mechanical weathering, and below the reach of plant roots, normally are not considered to be soil.

Substratum.—Any layer lying beneath the solum or true soil. It is applied to both parent materials and to other layers unlike the parent material, below the B horizon, or the subsoil.

Texture, soil.—The relative proportions of the various size groups of individual particles in a mass of soil. Specifically, the proportions of sand, silt, and clay. Coarse-textured or coarse-grained soils contain a high proportion of sand; fine-grained soils are high in clay.

Textural class.—A defined range in percentages of particles in each size class. Only mineral particles finer than 2.0 millimeters are considered in the definition of basic textural classes. Terms like "gravelly" or "mucky," which indicate the presence of large amounts of coarser particles or organic matter, may be used to modify the basic textural class names. Textural classes are defined in terms of size distribution. Gradation and plastic properties of the soil are not directly considered in the definition of textural classes.

Sand: (1) As a soil separate, individual rock or mineral particles ranging in diameter from 2.0 millimeters (No. 10 sieve) to 0.05 millimeter. (2) As a textural class, soil material that contains 85 percent or more of sand but in which the percentage of silt plus $1\frac{1}{2}$ times the percentage of clay does not exceed 15. The textural class name is normally modified to indicate the dominant size of sand particles; for example, very fine sand, coarse sand, and so on.

Silt: (1) As a soil separate, individual mineral particles that range in diameter between the upper size limit of clay, 0.002 millimeter, and the lower size limit of very fine sand, 0.05 millimeter. (2) As a textural class, silt contains 80 percent or more silt-size particles and less than 12 percent clay.

Clay: (1) As a soil separate, the mineral particles less than 0.002 millimeter in diameter. (2) As a textural class, soil material that contains 40 percent or more of clay, less than 45 percent sand, and less than 40 percent silt.

Loam: The textural class name for soil that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. The word *loam* is part of other textural class names as, for example, silt loam. This class name indicates textural properties between those of a loam and those of soils of the silt class.

Definitions of other terms used in this report are given in the Soil Survey Manual (10).

Engineering Soil Classification Systems

Most highway engineers classify soil material according to the system approved by the American Association of State Highway Officials (1). In this system, soil materials are classified in seven principal groups. The groups range from A-1, which consists of gravelly soil of high bearing capacity, to A-7, which consists of fine-grained soils having low strength when wet. In each group, relative engineering value of the soil material is indicated by a group index number. Group index numbers range from 0 for the best material to 20 for the poorest. The group index number is shown in parentheses, following the soil group symbol.

Some engineers prefer to use the Unified soil classification system (13). In this system, soil materials are identified as coarse grained, 8 classes; fine grained, 6 classes; and highly organic soils. An approximate classification of soils by this system can be made in the field. Soils are classified according to both systems in tables 6 and 8 in this part of the report.

Soil Characteristics Significant to Engineering

A brief description of the soils mapped in the Fairbanks Area and the estimated physical properties significant to engineering are given in table 6. Additional information about the soils can be obtained in the sections "Descriptions of the Soils" and "Formation, Classification, and Morphology of the Soils."

The interpretations of engineering properties of soils are given in table 7. Specific features or characteristics of soils that may affect engineering practices and estimates of the suitability of the soils for specific purposes are listed. The listing of features and the suitability ratings are based on information in table 6, actual test data available (table 8), and field experience. Brief statements about soil features that affect the engineering practices follow.

TABLE 6.—*Brief description of soils and*

[Dashes in columns indicate

Symbol on map	Soil name	Depth from surface to—			Description of soil and site	Depth from surface (typical profile)	Classification	
		Seasonally high water table ¹	Permafrost table ²	Bedrock or alluvial gravel			USDA texture	
Ad	Alluvial land.	<i>Feet</i> Less than 1.	<i>Feet</i> -----	<i>Feet</i> Less than 1.	Thin, silty mantle over rounded alluvial gravel; adjacent to river and frequently flooded.	<i>Inches</i> 0 to 60+ ---	Very gravelly sand.	
Br	Bradway very fine sandy loam.	Less than 1.	3 to 4-----	More than 6	Poorly drained, very fine sandy soil in old stream channels of alluvial plain.	0 to 2----- 2 to 36+---	Mucky silt loam. Very fine sandy loam with lenses of silt loam and fine sand.	
Ch	Chena very fine sandy loam.	6 to 10-----	More than 15.	Less than 1.	Excessively drained, very shallow, sandy soil over rounded, alluvial gravel.	0 to 4----- 4 to 7----- 7 to 18+---	Very fine sandy loam. Fine sand----- Very gravelly sand.	
EsD	Ester silt loam, 12 to 20 percent slopes.	Less than 1.	Less than 1.	1 to 2-----	Poorly drained, shallow, silty soils over bedrock on north slopes of ridges; normally frozen.	0 to 10-----	Silt loam-----	
EsE	Ester silt loam, 20 to 30 percent slopes.							
EsF	Ester silt loam, 30 to 45 percent slopes.							
FaA	Fairbanks silt loam, 0 to 3 percent slopes.	More than 15.	None-----	3 to 6+---	Well-drained, deep, silty soils of uplands.	0 to 36+---	Silt loam to silt--	
FaB	Fairbanks silt loam, 3 to 7 percent slopes.							
FaC	Fairbanks silt loam, 7 to 12 percent slopes.							
FaD	Fairbanks silt loam, 12 to 20 percent slopes.							
FaE	Fairbanks silt loam, 20 to 30 percent slopes.							
FaF	Fairbanks silt loam, 30 to 45 percent slopes.							
FmB	Fairbanks silt loam, moderately deep, 3 to 7 percent slopes.							
FmC	Fairbanks silt loam, moderately deep, 7 to 12 percent slopes.							
FmD	Fairbanks silt loam, moderately deep, 12 to 20 percent slopes.							
FmE	Fairbanks silt loam, moderately deep, 20 to 30 percent slopes.							
FmF	Fairbanks silt loam, moderately deep, 30 to 45 percent slopes.							
GmB	Gilmore silt loam, 3 to 7 percent slopes.	More than 15.	None-----	1 to 2-----	Well-drained, shallow, silty soils of uplands.	0 to 17----- 17 to 24-----	Silt loam to silt-- Gravelly sandy loam.	
GmC	Gilmore silt loam, 7 to 12 percent slopes.							
GmD	Gilmore silt loam, 12 to 20 percent slopes.							
GmE	Gilmore silt loam, 20 to 30 percent slopes.							
GmF	Gilmore silt loam, 30 to 45 percent slopes.							

See footnotes at end of table.

their estimated physical properties

data are not available]

Classification—Con.		Percentage passing sieve—			Permeability ³	Available water ⁴	Reaction	Dispersion ⁵	Shrink-swell potential ⁶
Unified	AASHO	No. 4 (4.76 mm.)	No. 10 (2 mm.)	No. 200 (0.74 mm.)					
GW-GM	A-1-a	60 to 75	40 to 50	5 to 10	<i>Inches per hour</i> More than 6.0.	<i>Inches per foot of depth</i>	<i>pH value</i>	Low	Low.
OL	A-5	100	100	60 to 70	0.6 to 2.0	1.5 to 2.0	6.0 to 6.5	High	Moderate.
ML	A-4	100	95 to 100	50 to 60	.6 to 2.0	1.5 to 2.0	7.5 to 8.0	Moderate	Low.
ML	A-4	100	95 to 100	50 to 60	.6 to 2.0	1.0 to 2.0	5.0 to 6.0	Moderate	Low.
SP-SM	A-3	100	90 to 100	5 to 10	2.0 to 6.0	.5 to 1.0	6.0 to 6.5	Low	Low.
GW	A-1-a	60 to 75	40 to 50	0 to 5	More than 6.0.	More than 0.5.		Low	Low.
ML	A-4	100	100	85 to 95	.2 to 0.6	(?)	4.0 to 5.0	High	Moderate.
ML, ML-CL	A-4, A-5	100	100	85 to 100	.2 to 0.6	2.0 to 2.5	5.0 to 6.5	High	Low.
ML, ML-CL	A-4	100	100	85 to 95	.2 to 0.6	2.0 to 2.5	5.0 to 6.0	High	Low.
GM	A-1-b	50 to 60	30 to 40	15 to 25	.2		6.0 to 6.5	Low	Low.
ML	A-4	100	100	85 to 95	.2 to 0.6	2.0 to 2.5	5.0 to 6.0	High	Low.
GM	A-1-b	50 to 60	30 to 40	15 to 25	Less than 0.2		6.0 to 6.5	Low	Low.

