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Issued June 1962

SOIL SURVEY

Kenai-Kasilof 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 Kenai-Kasilof Area will serve several groups of readers. It will provide general information about this part of Alaska; will help farmers in planning the kind of management that protects their soils and provides good yields; and will assist engineers in selecting sites for roads, buildings, and other structures. It adds to our fund of knowledge about soils.

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 the soils

Use the index to map sheets to locate areas on the large map. The index is a small map of the Area that shows the location of each sheet of the large map. When the correct sheet of the large map is found, it will be seen that the boundaries of the soils are outlined in red and that there is a red symbol for each soil, wherever it is shown on the map. Suppose, for example, an area on the map has the symbol KnA. The legend for the detailed map shows that this symbol stands for Kenai silt loam, nearly level. This soil and all others mapped in the Kenai-Kasilof Area are described in the section "Descriptions of the Soils."

Finding information

This report has several sections for different groups of readers. The section "General Description of the Area," which discusses the geology, climate, the early settlement and development, and the industries of the Area, will be of interest mainly to those not familiar with the Area.

Farmers and those who work with farmers can learn about the soils in the section "Soils of the Area" and then turn to the section "Use and Management of the Soils." In this way, they can first identify the soils on their farms and then learn about the suitability of these soils for agriculture and the methods of maintaining productivity. The soils are listed by management groups; that is, groups of soils that need similar management and respond in about the same way. For example, Kenai silt loam, nearly level, is in management group 5. Some suggestions on the management needed for this soil will be found under the heading "Management group 5" in the section "Use and Management of the Soils." The guide to mapping units and management groups, which is just before the map sheets, lists the name of each soil, the page on which it is described, the number of the management group in which it is placed, and the page on which the management group is described.

Those who need only a general idea of the soils can refer to the section "General Soil Areas." This section tells briefly about the principal patterns of the soils, where they are located, and how they differ from each other.

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

Engineers and builders will find information that will assist them in building and maintaining roads and other structures in the section "Engineering Applications."

People who are interested in the forests in the Area will find some current information about their nature and composition summarized in the section "Native Vegetation."

* * * * *

This soil survey was made as a part of the technical assistance furnished by the Soil Conservation Service to the Kenai-Kasilof Soil Conservation Subdistrict and the Ninilchik Soil Conservation Subdistrict. Help in farm planning can be obtained from the staff of the Soil Conservation Service assisting these subdistricts. Fieldwork for the survey was completed in 1957. Unless otherwise indicated, all statements in the report refer to conditions in the Area at the time the fieldwork was in progress.

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SOIL SURVEY OF KENAI-KASILOF AREA, ALASKA

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

General Description of the Area

The Kenai-Kasilof Area lies in the northwestern part of the Kenai Peninsula of south-central Alaska. To the west and north, the Area is bounded by Cook Inlet, an arm of the Gulf of Alaska. To the east, low choppy hills lie between the Kenai-Kasilof Area and the Kenai Mountains, which make up the eastern part of the peninsula. The survey area includes almost all of the Kenai-Kasilof Soil Conservation Subdistrict and a part of the Ninilchik Soil Conservation Subdistrict. Most of the Area borders on the Kenai National Moose Range; the southern part of the Area is included in the range.

The Area consists of low hills, broad level plains, bogs or muskegs, and many small lakes. Although no point is at an altitude of more than 500 feet above sea level, many of the hills are steep or extremely rough and hummocky. Lands suitable for agricultural development are on the broad plains bordering the major rivers and much of the western coastline and on the less steeply sloping hillsides.

Forests cover most of the Kenai-Kasilof Area except parts of the muskegs, which support only a dense cover of low shrubs and sphagnum moss, and several small areas covered by sedges, grasses, and forbs near the mouths of the principal streams. A more detailed description of the vegetation in the Area is given in the section "Native Vegetation."

Moose are abundant in the region, especially in recently burned or logged places where willows and aspen afford ample browse. Other animals include brown bear, black bear, beaver, lynx, mink, muskrat, weasel, and marten. Grouse, ducks, geese, and numerous other birds are abundant. Salmon and Dolly Varden trout are plentiful in the streams, and rainbow trout in the lakes.

The map on the back of this report shows the Kenai-Kasilof Area in relation to the rest of the Kenai Peninsula and Alaska.

Geology

Two broad physiographic provinces make up the Kenai Peninsula—the Kenai Mountains in the east and the Kenai Lowland in the west (*6*).[1] The Kenai-Kasilof Area lies in the northwestern part of the Kenai Lowland.