TABLE 6.—*Brief description of soils and*

Symbol on map	Soil name	Depth from surface to—			Description of soil and site	Depth from surface (typical profile)	Classification	
		Seasonally high water table ¹	Permafrost table ²	Bedrock or alluvial gravel			USDA texture	
GrB	Gilmore silt loam, very shallow, 3 to 7 percent slopes.	<i>Feet</i> More than 15.	<i>Feet</i> None-----	<i>Feet</i> Less than 1.	Well-drained, very shallow, silty soils of uplands.	<i>Inches</i> 0 to 8----- 8 to 18-----	Silt loam to silt Gravelly sandy loam.	
GrC	Gilmore silt loam, very shallow, 7 to 12 percent slopes.							
GrD	Gilmore silt loam, very shallow, 12 to 20 percent slopes.							
GrE	Gilmore silt loam, very shallow, 20 to 30 percent slopes.							
GrF	Gilmore silt loam, very shallow, 30 to 45 percent slopes.							
GtA	Goldstream silt loam, 0 to 3 percent slopes.	Less than 1.	1 to 3-----	More than 6.	Poorly drained, silty soils of alluvial plains.	0 to 4----- 4 to 19+	Silt loam----- Silt loam-----	
GtB	Goldstream silt loam, 3 to 7 percent slopes.							
GtC	Goldstream silt loam, 7 to 12 percent slopes.							
Lp	Lemeta peat.	0-----	1 to 3-----	More than 6.	Very poorly drained peat bogs.	0 to 25+---	Peat-----	
Me	Mine tailings.	More than 15.	More than 15.	-----	Coarse, angular gravel in gold-dredge fields.	0 to 60+---	-----	
MnA	Minto silt loam, 0 to 3 percent slopes.	2 to 3-----	Variable----	More than 6.	Moderately well drained, deep, silty soils on foot slopes.	0 to 30+---	Silt loam to silt.	
MnB	Minto silt loam, 3 to 7 percent slopes.							
MnC	Minto silt loam, 7 to 12 percent slopes.							
Sc	Salchaket very fine sandy loam.	10 to 15----	None or more than 15.	1 to 6-----	Well-drained, deep to shallow, sandy soils over rounded alluvial gravel.	0 to 3----- 3 to 10----- 10 to 26----- 26+-----	Silt loam----- Very fine sandy loam. Fine sand----- Very gravelly sand. Silt loam-----	
Sm	Salchaket very fine sandy loam, moderately deep.							
Ss	Salchaket very fine sandy loam, shallow.							
SuB	Saulich silt loam, 3 to 7 percent slopes.	Less than 1.	1 to 3-----	3 to 6+-----	Poorly drained, deep, silty soils over bedrock; on north slopes.	0 to 15+---	Silt loam-----	
SuC	Saulich silt loam, 7 to 12 percent slopes.							
SuD	Saulich silt loam, 12 to 20 percent slopes.							
Ta	Tanana silt loam.	Less than 1.	2 to 4-----	4 to 6+-----	Imperfectly drained, silty soils of alluvial plains.	0 to 4----- 4 to 20+---	Silt loam-----	

¹ Depth to water table before clearing of vegetation. In soils with permafrost and free water perched above frozen ground, the water table may drop when the surface mat of vegetation is removed.

² The permafrost table drops when the mat of surface vegetation is removed.

³ Permeability is for soil without compaction; for wet soils, the permeability is that to be expected after removal of free water.

their estimated physical properties—Continued

Classification—Con.		Percentage passing sieve—			Permeability ³	Available water ⁴	Reaction	Dispersion ⁵	Shrink-swell potential ⁶
Unified	AASHO	No. 4 (4.76 mm.)	No. 10 (2 mm.)	No. 200 (0.74 mm.)					
ML..... GM.....	A-4..... A-1-b.....	100 50 to 60	100 30 to 40	85 to 95 15 to 25	<i>Inches per hour</i> .2 to 0.6..... Less than 0.2	<i>Inches per foot of depth</i> 2.0 to 2.5.....	<i>pH value</i> 5.0 to 6.0..... 6.0 to 6.5.....	High..... Low.....	Low. Low.
OL..... ML.....	A-5..... A-4.....	100 100	100 100	80 to 90 80 to 90	.2 to 0.6..... .2 to 0.6.....	2.0 to 2.5..... 2.0 to 2.5.....	5.0 to 5.5..... 6.5 to 7.0.....	High..... High.....	Moderate. Moderate.
Pt.....							4.5 to 5.0.....		
GW.....	A-1-a.....	20 to 30	10 to 20	0 to 5					Low.
ML.....	A-4.....	100	100	85 to 95	.2 to 0.6.....	2.0 to 2.5.....	4.5 to 5.0; grading to 7.5 to 8.0 below 15 inches.	High.....	Moderate.
ML..... ML.....	A-4, A-5..... A-4.....	100 100	100 100	80 to 95 60 to 90	.2 to 0.6..... .6 to 2.0.....	2.0 to 2.5..... 1.5 to 2.0.....	5.0 to 5.5..... 6.0 to 6.5.....	High..... Moderate.....	Low. Low.
SM or ML.....	A-2 or A-4.....	100	90 to 100	5 to 80	2.0 to 6.0.....	.5 to 1.0.....	7.5 to 8.0.....	Low.....	Low.
GP or SP.....	A-1-a or A-3.....	15 to 70	10 to 60	0 to 5	More than 6.0.	Less than 0.5.		Low.....	Low.
ML.....	A-4.....	100	100	85 to 95	.2 to 0.6.....	2.0 to 2.5.....	5.0 to 6.0.....	High.....	Moderate.
MH, OH or OL..... ML.....	A-4 or A-7..... A-4 or A-5.....	100 100	95 to 100 95 to 100	70 to 90 90 to 100	.2 to 0.6.....	2.0 to 2.5.....	7.0 to 7.5.....	High.....	Moderate to high. Moderate.

⁴ An approximation of capillary water in the soil profile when wetted to field capacity. The amount of water that will wet "air-dry" soil to a depth of 1 foot without deeper percolation. In poorly drained soils, water in excess of this amount is normally present in the soil profile before drainage.

⁵ Refers to the degree and rapidity with which soil structure breaks down, or slacks, in water.

⁶ The shrink-swell potential is an indication of the volume change to be expected in the soil with changes in moisture content.

⁷ Soil is normally frozen; no estimate made.

TABLE 7.—*Interpretation of*

[Dashes in columns indicate

Soil series and map symbol	Susceptibility to frost action	Suitability as source of—				Soil features affecting engineering practices	
		Road subgrade (undisturbed material)	Road fill (disturbed material)	Topsoil	Sand and gravel	Vertical alinement of highways	
						Material	Drainage
Alluvial land (Ad)	-----	Fair to poor; high water table.	Poor; high water table.	Poor-----	Poor; very high water table.	No adverse features.	High water table.
Bradway (Br)	High to moderate.	Fair to poor--	Poor-----	Fair; usually wet.	Poor; uniformly graded very fine sandy material.	No adverse features.	High water table.
Chena (Ch)	Moderate to low.	Good to fair--	Good-----	Fair-----	Good; gravel substratum.	No adverse features.	No adverse features.
Ester (EsD, EsE, EsF).	High-----	Fair to poor--	Poor-----	Poor-----	Poor; bedrock near surface.	Shallowness to bedrock.	Wet or frozen under natural vegetation.
Fairbanks (FaA, FaB, FaC, FaD, FaE, FaF, FmB, FmC, FmD, FmE, FmF).	High to moderate.	Fair to poor--	Fair to poor; erodible.	Good-----	Poor to not suitable.	Shallow to bedrock in places; erodible in cut slopes.	No adverse features.
Gilmore (GmB, GmC, GmD, GmE, GmF, GrB, GrC, GrD, GrE, GrF).	High to moderate.	Fair to poor--	Poor to fair; erodible.	Good, but shallow to bedrock.	Poor; bedrock near surface.	Shallow to bedrock.	No adverse features.
Goldstream (GtA, GtB, GtC).	High-----	Fair to poor--	Poor-----	Good; usually wet.	Unsuitable-----	Deep, silty material with permafrost.	Wet to surface; permafrost.
Lemeta peat (Lp).	High-----	Unsuitable-----	Unsuitable.	Unsuitable-----	Unsuitable-----	Peat soil with permafrost.	Wet to surface; permafrost.
Mine tailings (Me).	-----	-----	-----	-----	-----	-----	-----
Minto (MnA, MnB, MnC).	High to moderate.	Fair to poor--	Poor-----	Good-----	Unsuitable-----	Deep, silty material; erodible.	Seasonally high water table.
Salchaket (Sc, Sm, Ss).	Moderate to low.	Good to fair--	Good-----	Fair-----	Good to fair; depth to gravel substratum variable.	No adverse features.	No adverse features.

engineering properties of soils

data not applicable]

Soil features affecting engineering practices—Continued							Remarks
Dikes and levees	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways	
	Reservoir area	Embankment					
Rapid permeability.							Frequently flooded.
Moderate permeability; high water table.	Moderate permeability; high water table.	Moderate permeability; instability.	High water table; moderate permeability.	High water table.	(Not needed)	(Not needed)	Ground water perched above permafrost.
Rapid permeability.	Rapid permeability.	Good stability; rapid permeability.	(Not needed)	Low water-holding capacity; rapid permeability.	(Not needed)	(Not needed)	
	Shallowness to bedrock.	Poor stability			Shallowness to bedrock.		Perennially frozen under natural vegetation.
Susceptibility to piping.	Susceptibility to piping.	Poor stability	(Not needed)	Moderate water-holding capacity; moderate permeability.	High erodibility.	High erodibility.	
Silty material; susceptibility to piping; weathered bedrock stable.	Shallowness to bedrock.	Silty material has no stability; weathered bedrock has good stability.	(Not needed)	Moderate water-holding capacity.	High erodibility.	High erodibility.	
Silty material; susceptibility to piping.	High water table; permafrost.	Poor stability	High water table; moderate permeability.	High water table.	Moderate erodibility.	Moderate erodibility.	Ground water perched above permafrost.
Peat soil	High water table; permafrost.	Peat soil	High water table.	High water table.	(Not needed)	(Not needed)	
							Good source of coarse aggregate.
Silty material; susceptibility to piping.	Susceptibility to piping.	Poor stability	Moderate permeability.	Moderate water-holding capacity.	High erodibility.	High erodibility.	Melting of underground ice masses may result in irregular subsidence or pitting.
Rapid permeability.	Rapid permeability.	Good stability; rapid permeability.	(Not needed)	Low to moderate water-holding capacity; rapid permeability.	(Not needed)	(Not needed)	Silty lenses in subsoil may impede drainage.