The Area is underlain by the gently folded silty and sandy sediments and thin lignite beds of the Kenai formation of Tertiary (Eocene) age. These sediments are exposed at the surface only in a few places in the south and east; over most of the Area, they are buried by thick glacial and alluvial deposits.

During the period of maximum glaciation, most of the Kenai Lowland was occupied by a large valley glacier that filled most of the Cook Inlet basin. Apparently the glacial deposits in the Kenai-Kasilof Area were made by this main glacier and by tributary glaciers from the Kenai Mountains. Thick beds of sand and gravel, now broad terraces, were deposited along the two principal streams of the Area, the Kenai and Kasilof Rivers, during the retreat of these glaciers. Another large outwash plain occupies much of the area north of Kenai. Hilly moraines made up of either coarse-textured material or compact, fine-grained material occur in most of the remainder of the Area.

Strong winds off the retreating glaciers removed silty material from the sparsely vegetated land and deposited it as a mantle of loess, ranging in thickness from a few inches to several feet, over the entire Area. In several places along larger rivers, notably in the region north of Sterling, these winds built up sand dunes.

The Kenai and Kasilof Rivers still carry a heavy load of silt from glaciers in the Kenai Mountains. Tributary streams, which do not carry glacial waters, are either clear or stained with organic matter from peat bogs.

All along the coastline, wave erosion has resulted in a continuous bluff that is 20 feet to more than 200 feet high and is interrupted only at the mouths of major streams. In most places, glacial deposits make up the upper part of the sea cliffs; sediments of the Kenai formation are exposed in the lower part. A narrow gravelly beach lies between these bluffs and the sea.

Climate [2]

The Kenai-Kasilof Area lies in a transitional zone influenced by both maritime and continental climatic factors. It therefore exhibits some characteristics of both zones.

Precipitation.—Perhaps the most pronounced maritime effect is in the amount of precipitation. Annual rainfall

[1] Italic numbers in parentheses refer to Literature Cited, p. 55.

[2] This section was prepared by C. E. WATSON, State climatologist, Weather Bureau, Anchorage.

is about 16 to nearly 19 inches, but the amount varies greatly by seasons. During the winter season—October through March—precipitation averages about ¾ to 1¾ inches per month. The lightest wintertime fall is in February and March. With the coming of spring precipitation dips to its lowest monthly average; the least amount generally falls in April. From late June through September the amount of rainfall increases sharply. All reporting stations in the Area show average amounts of 2 to 2½ inches during July and 2½ to nearly 3¼ inches in August. At Kenai and Kasilof on the coast, September is the month of heaviest rainfall; at Sterling, the heaviest rainfall comes in July and August. Table 1 shows the average monthly and annual precipitation at Kenai and at Sterling, which is about 15 miles inland.

TABLE 1.—*Average monthly and annual temperatures and precipitation at Kenai and Sterling*

Month	Kenai CAA [1]			Sterling		
	Average temperature [2]	Average precipitation		Average temperature [5]	Average precipitation	
		Rainfall [3]	Snowfall [4]		Rainfall [5]	Snowfall [6]
	°F.	*Inches*	*Inches*	°F.	*Inches*	*Inches*
January	11.0	0.91	13.0	6.4	0.92	10.1
February	16.5	.91	10.8	13.9	.91	13.6
March	22.4	.92	9.9	19.0	.62	9.0
April	32.9	.79	5.2	33.0	.70	4.2
May	43.2	.79	1.3	43.3	.70	[7]
June	49.6	1.10	-------	51.3	.96	-------
July	53.6	2.24	-------	54.6	2.57	-------
August	53.3	3.14	-------	53.8	2.56	-------
September	46.3	3.31	[7]	45.3	2.34	[7]
October	34.4	2.10	2.7	32.1	1.52	4.1
November	22.2	1.62	8.6	20.0	.99	8.0
December	10.6	1.10	14.8	7.1	1.44	15.7
Year	33.0	18.93	[8] 66.3	31.7	16.23	[8] 64.7

[1] Known as Kenai until 1949.
[2] 22-year record.
[3] 28-year record.
[4] 21-year record.
[5] 9-year record.
[6] 8-year record.
[7] Trace; amount too small to measure.
[8] Seasonal.

The relatively light rainfall in the early part of the growing season is offset largely by the abundant supply of moisture in the soil from the melted snow of winter. Critical drought conditions are seldom reached in any of the occasional dry periods early in spring. Rainfall from late in June through the rest of the growing season is ample for crop maturity.

The total amount of snowfall in winter is 55 to 65 inches. Temperatures seldom remain below freezing for an entire month, even in the coldest part of winter, and at least brief periods of thawing occur every month. This thawing keeps the snow cover at a reasonable depth. The maximum depth of accumulated snow recorded at Kenai was 57 inches in April 1946. In the average winter the maximum depth that accumulates in the Area is less than 3 feet. The occasional thawing periods also result in a relatively high moisture content in the snow. When the spring break-up occurs, the soils become saturated. In the lowlands many soils are too wet to be cultivated and planted early in spring. This is not a problem at slightly higher altitudes.

Temperature.—The influence of the nearby ocean is further shown in the high temperatures reached in summer. The highest temperature recorded at Sterling was 90°F. in June 1953, and at Kenai, 89°F. in September 1883. The low temperatures in winter, however, indicate a climate more like that of a continental interior. The record low temperature at Sterling was —51°F. in January 1952, and at Kenai, —48°F. in February 1947. These temperatures are unusually low for a region so close to the open waters of Cook Inlet. Table 1 shows the average monthly and annual temperatures at Kenai and Sterling.

The cold air draining from the vast glacial areas of the Kenai Range is partly responsible for the extremely low temperatures and the occasional persistent cold weather particularly noticeable around Sterling, but it does not sufficiently explain some of the fluctuations and irregularities in temperature at altitudes not normally affected by this drainage of cold air. Kasilof, which is about 100 feet above the channel of the Kasilof River, also has periods of extreme cold, but they are less frequent than at Sterling.

It is likely that occasionally the air over the glaciers, which is extremely cold because of radiation, is moved by prevailing winds to the lower elevations to the west. When low-pressure systems are located around the Alaskan Peninsula, or a little to the east, the air moves in a prevailing easterly or northeasterly direction across the Kenai glacial area, and the cold air is moved out onto the plains below. The cold air thus affects most points in the Area and may cause rapid fluctuations in temperature at any given locality. Extremely low temperatures are reached at the reporting stations, even under cloudy or partly cloudy conditions, which indicates that other factors in addition to drainage and radiation affect the temperatures.

There are some indications that air flowing across the Kenai Range occasionally produces some foehn (chinook) effects. The occasional pronounced increases in temperature at Kenai on clear days, even in the coldest part of winter, indicate that warm air has moved across the glaciers in the Kenai Range and out over the plains too rapidly to be cooled.

During summer, the sharp drops in temperature at night along the rivers may result from still another factor—the cooling effect of water flowing from lakes that drain the glacial icefields. Water flows rapidly from Skilak Lake, where the water temperature is low even in summer, and it is probably warmed very little as it flows through the Sterling area to Kenai. At night the effect of this cool water, which is only slightly above freezing, is to reduce the temperature sharply.

The average annual maximum and minimum readings at Kenai, Kasilof, and Sterling are about the same—differences of about 1 degree for maximum temperatures and within 3 degrees for minimum temperatures. The temperatures on individual days, however, vary considerably. Minimum readings at the three towns may differ by 20 to 25 degrees on any given day.

Length of freeze-free season.—Little maritime influence is shown in the rather spotted pattern of killing freezing

temperatures. When the temperature reaches 32°F. or even lower as the result of slow-moving, downslope air drainage, the most pronounced effect is on the vegetation at lower altitudes; there is practically no effect on that at higher altitudes. Furthermore, although a freezing temperature is recorded unseasonably early in fall at the level of the instrument shelter, the heat retained in the soil may be enough to keep plants from being damaged. This phenomenon is much more frequent in the Kenai-Kasilof Area than that of killing frosts at temperatures above freezing, which so frequently occur in the central plains where surface radiation may reduce the temperature to freezing or below at the plant level, even though the temperature at the instrument-shelter level remains well above freezing.

Throughout the Area, these varied factors combine to produce erratic temperatures during the growing season. Furthermore, it is difficult to anticipate which particular place will be affected. If air drainage were the basic reason for the sudden cooling and occasional freezing late in spring and early in fall, and occasionally even in summer, the most pronounced effects would be in the lowlands adjacent to the rivers. This is not always so. Kasilof, which is well above the bed of the Kasilof River, has sharp and sudden freezes late in spring and early in fall. On some days, the temperature is lower at Kasilof than at either Kenai or Sterling.