TABLE 7.—*Interpretation of*

Soil series and map symbol	Susceptibility to frost action	Suitability as source of—				Soil features affecting engineering practices	
		Road subgrade (undisturbed material)	Road fill (disturbed material)	Topsoil	Sand and gravel	Vertical alinement of highways	
						Material	Drainage
Saulich (SuB, SuC, SuD).	High-----	Fair to poor..	Poor-----	Good, but usually wet.	Not suitable---	Deep, silty material with permafrost.	Wet to surface; permafrost.
Tanana (Ta)----	High-----	Fair to poor..	Poor-----	Good, but usually wet.	Fair to poor; depth to gravel substratum variable.	Deep, silty material with permafrost.	Wet to surface; permafrost.

Permafrost, or perennially frozen soil, creates many engineering problems in the Fairbanks Area. In the uplands, perennially frozen subsoil occurs on the north slopes of ridges and in the sloping valleys along the secondary drainageways. On the alluvial plains, large areas of nearly level soils are underlain by permafrost. Removal of the insulating surface moss or litter from these soils causes thawing in the upper part of the permafrost. This is commonly accompanied by subsidence of the overlying soil. Roads and structures on these soils may settle unevenly unless special construction methods are used. Level and sloping soils are nearly always saturated in summer in the zone above permafrost. Failure to remove excess water, especially along roads, often results in even more unsettled conditions because of severe heaving of soil in spring. There is an additional hazard in areas of Minto soils on foot slopes. In these areas very irregular subsidence or, in some places, the formation of deep, steep-walled pits may be caused by the melting of underground masses of ice.

Frost action in soils with and without permafrost is a major problem in all soils of the Area. A precise correlation has not been established, but it is believed that in the Fairbanks Area only soils containing less than 3 percent of material finer than 0.074 millimeter (No. 200 sieve) can be considered nonsusceptible to heaving by frost. Except for the gravelly substratum under the soils of the

alluvial plains, no soil that occurs naturally in the Fairbanks Area can meet this requirement.

The rating of a soil as to its susceptibility to frost action depends on the texture of the soil material and the depth to the high water table during the freezing period. Silt and fine sand with a high water table are rated "High."

Because of the difficulty in maintaining proper control of moisture for compaction when soil is frozen, the construction of embankments and other earthworks with frost-susceptible material should be avoided in winter:

The suitability of a soil for "Road subgrade (undisturbed material)" depends on its texture, natural water content, and the depth to the water table and permafrost. Silty or fine sandy soils with a high water table and shallow depth to permafrost are rated "Fair to poor." Where the permafrost and water table are deep and the soils are sandy, the soils are rated "Good to fair." Muck and peat soils are rated "Unsuitable."

The suitability of a soil for "Road fill (disturbed material)" depends largely on the texture of the soil, its natural water content, and depth to permafrost. Soils with a shallow zone of permafrost are rated "Poor." Highly erodible silty soils are rated "Fair to poor." Sandy and gravelly soils where permafrost is deep, or not present, are rated "Good."

On the alluvial plain, most soils are underlain by a thick deposit of rounded, well-graded gravel. The thickness of the finer material over the gravel is variable. In the Gold-

engineering properties of soils—Continued

Soil features affecting engineering practices—Continued							Remarks
Dikes and levees	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways	
	Reservoir area	Embankment					
Silty material; susceptibility to piping.	High water table; permafrost; susceptibility to piping after clearing.	Poor stability.	High water table; moderate permeability.	High water table.	High erodibility.	High erodibility.	Ground water perched above permafrost.
Silty material; susceptibility to piping.	High water table; permafrost.	Poor stability.	High water table; moderate permeability.	High water table.	(Not needed)	(Not needed)	Ground water perched above permafrost.

stream soils, the gravel under frozen silty material is generally so deep that it cannot be excavated economically. In many areas of Tanana soil, the gravel can be reached fairly easily. The gravel is most readily excavated from the Chena soil and from the shallow and moderately deep Salchaket soils. In many places, however, the water table is high enough to interfere with excavation.

In the uplands, angular gravel from weathered schist can be obtained from the gently or moderately sloping Gilmore soils near the tops of ridges and from Mine tailings in the valleys. As a rule, the other upland soils are not a suitable source of gravel.

The sloping, silty soils of the uplands are subject to severe gully erosion. For prevention of gulying, road ditches and diversion ditches in fields should be at least 2 feet deep, have side slopes of a gradient no steeper than 3 to 2, and have a permanent cover of grass. In addition, they must always be free of obstructions. These ditches must be kept open in spring so that water does not pond behind snow or ice. Lateral ditches in fields should have side slopes of about 5 to 1, so that they can be crossed with farm machinery. Grassed ditches, terraces, and waterways should have a grade of not more than 5 percent.

Stock ponds or reservoirs in the uplands must be lined with impermeable material to prevent seepage. Large quantities of water moving through silty upland soils may form subsurface tunnels that can effectively drain the pond.

The silty, well-drained soils of the uplands are not well suited to the off-road movement of vehicles and heavy equipment. After clearing, these soils are very dusty when dry and soft and slippery when wet. On both uplands and alluvial plains, silty soils with permafrost are wet throughout the summer under natural conditions and will not support repeated passes of equipment. The Chena, Salchaket, and other well-drained, sandy soils, are suitable for cross-country movement of equipment except when they are too dry to provide traction.

Other sources of information on the engineering properties of soils in the Fairbanks Area include published reports by Lindholm, Thomas, and Davidson (3); Péwé (9); Williams (14); and Williams, Péwé, and Paige (15).

Soil Test Data

As shown in table 8, profiles of soils in three of the most extensive soil series in the Fairbanks Area were tested according to standard procedures (1). Samples were chosen to indicate the range in physical properties for each series. For each series, there are test data on three soil profiles. One of these profiles, or at most two of them, represents the modal, or typical, nature of the soil series; the other profiles are within the allowable range of variation for the series but differ from the modal profile in texture, consistence, or some other property significant in engineering.

TABLE 8.—*Engineering*

Soil name and location	Parent material	Bureau of Public Roads report number	Depth	Horizon	Moisture-density ²	
					Maximum dry density	Optimum moisture
Fairbanks silt loam: SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 18, T. 1 N., R. 1 E. (modal) ---	Micaceous loess.	S37857	<i>Inches</i> 0-3	A ₁	<i>Lb. per cu. ft.</i> 77	<i>Percent</i> 30
		S37858	7-21	B ₂	105	16
		S37859	25-40	C ₁	102	17
NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 27, T. 1 N., R. 2 E. (modal) ---	Micaceous loess.	S37860	0-3	A ₁	83	26
		S37861	7-15	B ₂	104	17
		S37862	20-30+	C ₁	105	16
SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 29, T. 1 S., R. 2 W. (slightly coarser).	Micaceous loess.	S37863	0-3	A ₁	82	27
		S37864	6-15	B ₂	97	19
		S37865	26-40	C ₁	102	16
Salchaket very fine sandy loam: NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 19, T. 1 S., R. 2 E. (modal) --	Alluvium (Flood plain).	S37866	0-3	A ₁	76	32
		S37867	10-26	C ₂	93	19
		S37868	26-36+	D	127	5
NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 15, T. 1 S., R. 1 E. (thicker deposit).	Alluvium (Flood plain).	S37869	3-16	C ₁	84	25
		S37870	16-24	C ₂	89	22
		S37871	24-36+	C ₃	90	21
SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 3, T. 2 S., R. 2 E. (shallower) -	Alluvium (Flood plain).	S37872	1-10	C ₁	90	21
		S37873	10-15	C ₂	97	17
		S37874	15-20	D ₁	114	10
Tanana silt loam: SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 22, T. 1 S., R. 1 W. (modal) --	Alluvium (Flood plain).	S37875	0-4	A ₁	52	60
		S37876	4-12	C _{st1}	81	30
		S37877	12-20	C _{st2}	88	24
SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 27, T. 1 N., R. 2 E. (more poorly drained).	Alluvium (Flood plain).	S37878	0-2 $\frac{1}{2}$	A ₁	35	99
		S37879	2 $\frac{1}{2}$ -13	C ₁	98	19
		S37880	13-20	C ₂	100	18
NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 1, T. 1 S., R. 2 W. (lower in clay).	Alluvium (Flood plain).	S37881	0-3	A ₁	63	43
		S37882	3-11	C ₁	99	20
		S37883	21-30+	C ₃	102	17

¹ Tests performed by the Bureau of Public Roads in accordance with standard procedures of the American Association of State Highway Officials (1).