Although the average freeze-free season, or growing season, in the Area as a whole is less than 100 days, the length varies considerably from place to place. Over a period of 16 years, the length has ranged from 67 to 133 days at Kenai and from 90 to 140 days at Kasilof. In 10 years, the length has ranged from 38 days to 97 days at Sterling. In some years freezing temperatures have occurred in every month at both Kenai and Sterling. Sterling is more affected than Kenai by the drainage of cold air from the Skilak Lake area and possibly from the vast Harding Ice Field. When the temperature at Sterling is freezing or below, plants on some of the surrounding higher land may not be affected. Generally, however, the higher uplands near Sterling will have the same length of growing season as Sterling because the cold air spreading out over the lowlands affects practically all elevations. Long periods of daylight in summer compensate somewhat for the relatively short growing season.

The probability of freeze-free periods within certain temperature limits is shown for Kenai and Sterling in figures 1 and 2. The average length of time between specified temperature limits is shown in table 2.

TABLE 2.—*Average dates for beginning and end of season in which temperature does not fall below the limit indicated*

Temperature limit	Kenai [1]	Sterling [2]
°F.		
32	May 27 to Sept. 3	June 21 to Aug. 28.
28	May 9 to Sept. 23	May 29 to Sept. 11.
24	Apr. 30 to Oct. 2	May 13 to Sept. 20.
20	Apr. 22 to Oct. 12	Apr. 27 to Sept. 27.
16	Apr. 15 to Oct. 23	Apr. 15 to Oct. 10.

[1] 16-year record. [2] 10-year record.

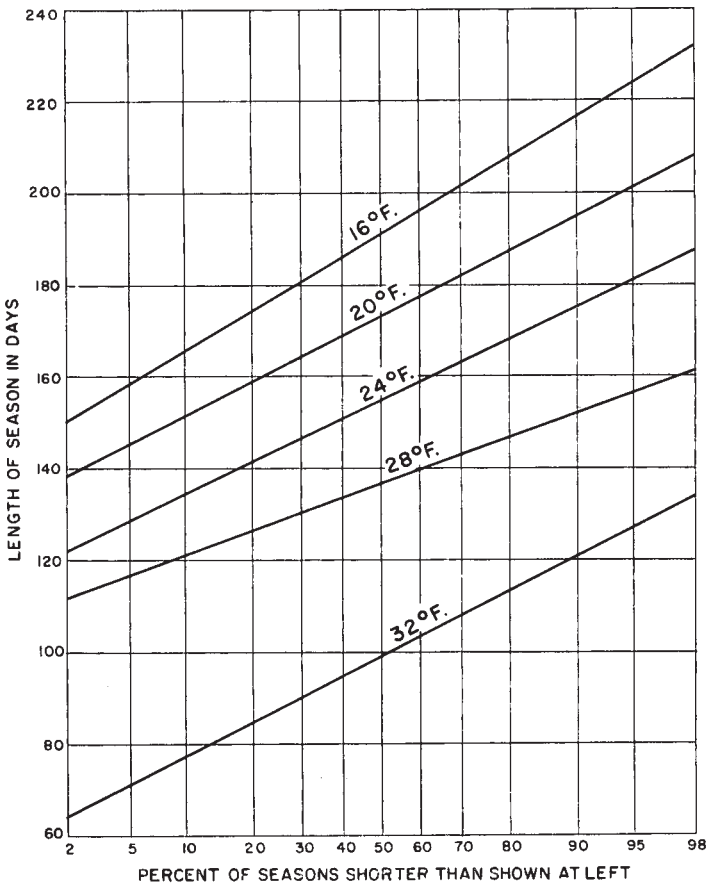

***Figure 1.*—Probability, in percent, that the season of temperatures above the limit indicated will be shorter than the number of days shown at the left of the figure, at Kenai.**

Wind.—The Kenai-Kasilof Area lies in a relatively sheltered part of the Kenai Peninsula, protected by the Kenai Range to the east and by the Aleutian Range across Cook Inlet to the west. Consequently, there are seldom any strong winds from either the east or the west. Any strong winds that reach the Area are channeled up Cook Inlet. Kenai and Kasilof are much more affected by these winds than Sterling, which is farther inland. Sterling is better protected also against any winds that might come from the east because it is so much closer to the Kenai Range. No wind data are available for either Kasilof or Sterling, but wind records at Kenai show that the prevailing direction is north to northeast from September through April and south to southwest from May through August.

Settlement and Development

The earliest white settlement in the Area was St. George, a trading post established in 1786 on a bluff near the mouth of the Kasilof River by a Russian fur-trading organization, the Lebedev-Lastochkin Company. In 1791, a second and larger post, Fort St. Nicholas, was built at the mouth of the Kenai River by a rival organization, the Shelikof Company. The years that followed were marked by uprisings of the native Kinnats (known

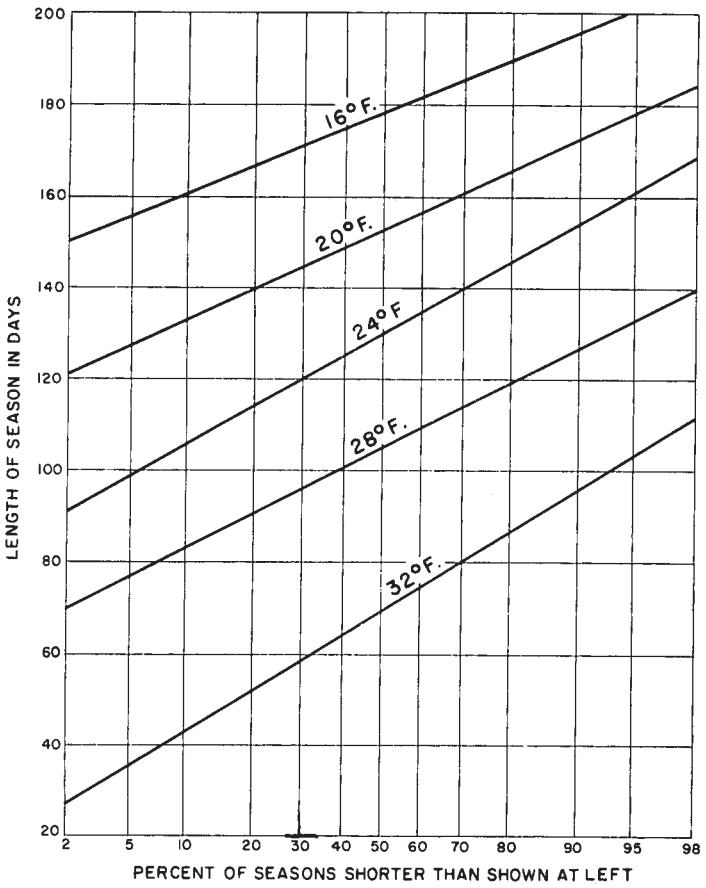

***Figure 2.*—Probability, in percent, that the season of temperatures above the limit indicated will be shorter than the number of days shown at the left of the figure, at Sterling.**

as Kenaitze by the Russians), an Athabascan Indian tribe, and by fighting between employees of the two fur-trading companies. Eventually the Russian-American Company, the successor to the Shelikof Company, took control of the entire Area and administered it until Alaska was purchased by the United States in 1867.

A brickyard at Fort St. Nicholas supplied many of the settlements in the region, but fur trapping was the principal occupation of the Russians. Without any controls, however, the population of fur-bearing animals was soon depleted. Under American rule, fishing, especially for salmon, became the principal industry. Canneries were built near the mouths of the Kenai and Kasilof Rivers. At present, most of the fish caught commercially are sold to two canneries at Kenai, which occupies the site of Fort St. Nicholas.

Civilian work at Wildwood Station, an Army base built near Kenai in 1952, and services related to tourist travel are the other principal sources of income. The recent discovery of oil in the region may result in substantial employment in that industry.

Few attempts at farming were made before the present century. The Russians kept only a few head of cattle at Fort St. Nicholas and had several acres of potatoes, turnips, and grasses. Agriculture had made little progress by 1899, when, in an effort to learn more about the agricultural possibilities of the region, a branch of the Alaska Agricultural Experiment Station was established at Kenai. The final report of this branch (*2*), made in 1908, noted the crops that could be grown successfully at that time.

Because of the lack of suitable markets for farm products, there was little homesteading in the Area before 1945. As a result of the homestead laws for veterans of World War II, however, more than 15,000 acres was taken up by homesteaders near Sterling, Kenai, Soldatna, and Cohoe, but less than 2 percent of this land has actually been farmed. Since the establishment of Wildwood Station there has been a marked increase in farming and gardening, but the total cropland in the Kenai-Kasilof Area is still less than 500 acres. As yet, most farms are not large enough for full-time operation. All but a few homesteaders must rely on employment elsewhere for much of their income (*3*).

At the present time, there are no incorporated cities in the Kenai-Kasilof Area. Kenai is the largest village; other settlements and post offices are Soldatna, Sterling, Kasilof, Cohoe, and Clam Gulch. Kenai has many of the facilities normally found in small communities—churches, a school, and telephone and telegraph service. The recently paved Sterling Highway connects the Area with Seward and Anchorage. There is daily commercial airline service from Kenai to Anchorage, Homer, and Kodiak, and charter service to other points.