² Based on Standard Specifications for Highway Materials and Methods of Sampling and Testing (Pt. 2, Ed. 8): The Moisture-density Relations of Soils Using 5.5-pound rammer and 12-in. drop, AASHTO Designation T 99-57, Method A (1).

³ Mechanical analyses according to the American Association of State Highway Officials Designation T 88. Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including

test data¹

Mechanical analyses ³										Liquid limit	Plasticity index	Classification		
Percentage passing sieve—					Percentage smaller than—				AASHO ⁴			Unified ⁵		
2 in.	¾ in.	No. 4 (4.75 mm.)	No. 10 (2.0 mm.)	No. 40 (0.425 mm.)	No. 200 (0.075 mm.)	0.075 mm.	0.0425 mm.	0.025 mm.		0.015 mm.				
			100	98	93	88	51	17	10	46	7	A-5(9)-----	ML.	
				100	97	90	48	20	14	28	6	A-4(8)-----	ML-CL.	
				100	99	93	45	12	5	27	4	A-4(8)-----	ML-CL.	
				100	96	92	55	18	11	38	7	A-4(8)-----	ML.	
				100	98	93	54	22	16	30	6	A-4(8)-----	ML-CL.	
				100	99	94	55	19	12	30	6	A-4(8)-----	ML.	
			100	99	96	93	60	18	11	41	6	A-5(8)-----	ML.	
				100	98	95	60	19	12	32	6	A-4(8)-----	ML.	
				100	94	75	26	8	5	(⁶)	(⁶)	A-4(8)-----	ML.	
				100	97	96	69	23	12	50	9	A-5(10)-----	ML.	
100	76	18	12	100	76	52	16	5	2	(⁶)	(⁶)	A-4(8)-----	ML.	
				100	9	4	3	2	1	0	(⁶)	(⁶)	A-1-a(0)---	GP.
				100	92	80	33	7	5	(⁶)	(⁶)	A-4(8)-----	ML.	
				100	97	89	40	4	2	(⁶)	(⁶)	A-4(8)-----	ML.	
				100	65	38	11	4	1	(⁶)	(⁶)	A-4(6)-----	ML.	
				100	79	56	19	5	1	(⁶)	(⁶)	A-4(8)-----	ML.	
100	95	74	67	100	14	8	4	1	1	(⁶)	(⁶)	A-2-4(0)---	SM.	
				100	60	8	5	4	3	(⁶)	(⁶)	A-3(0)-----	SP-SM.	
			100	98	85	81	66	36	18	96	20	A-7-5(16)---	OH.	
				100	93	87	65	35	19	48	6	A-5(10)-----	ML.	
				100	92	82	39	12	5	37	6	A-4(8)-----	ML.	
			100	95	69	66	46	11	6	(⁶)	(⁶)	A-4(7)-----	OL.	
				100	99	95	55	19	12	31	5	A-4(8)-----	ML.	
				100	99	95	54	16	12	30	5	A-4(8)-----	ML.	
			100	97	90	87	66	28	17	64	11	A-7-5(12)---	MH.	
				100	99	97	66	23	13	34	8	A-4(8)-----	ML.	
				100	99	94	55	18	10	29	5	A-4(8)-----	ML-CL.	

that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.

⁴ Based on Standard Specifications for Highway Materials and

Methods of Sampling and Testing (Pt. 1, Ed. 8): The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, AASHO Designation M 145-49 (1).

⁵ Based on the Unified Soil Classification System, Tech. Memo. No. 3-357, v. 1, Waterways Expt. Sta. Corps of Eng., March 1953 (13).

⁶ Nonplastic.

Formation, Classification, and Morphology of the Soils

Soil properties are strongly influenced by climate—temperature and the amount, kind, and distribution of precipitation. Temperature and precipitation characteristics also determine, to a considerable extent, the kind of vegetation that will grow in an area. This vegetation, in turn, profoundly influences soil characteristics. The extent that soil material or parent rock has been changed by climatic and biologic forces depends, in large part, on the length of time that these soil-forming processes have been active. Local variations in topography also affect the nature and intensity of soil development. For example, soils formed in low areas having a permanently high water table may be very different from those that formed on well-drained uplands.

Factors of Soil Formation

Soils of the Fairbanks Area have formed in two different, but related, parent materials. Those on the uplands have formed in micaceous loess derived from glacial outwash. Those on the alluvial plains have formed either in water-deposited, micaceous sand and silt that was derived primarily from glaciers, or in silty material that has washed from nearby hillsides. Some depressions in the alluvial plains contain peat soils.

The Fairbanks Area has a continental climate characterized by long, cold winters and short, warm summers. The total annual precipitation is only about 12 inches, about half of which falls as rain in the short summer season. Most of this is retained if the soil is covered by native vegetation. Uncultivated, well-drained soils are generally moist throughout the summer but may be dry if the rainfall is exceptionally low. Other soils are moist or wet all summer. The soils in most cleared fields, however, are deficient in moisture part of the time.

Topographic position and aspect greatly influence the drainage characteristics of soils in the Fairbanks Area. In the uplands, the north-facing slopes receive much less solar heat than the south-facing slopes. As a result, the soil on north-facing slopes is generally underlain by permafrost and is always cold and wet. In contrast, most of the soil on south-facing slopes is not perennially frozen, and it is well drained or moderately well drained. In the broad, low areas of the alluvial plains, the soil has a high permafrost table and is poorly drained. On slightly higher ground on the plains, the soil has a deeper permafrost table and is imperfectly drained. On levees along rivers, permafrost is deep or absent, and the soil is well drained.

All well drained and most moderately well drained soils in the Area have formed under a boreal forest dominated by white spruce, paper birch, and quaking aspen. The imperfectly drained soils support a poor growth of these trees, mixed with black spruce, tamarack, and willow. The ground is covered by a dense growth of moss and low shrubs. The poorly drained and very poorly drained soils support a sparse tree cover consisting mainly of black spruce. They have a ground cover of mosses, shrubs, and sedge tussocks. Additional information regarding the vegetation of the Fairbanks Area is given in the section "Vegetation."

The Fairbanks Area has never been glaciated, but it is likely that all soils in the Area have developed since the time of maximum glacial advance in the mountains to the south. Only well-drained soils of the uplands, on which loess is no longer being deposited, can be considered to be mature. Soils forming in the very recent deposits of the alluvial plains are young and have not had time for horizon differentiation. The poorly drained soils on both uplands and alluvial plains show little development of horizons.

Classification and Morphology

Soils are classified on the basis of profile characteristics into categories that are progressively more inclusive. The lowest categories commonly used in the field—series, type, and phase—are discussed in the section "How Soils Are Named, Mapped, and Classified." In a higher category of classification are great soil groups. Each great soil group contains many soils that have common characteristics developed as a result of environmental influences. The 11 soil series identified in the Fairbanks Area have been placed in 5 great soil groups as follows.

Great soil group and series:

- Subarctic Brown Forest soils:
 - Fairbanks
 - Gilmore
 - Minto
- Alluvial soils:
 - Chena
 - Salchaket
- Low-Humic Gley soils:
 - Bradway
 - Tanana
 - Ester¹
 - Goldstream¹
 - Saulich¹
- Bog soils:
 - Lemeta

¹ Intergrading to Bog soils.

The characteristics of the soils in each great soil group are described in the following pages.

Subarctic Brown Forest soils

Soils of the Fairbanks, Gilmore, and Minto series are Subarctic Brown Forest soils. The Minto soils are only moderately well drained and have some of the characteristics of the Low-Humic Gley soils.

The Subarctic Brown Forest soils have developed under forest in the Fairbanks Area and other subarctic regions. These areas have a continental climate characterized by low annual precipitation; short, warm summers; and long, cold winters. The soils are well drained and have fairly thin accumulation of litter and mosses on the surface. These accumulations are underlain by brown surface soil and subsoil. The soils are generally medium to strongly acid and may have a weakly bleached layer below the surface horizon. Base saturation is high. The subsoil may contain thin, wavy bands of material high in clay. Structural development is weak.

FAIRBANKS SERIES

Soils of the Fairbanks series are believed to be mature representatives of the Subarctic Brown Forest group. These soils occur principally on southerly slopes of hills

and have developed in micaceous loess. The sources of the loess are outwash plains and flood plains of streams carrying glacial outwash material (8). It is not likely that there have been additions of loess in substantial amounts since the last major retreat of the glaciers. Consequently, soil formation and horizon differentiation have been progressing for a long time without interruption.

Typical profile of Fairbanks silt loam (undisturbed) (SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 18, T. 1 N., R. 1 E., Fairbanks meridian) :

- A₀₀ 2½ to 2 inches, litter of leaves and twigs.
- A₀ 2 inches to 0, dark reddish-brown (5YR 2/2) mat; pieces of charcoal; mycelia; slightly acid; abrupt, smooth boundary.
- A₁ 0 to 4 inches, dark yellowish-brown (10YR 3/4) silt loam; weak, very fine, crumb structure; very friable; many roots; slightly acid; abrupt, wavy boundary.
- A₂(?) 4 to 7 inches, grayish-brown (10YR 5/2) silt; very weak, very thin, platy structure breaking to granular structure when crushed; very friable; few roots; strongly acid; abrupt, wavy boundary.
- B₂₁ 7 to 17 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, very thin, platy structure; roughly horizontal, undulating bands of dark yellowish-brown (10YR 4/3) fine silt loam or silty clay loam, ¼ inch thick, occur at vertical intervals of 4 or 5 inches in this and the B₂₂ horizon; very friable; very few roots; strongly acid; gradual boundary.

- B₂₂ 17 to 26 inches, dark grayish-brown (10YR 4/2) to grayish-brown (10YR 5/2) silt loam; moderate, very thin, platy structure; very friable; very few roots; medium acid; gradual boundary.
- C₁ 26 to 38 inches, dark grayish-brown (2.5Y 4/2) silt; few, small mottles of brown; moderate, very thin, platy structure; some plate faces slightly darker than bulk of horizon; very friable; almost no roots; slightly acid; gradual boundary.
- C₂ 38 to 48 inches +, olive-gray (5Y 4/2, 5/2) silt; brown mottles more prominent than in C₁ horizon; very friable; no roots; slightly acid.

Results of analyses of samples from this profile are shown in table 9.

The thin bands of fine material in the subsoil are an outstanding characteristic of the Fairbanks soils. These bands are roughly horizontal, but they undulate through the B horizon and are usually interconnected. In places they may be as much as half an inch thick, but normally they are much thinner. The upper and lower boundaries of the bands are very abrupt. Within the bands, the soil is arranged in fine blocks, commonly with faint clay films on the peds. Most of the clay accumulation in the B horizon that is indicated by the particle-size analysis in table 9 is in these bands. The texture of the bulk of the B horizon differs little from that of horizons above and below it.

TABLE 9.—Physical and chemical properties of a profile of Fairbanks silt loam

[Analyses by Soil Survey Laboratory, Lincoln, Nebr.]

PHYSICAL PROPERTIES

Depth from surface	Horizon	Particle-size distribution							Textural class	Moisture held at tension of—		
		Very coarse sand (2-1 mm.)	Coarse sand (1-0.5 mm.)	Medium sand (0.5-0.25 mm.)	Fine sand (0.25-0.1 mm.)	Very fine sand (0.1-0.05 mm.)	Silt (0.05-0.002 mm.)	Clay (less than 0.002 mm.)		1/10 atmosphere	1/2 atmosphere	15 atmospheres
<i>Inches</i>		<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>		<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
0-4	A ₁	0.3	0.8	0.6	1.9	8.6	78.0	9.8	Silt loam	65.4	36.0	12.0
4-7	A ₂	.1	.2	.2	.8	10.4	80.5	7.8	Silt	35.4	20.5	4.7
7-17	B ₂₁	.1	.2	.2	.7	10.7	74.9	13.2	Silt loam	35.0	17.7	6.1
17-26	B ₂₂	-----	.1	.2	.8	8.6	78.1	12.2	Silt loam	35.7	21.3	5.9
26-38	C ₁	-----	.1	.1	.7	10.3	81.8	7.0	Silt	35.8	18.2	4.7
38-48	C ₂	-----	.1	.2	.7	11.7	82.4	4.9	Silt	37.5	17.7	4.1

CHEMICAL PROPERTIES

Depth from surface	Horizon	Reaction in 1:1 soil-water suspension	Organic carbon	Nitrogen	Carbon-nitrogen ratio	Free iron oxide (Fe ₂ O ₃)	Exchangeable cations (milliequivalents per 100 grams of soil)						Base saturation	Calcium-magnesium ratio
							Ca	Mg	Na	K	H	Sum		
<i>Inches</i>		<i>pH</i>	<i>Percent</i>	<i>Percent</i>		<i>Percent</i>						<i>Percent</i>		
0-4	A ₁	6.3	4.67	0.225	20.8	1.7	20.6	4.1	-----	0.4	8.1	33.2	76	5.0
4-7	A ₂	5.5	.68	.041	16.6	1.5	6.5	3.2	-----	.2	4.0	13.9	71	2.0
7-17	B ₂₁	5.3	.38	.028	13.6	1.8	6.2	4.6	0.1	.2	2.8	13.9	80	1.3
17-26	B ₂₂	5.6	.29	.026	11.2	1.8	5.5	5.8	.1	.2	2.4	14.0	83	.9
26-38	C ₁	6.1	.29	.028	10.4	1.4	5.2	5.2	.2	.2	2.0	12.8	84	1.0
38-48	C ₂	6.4	.32	.029	11.0	1.3	5.0	3.9	.2	.1	1.2	10.4	88	1.3

¹ pH in 1:5 soil-water suspension.

The mechanism of movement and deposition of the clay is uncertain, but the bands are believed to be the result of clay movement within the soil. The bands can be considered, therefore, to be an early stage in the development of a textural B horizon. The presence of a thin, slightly bleached zone above the thicker bands in many profiles indicates that the bands restrict percolation and that water, moves laterally in the soil above them.

In the A₂, B₂₁, and B₂₂ horizons, colors of the vertical plate edges, when dry, are darker by one step in value than the horizontal plate surfaces.

The clay minerals in the Fairbanks soils consist of mixed-layer montmorillonite-vermiculite, some mica, and a trace of kaolinite. Mica is dominant in the parent loess, and there is little of the mixed-layer material.⁴

Some leaching of cations has taken place in the development of the Fairbanks soils, but base saturation remains fairly high. There is evidence of movement of free iron from the surface soil to the subsoil, accompanied probably by small quantities of organic matter, but the degree of podzolization is slight. As the Fairbanks soils undergo further development, they will probably become more acid, but it is unlikely they will develop toward Podzols.

GILMORE SERIES

The Gilmore soils are similar to the Fairbanks soils but have developed in shallower loess. Bedrock, rather than the parent loess, underlies these soils. In some places, the upper part of the underlying schist has been modified by soil-forming processes.

Profile of a relatively deep, undisturbed Gilmore silt loam (about 12 miles west of the Fairbanks Area, near the top of a high ridge in Bonanza Creek Experimental Forest):

- A₀₀ 4½ to 3 inches, mat of moss and forest litter.
- A₀₁ 3 inches to 1 inch, very dark brown (10YR 2/2) mat of roots, moss, and partially decomposed organic material; mycelia; slightly acid.
- A₀₂ 1 inch to 0, very dark brown (10YR 2/2) well-decomposed organic matter; fewer mycelia than in horizon above; heavier concentration of roots than in lower horizon; medium acid; abrupt, smooth boundary.
- A₁ 0 to 2 inches, very dark grayish-brown (10YR 3/2) silt loam; very weak, very thin, platy structure breaking easily to weak, very fine granules; very friable; roots plentiful; strongly acid; clear, smooth boundary.
- A₂ 2 to 5 inches, brown (10YR 5/3) silt loam; weak, very thin, platy structure; very friable; roots plentiful; few angular pebbles of schist in this and lower horizons; strongly acid; clear, wavy boundary.
- B₂ 5 to 8 inches, dark-brown (10YR 4/3) silt loam; moderate, very thin, platy structure; very friable; roots plentiful; lowest ½ inch in this horizon is somewhat lighter in color than upper part; strongly acid; abrupt, wavy boundary.
- 8 to 8¼ inches, thin band, roughly horizontal, of dark-brown (10YR 3/3) fine silt loam or silty clay loam; moderate, very fine, subangular blocky structure; faint clay films on peds; friable; very strongly acid; abrupt, wavy boundary. (This band is undulating and in places is divided into several thinner bands.)
- B₃ 8¼ to 17 inches, dark grayish-brown (10YR 4/2) silt loam; moderate, very thin, platy structure; very friable; roots plentiful to few; very thin, irregular band of fine silt loam in middle of horizon; strongly acid; abrupt, wavy boundary.
- D 17 to 24 inches +, weathered mica schist; slightly acid.

Profile of a shallower Gilmore silt loam in a burned area of aspen forest (near the center of section 15, T. 1 N., R. 1 W., Fairbanks meridian):

- A₀₀ and A₀ 1 inch to 0, brown mat of partially decomposed forest litter.
- A₁ 0 to 3 inches, reddish-brown (5YR 4/3) silt loam near top of horizon to dark-brown (10YR 4/3) silt loam near bottom of horizon; weak, very thin, platy structure; friable; clear, smooth boundary.
- A₂ 3 to 5 inches, brown (10YR 5/3) silt loam; moderate, very thin, platy structure; friable; clear, wavy boundary.
- B₂ 5 to 9 inches, dark-brown (7.5YR 4/4) silt loam; moderate, very thin, platy structure; color on plate faces is one value step lighter than on plate edges; friable; clear, wavy boundary.
- B₃ and D 9 inches +, yellowish-brown (10YR 5/6) gravelly sandy loam; many platy fragments; grades into hard schist rock.

Bands of finer material have not developed in this profile.