In 1950 the population of Kenai was 321 and that of Kasilof, 62. It is estimated that in 1958 there were about 2,150 permanent residents in the entire Kenai-Kasilof Area. They were distributed among the following centers: 800 in Kenai village, 300 in the vicinity of Kenai, 600 in Soldatna and vicinity, 200 in Sterling and vicinity, 100 in the vicinity of Kasilof post office, 75 in the vicinity of Cohoe post office, and 75 in the vicinity of Clam Gulch post office.

How Soils Are Mapped and Named

Most soils are made up of a succession of nearly horizontal layers, or horizons; these horizons collectively make up the soil profile. The classification of soils is based on the characteristics of soil profiles and their component horizons. The properties of horizons that are especially important in soil classification are (1) the kind and amount of organic matter; (2) color; (3) texture, or the relative proportions of gravel, sand, silt, and clay in the soil; (4) structure, or the arrangement of individual soil particles into aggregates or clusters; (5) consistence, or the degree of compaction or plasticity; (6) aeration and drainage; and (7) reaction, or the degree of acidity or basicity. Other characteristics considered in classifying soils include the thickness and arrangement of the horizons in the profile and the depth to an underlying material different from the material in which the soil formed.

Soils that have profiles almost alike make up a *soil series*. Except for texture of the surface layer, the major horizons of all the soils in one series are similar in thickness, arrangement, and other important characteristics. The soil series has been set up as a convenient unit of classification for a group of similar soils. Each soil series is given the name of a town or other geographic feature

near the place where a soil in that series was first observed and identified. Soldatna, Kenai, Cohoe, Naptowne, Tustumena, and Salamatof are some important soil series in the Kenai-Kasilof Area.

Soils within a series may differ in the texture of the surface layer. Thus, each soil series consists of one or more *soil types*, or bodies of soil within a series that have a surface layer of the same textural class. The name of the soil type consists of the series name and the name of the textural class of the surface layer, such as Kenai silt loam or Anchorage very fine sandy loam. In the Kenai-Kasilof Area, there is no significant variation in surface texture in any of the soil series. Each series includes only one soil type.

To get useful mapping units, many soil types are divided into *phases* because of some feature important in the use or management of the soil. If, for example, a soil type has a wide range of slopes, slope phases of that soil type are recognized. Kenai silt loam, gently sloping, is an example of a phase mapped in this Area. Other phases recognized in this Area are based on plant cover and on depth to a contrasting substratum.

In some rougher areas, two or more soils occur in such intricate geographic association that they cannot be shown separately on the soil map; in these areas, the mapping units are *associations* of soil types or phases. Cohoe-Kenai association is an example of an association mapped in this Area.

Areas of recently deposited or recently exposed materials that have little vegetation and show little, if any, soil development are mapped and named as *land types*. Gravelly beach, Sea cliff, Tidal flats, and Tidal marsh are land types mapped in the Kenai-Kasilof Area.

Within the boundaries of most mapping units there are likely to be patches or inclusions of other soils too small to be delineated separately on the map. The main soils present as inclusions are listed in the description of each mapping unit. Nowhere do the inclusions make up more than a small percentage of the mapping unit.

In making this survey, soil scientists examined the soils throughout the Area in detail and drew lines on a set of aerial photographs to show the boundaries between mapping units. The printed soil maps show the photographic background, the soil boundaries and symbols in red, and the main streams, roads, and place names in black. The principal mapping units in this Area are soil types and phases. A description of each mapping unit is given in the section "Descriptions of the Soils."

General Soil Areas

Soils in 28 different series have been recognized and mapped in the Kenai-Kasilof Area. The most extensive are the Soldatna, Tustumena, Naptowne, Kenai, Cohoe, and Salamatof soils. Each of these soils is dominant in large parts of the Area, although other soils of lesser extent occur in each of the general soil areas.

The general soil areas are shown on the small-scale, colored map that appears in the back of this report. This general map does not show the kind of soil at any particular place but a pattern of several different soils. It is useful to those who need only a general idea of the soils, to those who want to compare different parts of the Area, and to those who want a general idea of the extent of the different kinds of soils.

1. Soldatna Soil Area

Soldatna soils are dominant in a large section north of Kenai and in smaller blocks near Soldatna and in the southern and eastern parts of the Area. These areas consist of broad, nearly level plains and, to a lesser extent, rolling to steep hills. Lakes and muskegs are fairly common. The native vegetation is mostly forest in which white spruce, birch, and aspen are the dominant trees. Balsam poplar (cottonwood), willow, and black spruce occur in the low areas, and thickets of alder are common along the northern coast.