MINTO SERIES

The Minto series consists of moderately well drained soils on colluvial slopes near the bases of ridges. The soils have characteristics that are intermediate between those of the Subarctic Brown Forest soils and the Low-Humic Gley soils. The Minto soils are always wetter than the Fairbanks soils. In addition, they are grayer throughout the profile and have mottled subsoil. There has apparently been no movement of clay within the profile; bands of fine material are not evident.

Profile of Minto silt loam (undisturbed) on a long slope of 3 percent (about 3 miles east of the Little Chena River Bridge on the Chena-Hot Springs Road):

- A₀₀ 4 to 3 inches, relatively unweathered mat of roots, moss, and forest litter; abrupt, smooth boundary.
- A₀ 3 inches to 0, dark reddish-brown (5YR 2/2) mat of roots and partially decomposed organic material; many mycelia; extremely acid; abrupt, smooth boundary.
- A₁ 0 to 3 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, fine, granular structure; friable; roots plentiful; charcoal particles throughout horizon but mostly near the surface; very strongly acid; clear, wavy boundary.
- B (?) 3 to 7 inches, dark grayish-brown (2.5Y 4/2) silt loam; many, large, distinct mottles of dark yellowish brown and a few, dark streaks along old root channels near top of horizon; mottles have diffuse boundaries; weak, medium, subangular blocky structure breaking to very weak, very thin plates; many fine spherical pellets of silt loam, less than 2 millimeters in diameter, that crush to same color as matrix; very friable; few roots; strongly acid; clear, wavy boundary.
- C₁ 7 to 15 inches, dark grayish-brown (2.5Y 4/2) silt loam; few, medium, faint mottles of olive brown; moderate, very thin, platy structure; very friable; few roots; slightly acid; gradual boundary.
- C₂ 15 to 30 inches +, dark grayish-brown (2.5Y 4/2) silt; many horizontal streaks of olive brown; moderate, very thin, platy structure; very friable; roots few or absent; mildly alkaline.

The Minto soils are not underlain by a continuous layer of permafrost, as are the adjoining silty soils of the alluvial plains. However, underground masses of ice or wedges of ice in a polygonal pattern occur sporadically at a depth of 4 feet or more. Removal of the insulating mat of organic material from the soil surface through clearing or by forest fire results in higher soil temperatures and the eventual melting of this underground ice. Subterranean cavities are thus formed. They are enlarged by ground

⁴Analyses by HSIN-YUAN TU, Soil Survey Laboratories, SCS, Beltsville, Md.

water and extended through tunneling, or piping, to other parts of the field. In time, the layer of soil above the cavities collapses and forms deep, steep-walled pits or an irregular, hummocky microrelief. As a rule, these thermokarst mounds and pits do not appear for 8 to 10 years after clearing. However, uneven subsidence begins in some fields only 2 to 3 years after clearing. In other fields, as much as 30 years may elapse before thermokarst pitting becomes evident.

These phenomena occur mainly on colluvial slopes where buried, discontinuous masses of underground ice exist. Tunneling may occasionally extend up the slope to adjoining areas of moderately sloping Fairbanks soils.

Péwé (?) has published a detailed description of thermokarst phenomena in cultivated fields.

Alluvial soils

Soils of the Salchaket and Chena series are Alluvial soils. They are well-drained and excessively drained soils on alluvial plains along the main rivers. They are forming from recent alluvium, which has been altered only slightly by soil-forming processes.

SALCHAKET SERIES

The Salchaket soils consist of stratified sandy and silty material over a substratum of water-laid gravel. Sandy material is dominant in most profiles, but a thin, silty surface layer is common. Depth to gravel varies greatly, even within short distances. It may range from as little as 10 inches to more than 6 feet. The native vegetation on Salchaket soils is essentially the same kind of white spruce-birch forest under which the Subarctic Brown Forest soils have developed.

Profile of a moderately deep, undisturbed Salchaket very fine sandy loam (NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 19, T. 1 S., R. 2 E., Fairbanks meridian) :

- A₀ 7 inches to 0, mat of moss, roots, and partially decomposed organic material; mycelia; very strongly acid; abrupt, smooth boundary.
- 0 to 3 inches, mixed olive-brown (2.5Y 4/4) and grayish-brown (2.5Y 5/2) silt loam; black lenses of highly decomposed organic matter, as much as 1 inch thick, especially near base of horizon; weak, medium, granular structure; very friable; roots plentiful; very strongly acid; abrupt, smooth boundary.
- 3 to 10 inches, mixed gray (10YR 6/1) and brown (7.5YR 4/4) very fine sandy loam; few black lenses, like those in horizon above; very weak, medium, subangular blocky structure; very friable; roots plentiful; slightly acid; abrupt, smooth boundary.
- 10 to 26 inches, gray (10YR 5/1) fine sand; common, medium, distinct mottles of strong brown; very thin, slightly browner horizontal layers a few millimeters apart; structureless; loose; few roots; mildly alkaline; abrupt, smooth boundary.
- 26 inches +, gravel and coarse sand; all pebbles rounded; most have diameters of less than 1 inch, but some are as large as 3 inches; many feet thick.

In many places, thin silty lenses are in the profile. These commonly stay frozen in spring and early summer, long after the sandy strata have thawed. Permafrost is deep or absent.

The Salchaket soils generally have a mottled appearance. This color variegation is believed to be an early stage in the development of horizons that are similar to those in the Subarctic Brown Forest soils. It is not

believed that the mottles indicate poor drainage. It is possible, however, that the mottling originated during an earlier period of poor or imperfect drainage.

CHENA SERIES

The Chena series consists of shallow, excessively drained soils made up of less than 10 inches of stratified material over alluvial gravel. The soils are mainly sandy, but thin silty strata may occur.

Profile of Chena very fine sandy loam (undisturbed) (NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 28, T. 2 S., R. 3 E., Fairbanks meridian) :

- A₀₀ and A₀ 2½ inches to 0, dark reddish-brown (5YR 2/2) mat of roots and partially decomposed organic material; very thin layer of undecomposed leaves and needles; mycelia; very strongly acid; abrupt, smooth boundary.
- A₁ 0 to 1 inch, very dark grayish-brown (10YR 3/2) and dark grayish-brown (10YR 4/2) silt loam; weak, very fine, granular structure; friable; many roots; very strongly acid; abrupt, smooth boundary.
- A₃ 1 to 4 inches, dark yellowish-brown (10YR 4/4) very fine sandy loam; very weak, fine, subangular blocky structure; very friable; few roots; medium acid; abrupt, wavy boundary.
- C 4 to 7 inches, grayish-brown (10YR 5/2) fine sand grading to light brownish gray (10YR 6/2) with depth; few yellowish-brown streaks along old root channels; single grain; loose; few roots; slightly acid; abrupt, wavy boundary.
- D 7 to 18 inches +, gravel and coarse sand; single grain; loose; all gravel rounded; few pebbles more than 3 inches in diameter; many feet thick.

Low-Humic Gley soils

Soils of the Tanana, Bradway, Ester, Goldstream, and Saulich series are Low-Humic Gley soils. The last three series named are intergrades to Bog soils.

The Low-Humic Gley great soil group consists of imperfectly drained and poorly drained soils that have thin, organic surface horizons and highly mottled mineral horizons. There is no textural differentiation resulting from soil-forming processes. Many profiles, however, have textural stratification because the soils are composed of alluvial material. Under the native vegetation, Low-Humic Gley soils in the Fairbanks Area are underlain by permafrost. After clearing and subsequent warming of the soil, the depth to the permafrost table increases from less than 3 feet to more than 6 feet. As a result, internal drainage of the soil is improved. Some soils in areas that have been cleared for many years become somewhat browner than when under the native vegetation.

Low-Humic Gley soils that intergrade toward Bog soils are those of the Ester, Goldstream, and Saulich series. These soils have thin, dark A horizons over gray or mottled B or C horizons comparable to those of typical Low-Humic Gleys. They are, however, covered with a surface layer of sphagnum moss, roots, or a mixture of these, that ranges from 5 to 13 inches in thickness.

TANANA SERIES

The Tanana series consists of imperfectly drained soils of the alluvial plains. These soils are dominantly silty but may contain lenses of sand at any depth. The native vegetation is forest consisting of scrubby black spruce, white spruce, birch, tamarack, and willow. Under the trees is a ground cover consisting of moss and shrubs. The soil is perennially frozen to within 30 inches of the surface, and it is always wet above the permafrost.

Typical profile of Tanana silt loam (undisturbed) (SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 22, T. 1 S., R. 1 W., Fairbanks meridian):

- A₀₀ and A₀ 5 inches to 0, dark-brown (7.5YR 3/2) mat of roots, moss, and lichen; color grades to black (10YR 2/1) at bottom of horizon; mycelia; strongly acid; abrupt, smooth boundary.
- A₁ 0 to 4 inches, olive-gray (5Y 4/2) silt loam; many large patches of grayish brown (2.5Y 5/2); many streaks and patches of black (10YR 2/1); the maximum number of black streaks are in this horizon, but similar streaks occur throughout the profile in an irregular pattern; massive; friable; roots plentiful; neutral; clear, irregular boundary.
- C_g 4 to 20 inches, olive-brown (2.5Y 4/4) silt loam; streaks and patches of black and grayish brown; few, medium, distinct mottles of dark brown; few smooth concretions of brown; massive; friable when moist, nonsticky when wet; few roots; mildly alkaline; frozen at depth of 20 inches (Sept. 3, 1958); 3 to 10 feet thick over gravelly substratum.