Most of the soils on the uplands in this general soil area formed in silty material deposited over a gravelly or coarse sandy substratum. The Soldatna soils, which are the most extensive, are well drained and have developed in moderately deep, silty deposits, both on the plains and in the hills. The principal associated soils are the Nikishka, Longmare, Kalifonsky, and Boulder Point soils. The Nikishka soils, which are mostly on hills, are also well drained, but they are shallower than the Soldatna soils. The Longmare soils are deeper than the Soldatna soils but are not so well drained; they occur principally in a broad plain just northwest of Kenai. Still wetter are the Kalifonsky soils, which occupy low areas bordering on lakes and muskegs and parts of some narrow drainageways. The Boulder Point soils are on hills, mostly along the north coast. They are well drained, but they are somewhat coarser and darker than the other soils of the uplands. Several less extensive soils occupy the drainageways and depressions; most of these soils are poorly drained.

Only a small part of the Soldatna soil area has been cleared, mostly near Kenai and Soldatna. Roughly one-half the acreage, however, is considered suitable for cultivated crops. The remainder is either too steep, too rough, or too wet to be cultivated successfully, although some of it is suitable for pasture or for the production of wild hay.

2. Tustumena Soil Area

Tustumena soils are dominant on broad, level plains along the major rivers in the vicinity of Sterling, in the section south and west of the Kenai River below Soldatna, and in the Cohoe and Kasilof areas. These plains are lower than the bordering hills and grade to large muskegs, especially near the coast.

Most of this soil area is covered by a spindly growth of young aspen and spruce and a few birches and willows. In some places there are patches of older and taller trees. Over most of the area, there is a fairly thick ground cover of shrubs, grasses, and forbs, such as fireweed. The surface of the soils is hummocky, largely because of many old, burned stumps of trees and tussocks of grass. Wetter areas are commonly covered by large tussocks of grass, but some wet areas support a forest of spruce and aspen.

The soil pattern in the Tustumena area is less complex than that in most of the other soil areas. The principal

soils are in the Tustumena, Kasilof, and Pincher series. The Tustumena soils are well drained; they developed in moderately deep, wind-laid, silty material that lies over a water-laid substratum of gravel or coarse sand. The Kasilof soils are also well drained, but they are much shallower than the Tustumena soils. Kasilof soils occur mostly on low terraces immediately adjacent to rivers. The Pincher soils are imperfectly drained and have a layered silty and sandy substratum; they occupy minor drainageways and shallow depressions on the broad plains. Several less extensive soils, mostly poorly drained, occur on the flood plains of streams and in the deeper depressions.

The Tustumena soil area has been fairly heavily homesteaded. There has been extensive clearing in a few places, notably along the Cohoe Road and in the vicinity of Sterling. Much of the cleared land has been allowed to revert to brush, but sizable areas are being cropped. Most of the Tustumena soil area is considered suitable for clearing and cultivation. The shallow Kasilof soils and the poorly drained soils of the flood plains and depressions, however, are not desirable for agriculture.

3. Naptowne Soil Area

Naptowne soils are most extensive in the hilly regions in the eastern and central parts of the Kenai-Kasilof Area. For the most part, this soil area consists of rolling to steep, low-lying hills, but there is also a fairly large amount of level or gently sloping land. There are many small lakes, muskegs, and secondary drainageways.

Forests of white spruce and birch cover most of the uplands. In areas that have been burned repeatedly, black spruce is the dominant tree. Balsam poplar, aspen, and black spruce are common in wet places. A few wet areas, however, support dense stands of tall grass, mostly bluejoint. Much of the Naptowne soil area was burned over in the great fire in 1947; many charred snags and windfalls remain in the forests. The regrowth consists mostly of black spruce, willows, aspen, and birch.

The Naptowne soils are well drained. They resemble the Soldatna soils in that they developed in moderately deep, silty material underlain by a gravelly substratum. The substratum of the Naptowne soils, however, is a little finer textured and firmer than that of the Soldatna soils. Many of the associated soils in the Naptowne soil area are the same as those in the Soldatna soil area, such as the moderately well drained Longmare soils, formed in deeper silty deposits, and the more poorly drained Kalifonsky soils in low areas adjacent to muskegs. Poorly drained soils occupy the flood plains of most of the secondary streams and depressions in the uplands.

Only a small part of the Naptowne soil area has been cleared, mostly for small gardens. Much of it is too steep or too rough to make good cropland, but many level to moderately sloping upland areas are suitable for clearing and crop production.