Results of analyses of samples from this profile are shown in table 10. The upper and lower parts of the C_g horizon were sampled separately. Many coarse particles are concretions, probably of iron or iron and manganese.

Stream-deposited gravel underlies most areas of Tanana silt loam, but it seldom occurs in the upper 4 feet of the profile. Underground ice is continuous in the Tanana soils. Consequently, thermokarst pits do not form after vegetation has been cleared and the soil has thawed to a greater depth. As a rule, however, there is a slight general subsidence in cleared areas.

Except for an accumulation of acid organic matter, especially in the upper part of the profile, the parent

material has been altered but little. The mineral soil is neutral to mildly alkaline, and base saturation is high.

BRADWAY SERIES

The Bradway soils are poorly drained, sandy members of the Low-Humic Gley group. In texture they are similar to the well-drained Salchaket soils, but they occupy lower areas in old stream channels in the alluvial plains. Under the native forest of black spruce or under the dense growth of sedge or grasses, the soil is perennially frozen below a depth of 36 inches, and it is always wet above the permafrost. The water table is at a depth of 18 inches or less.

Profile of Bradway very fine sandy loam (SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 23, T. 1 S., R. 1 E., Fairbanks meridian, in a severely burned area):

- A₀ 4 inches to 0, black (5YR 2/1) mat of roots, moss, partly decomposed organic material, and charcoal; slight admixture of silt; medium acid; horizon may be as much as 12 inches thick.
- A₁ 0 to 2 inches, black (5YR 2/1), mucky silt loam; weak, fine, granular structure; friable; roots plentiful; slightly acid; abrupt, wavy boundary.
- C_g 2 to 36 inches, dark-gray (N 4/0) very fine sandy loam; many, large, prominent mottles of dark brown; thin lenses of silt loam and fine sand, mostly below 24 inches; weak, thin, platy structure; very friable; few roots; mildly alkaline; water table at 18 inches; frozen at depth of 36 inches (Aug. 30, 1959).

In many places, the lower part of the soil is more highly gleyed than the upper part and has a greenish or bluish color. Gravel underlies the Bradway soils at a depth of more than 4 feet.

TABLE 10.—Physical and chemical properties of a profile of Tanana silt loam

[Analyses by Soil Survey Laboratory, Lincoln, Nebr.]

PHYSICAL PROPERTIES

Depth from surface	Horizon	Particle-size distribution						Textural class	
		Very coarse sand (2-1 mm.)	Coarse sand (1-0.5 mm.)	Medium sand (0.5-0.25 mm.)	Fine sand (0.25-0.1 mm.)	Very fine sand (0.1-0.05 mm.)	Silt (0.05-0.002 mm.)		Clay (less than 0.002 mm.)
Inches		Percent	Percent	Percent	Percent	Percent	Percent	Percent	
5-0	A ₀₀	0.2	2.2	1.6	3.7	9.1	64.6	18.6	Silt loam.
0-4	A ₁	.2	.4	.3	2.2	18.9	64.1	13.9	Silt loam.
4-12	C _{g1}	.1	.3	.2	1.9	17.3	67.3	12.9	Silt loam.
12-20	C _{g2}								

CHEMICAL PROPERTIES

Depth from surface	Horizon	Reaction in 1:1 soil-water suspension	Organic carbon	Nitrogen	Carbon-nitrogen ratio	Free iron oxide (Fe ₂ O ₃)	Exchangeable cations (milliequivalents per 100 grams of soil)					Base saturation	Calcium-magnesium ratio	
							Ca	Mg	Na	K	H			Sum
Inches		pH	Percent	Percent	Percent	Percent						Percent		
5-0	A ₀₀	¹ 5.4	41.12	1.086	37.9									
0-4	A ₁	7.1	16.61	.632	26.3	1.8	67.4	10.5	0.2	0.4	14.8	93.3	84	6.4
4-12	C _{g1}	7.4	5.07	.217	23.4	1.9	29.3	3.1	.1	.3	5.2	38.0	86	9.4
12-20	C _{g2}	7.7	2.89	.141	20.5	1.7	24.2	2.0	.1	.3	2.8	29.4	90	12.1

¹ pH in 1:3 soil-water suspension.

ESTER SERIES

The Ester series consists of shallow soils on steep, north-facing slopes near the tops of ridges. The Ester soils probably receive the least insolation of any of the soils of the Area. The lower part of the mat of moss on the surface may be frozen throughout the summer. A sparse forest of spindly black spruce covers most areas, but in many places this gives way to a dense cover of shrubs. Where intense fires have destroyed the mat of moss, the soil supports a stand of paper birch. The Ester soils commonly adjoin the well-drained Gilmore and Fairbanks soils, which occupy the south slopes of the same ridge (2).

Profile of Ester silt loam (undisturbed) (west of the Fairbanks Area, about 12 miles from Ester in Bonanza Creek Experimental Forest):

- 13 to 10 inches, live sphagnum moss.
- A₀ 10 inches to 0, slightly decomposed sphagnum moss; few mycelia; many roots of higher plants; extremely acid; abrupt, smooth boundary.
- A₁ 0 to 4 inches, very dark grayish-brown (2.5Y 3/2), micaceous silt loam; lenses and pockets of black (N 2/0), highly decomposed organic matter; few roots; very strongly acid; frozen (Sept. 20, 1958); abrupt, wavy boundary.
- C_g 4 to 10 inches +, olive-gray (5Y 4/2), micaceous silt loam; common, large, distinct mottles of olive brown; many streaks of black and dark brown; roots few or absent; frozen; underlying, weathered schist is at a depth of approximately 18 inches; strongly acid.

The thickness of the loess mantle over bedrock ranges from less than 10 inches to about 24 inches.

GOLDSTREAM SERIES

The Goldstream soils are silty, but they are somewhat finer than other soils of the Fairbanks Area. They have formed from alluvium deposited by slowly moving water and, in upland drainageways, from fine colluvial material derived from loess. Sandy lenses may occur in the profile, especially near large streams. For the most part, however, the Goldstream soils are silty throughout, and gravel is many feet below the surface. These soils are generally free of trees, but spindly black spruce, tamarack, and willow occur in places. They support a cover of low shrubs. The soil surface characteristically is very hummocky because of numerous closely spaced tussocks of sedge.

Profile of Goldstream silt loam (undisturbed) on the alluvial plains (NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 35, T. 1 N., R. 1 W., Fairbanks meridian):

- A₀₀ and A₀ 5 inches to 0, mat of moss and roots; moss is undecomposed in upper part of horizon but black in lower part; strongly acid; clear, wavy boundary.
- A₁ 0 to 4 inches, black (N 2/0 and 5Y 2/1) silt loam; weak, fine, subangular blocky structure; slightly sticky; many roots; strongly acid; clear, wavy boundary.
- C_g 4 to 19 inches, gray (5Y 5/1) silt loam; many, large, distinct mottles of olive brown and few irregular streaks of black; massive; sticky; few roots; neutral; frozen at depth of 19 inches (Aug. 28, 1959).

Under native vegetation, the depth to permafrost is seldom more than 24 inches and the water table is near the surface. The permafrost table is at a lower depth after removal of the moss cover, but the water table stays high unless artificial drainage is established.

SAULICH SERIES

The Saulich soils are on north-facing slopes in positions that are comparable to those of the Minto soils on south-facing slopes, although generally steeper. Saulich soils are on lower slopes, are deeper, and thaw to somewhat greater depths than the Ester soils.

Representative profile of Saulich silt loam (undisturbed) (SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 7, T. 1 N., R. 1 E., Fairbanks meridian):

- A₀₀ and A₀ 7 inches to 0, dark-brown (7.5YR 4/4, moist) to light-brown (7.5YR 6/4, squeezed dry) mat of moss and roots; mycelia in lower part; extremely acid; abrupt, smooth boundary.
- A₁ 0 to 4 inches, dark olive-gray (5Y 3/2) silt loam with black (5Y 2/1) streaks; very weak, very thin, platy structure; very friable when moist, nonsticky when wet; roots plentiful; very strongly acid; clear, wavy boundary.
- A₃ 4 to 7 inches, dark grayish-brown (2.5Y 4/2) and very dark grayish-brown (2.5Y 3/2) silt loam; few, thin, black streaks; weak, very thin, platy structure; very friable when moist, nonsticky when wet; few roots; strongly acid; clear, wavy boundary.
- C_g 7 to 15 inches, dark grayish-brown (2.5Y 4/2) silt loam; many, medium, faint mottles of olive brown, elongated horizontally; few streaks of black; weak, very thin, platy structure; very friable when moist, nonsticky when wet; few roots; medium acid; frozen at depth of 15 inches (Aug. 30, 1959); 3 feet to many feet in thickness.

The permafrost table in Saulich soils is generally at a depth between 12 and 30 inches. Where the natural cover of moss has been removed, however, the soil thaws to greater depths. Seep water from the higher lying Ester soils on the same slopes adds to the wetness of these soils. The additional moisture makes conditions favorable for the growth of a mossy mat, which insulates the soil and helps preserve the permafrost.

Bog soils

Bog soils have formed in organic material. Soils of the Lemeta series belong to the Bog great soil group.

LEMETA SERIES

The Lemeta soils consist mainly of peat formed from undecomposed sphagnum moss in which there are layers of peat formed from sedge. The peat is perennially frozen below a depth of 1 to 2½ feet. The water table is always just below the surface. Living vegetation is essentially the same as that on the Low-Humic Gley soils intergrading to Bog soils. A polygonal ground pattern has developed in many areas of these soils.

Profile of Lemeta peat (undisturbed) (NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 32, T. 1 N., R. 1 W., Fairbanks meridian):

- 0 to 13 inches, dark-brown (7.5YR 4/4, moist) to light-brown (7.5YR 6/4, squeezed dry) moss peat, arranged in thin, horizontal layers; upper few inches consist of living moss; few, very thin layers of black (N 2/0) sedge peat; many roots of higher plants, especially in upper 3 inches; strongly acid.
- 13 to 25 inches, moss peat, like that in horizon above but with many, roughly horizontal layers of black sedge peat; very strongly acid; frozen at a depth of 25 inches (Aug. 28, 1959).

Lemeta peat has accumulated in shallow lakes on the alluvial plains. Remnants of these lakes occur in several bogs. In other bogs, cave-in lakes have formed in connection with polygonal ground development.

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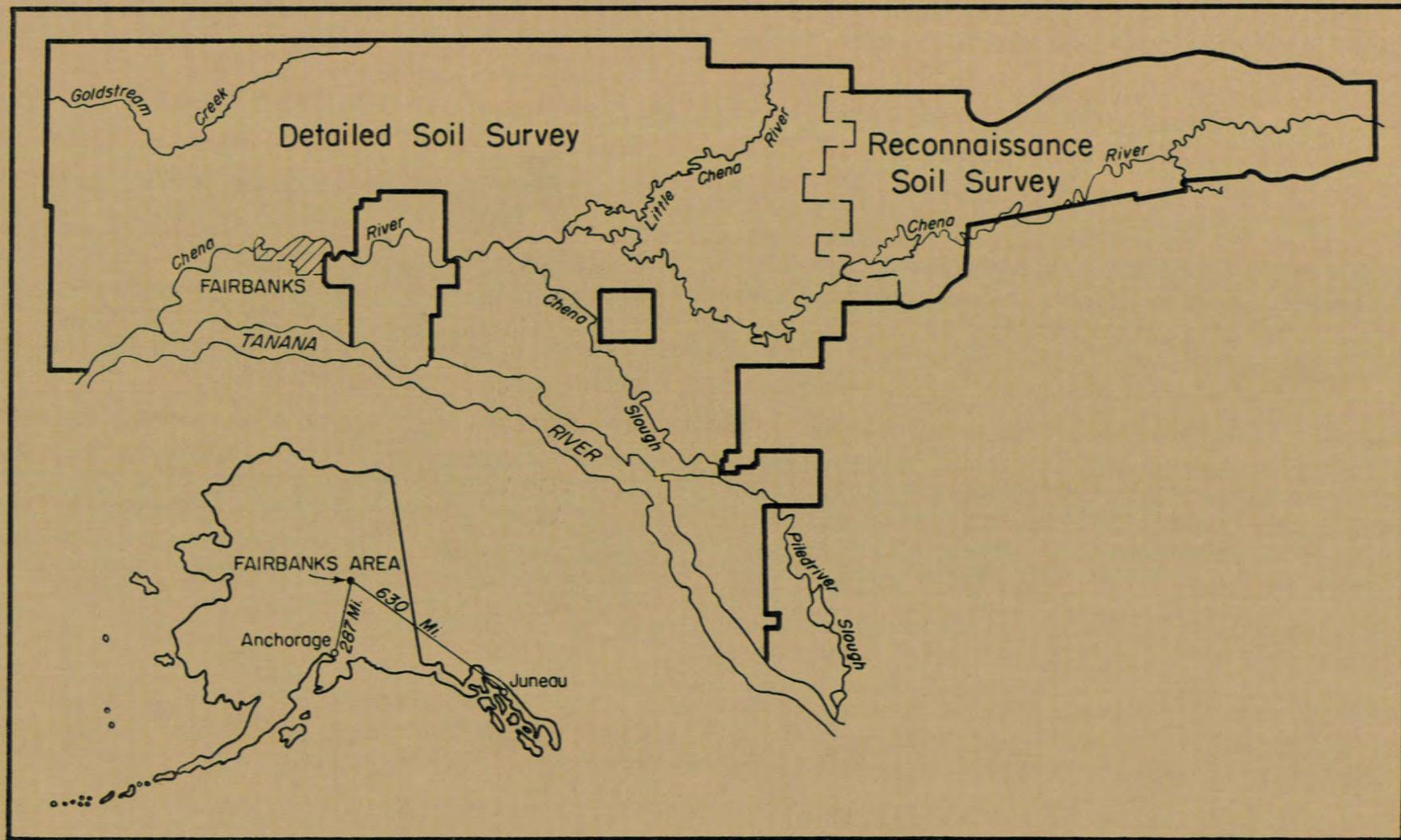
GUIDE TO MAPPING UNITS AND MANAGEMENT GROUPS
SURVEYED BY DETAILED MAPPING METHOD

<i>Map symbol</i>	<i>Mapping unit</i>	<i>Management group</i>	
		<i>Page</i>	<i>Page</i>
Ad	Alluvial land.....	10	22
Br	Bradway very fine sandy loam.....	10	21
Ch	Chena very fine sandy loam.....	10	21
EsD	Ester silt loam, 12 to 20 percent slopes.....	10	22
EsE	Ester silt loam, 20 to 30 percent slopes.....	10	22
EsF	Ester silt loam, 30 to 45 percent slopes.....	11	22
FaA	Fairbanks silt loam, 0 to 3 percent slopes.....	11	19
FaB	Fairbanks silt loam, 3 to 7 percent slopes.....	11	20
FaC	Fairbanks silt loam, 7 to 12 percent slopes.....	11	20
FaD	Fairbanks silt loam, 12 to 20 percent slopes.....	11	21
FaE	Fairbanks silt loam, 20 to 30 percent slopes.....	11	21
FaF	Fairbanks silt loam, 30 to 45 percent slopes.....	11	22
FmB	Fairbanks silt loam, moderately deep, 3 to 7 percent slopes.....	11	20
FmC	Fairbanks silt loam, moderately deep, 7 to 12 percent slopes.....	11	20
FmD	Fairbanks silt loam, moderately deep, 12 to 20 percent slopes.....	11	21
FmE	Fairbanks silt loam, moderately deep, 20 to 30 percent slopes.....	12	21
FmF	Fairbanks silt loam, moderately deep, 30 to 45 percent slopes.....	12	22
GmB	Gilmore silt loam, 3 to 7 percent slopes.....	12	20
GmC	Gilmore silt loam, 7 to 12 percent slopes.....	12	21
GmD	Gilmore silt loam, 12 to 20 percent slopes.....	12	22
GmE	Gilmore silt loam, 20 to 30 percent slopes.....	12	22
GmF	Gilmore silt loam, 30 to 45 percent slopes.....	12	22
GrB	Gilmore silt loam, very shallow, 3 to 7 percent slopes.....	12	21
GrC	Gilmore silt loam, very shallow, 7 to 12 percent slopes.....	13	22
GrD	Gilmore silt loam, very shallow, 12 to 20 percent slopes.....	13	22
GrE	Gilmore silt loam, very shallow, 20 to 30 percent slopes.....	13	22
GrF	Gilmore silt loam, very shallow, 30 to 45 percent slopes.....	13	22
GtA	Goldstream silt loam, 0 to 3 percent slopes.....	13	21
GtB	Goldstream silt loam, 3 to 7 percent slopes.....	13	21
GtC	Goldstream silt loam, 7 to 12 percent slopes.....	13	21
Gv	Gravel pits.....	14	22
Lp	Lemeta peat.....	14	22
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Sm	Salchaket very fine sandy loam, moderately deep.....	15	20
Ss	Salchaket very fine sandy loam, shallow.....	15	20
SuB	Saulich silt loam, 3 to 7 percent slopes.....	16	21
SuC	Saulich silt loam, 7 to 12 percent slopes.....	16	21
SuD	Saulich silt loam, 12 to 20 percent slopes.....	16	22
Ta	Tanana silt loam.....	16	21

SURVEYED BY RECONNAISSANCE MAPPING METHOD ¹

<i>Map symbol</i>	<i>Mapping unit</i>	<i>Page</i>
Ad	Alluvial land.....	10
ERE	Ester silt loam, steep.....	11
FBD	Fairbanks association, moderately sloping to moderately steep.....	12
FEF	Fairbanks-Ester association, steep to very steep.....	12
GEF	Gilmore-Ester association, moderately steep to very steep.....	13
GL	Goldstream-Lemeta association.....	13
GS	Goldstream-Saulich association.....	13
MS	Minto-Saulich association.....	15
SA	Salchaket association.....	15
TG	Tanana-Goldstream association.....	16

¹ Soils surveyed by reconnaissance method were not placed in management groups.



The boundaries and location of the Fairbanks Area in Alaska.

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