4. Kenai Soil Area

Kenai soils are dominant in the hilly sections northeast of Soldatna, east of Kasilof, and north of Clam Gulch. Slopes range from nearly level to steep; much of the area has an irregular, choppy topography. Forests of white spruce, birch, and aspen cover most of the uplands. Balsam poplar (cottonwood) and thickets of alder occur in some of the coastal areas. Black spruce and willows are dominant along drainageways and in upland depressions. A dense growth of tall grass, forbs, and shrubs covers the ground in these wetter areas.

Like the other principal soils of the uplands, the Kenai soils developed in silty, wind-laid material, but here the silty material lies over a slowly permeable, firm, clayey substratum. Associated with the Kenai soils are patches of the other principal soils of the uplands, especially the Cohoe soils. Poorly drained soils occupy the flood plains of secondary streams and the depressions in the uplands.

Although the level to moderately sloping uplands in this soil area are suitable for clearing, they are a little less desirable than those in the other general soil areas. The restricted permeability of the subsoil in the Kenai soils may delay spring planting and, in dry years, may contribute to summer droughtiness. About 60 percent of this soil area is too steep, too rough, or too wet for cultivation. Only a small part of the area has been cleared, mostly in the region north of Soldatna.

5. Cohoe Soil Area

Cohoe soils are most extensive in the southernmost part of the Kenai-Kasilof Area. Generally, the Cohoe soil area consists of nearly level to moderately sloping uplands that are broken by strips of more steeply sloping land and by broad muskegs. The native vegetation on the uplands is a forest of white spruce and birch. Balsam poplar, black spruce, and willows, together with tall grass, fireweed, and horsetail, occur on the poorly drained flood plains and depressions.

The Cohoe soils formed in moderately deep, silty material overlying layered coarse and fine material; the fine-textured layers are ordinarily firm and slowly permeable. In this soil area, the Cohoe soils occupy most of the uplands. Associated with them are the much less extensive, mostly poorly drained soils of the drainageways and depressions.

Because of the generally favorable topography, most of the Cohoe soil area is well suited to crops. Only a small part has been cleared, however, and that is used mostly for gardens. The steep and rough parts, as well as the wet spots, cannot be used for crops.

6. Salamatof Soil Area

This soil area consists of the soils, chiefly Salamatof peat, that occur in the many large bogs in the Kenai-Kasilof Area. The largest of these bogs borders on much of the coast between the Kenai and Kasilof Rivers. Other broad muskegs occur immediately north of Kenai and in the southern part of the Area. Smaller muskegs, a few acres to several square miles in size, occur in all parts of the Area.

Moss peat and a dense mat of shrubs cover the surface of most of the muskegs. Sedges, cottongrass, and horsetail are also common. Many muskegs support a dense stand of spindly black spruce; this tree also occurs in small clumps in the more open muskegs.

The most extensive soil in these bogs is Salamatof peat, which consists of a thick accumulation of raw peat. Other extensive soils of the muskegs are Doroshin peat, which has a shallower accumulation of peat than the Salamatof soils, and Starichkof peat, which consists largely of more finely divided peat. Some patches of mineral soils also occur in the Salamatof soil area, either as "islands" surrounded by muskegs or as strips bordering the muskegs. These soils are the imperfectly drained Kalifonsky soils and the somewhat better drained Longmare soils.

Because of wetness and the nature of the soil materials, most of the Salamatof soil area is suitable only for limited grazing. This would be true even if the soils were drained artificially, although some areas could be used as a source of wild hay.

Soils of the Area

The soils of the Kenai-Kasilof Area may be considered in three broad groups according to their topographic position: (1) Excessively drained to moderately well drained soils of the uplands; (2) imperfectly drained to very poorly drained mineral soils of the depressions and valley bottoms; and (3) poorly drained and very poorly drained soils of the muskegs or bogs.

Most of the soils of the uplands formed in a layer of silty, wind-laid material that is called loess. The principal differences among these soils lie in the thickness of this mantle of loess over the underlying material, in the nature of the underlying material, and in the kind and degree of profile development.

The mineral soils of the depressions and the valley bottoms differ in the degree of wetness, in the amount of organic matter accumulated, and in the texture of the layers within the soil profile. Peat soils are separated because of differences in the kind and fineness of the peat, in the thickness of the peat over the mineral substratum, and in the nature of the substratum.

In general, the soils of the uplands are infertile and strongly acid. Even in the first years after clearing, heavy fertilization is required for satisfactory yields of crops. With proper fertilization and management, however, good yields can be obtained on the level to moderately sloping, well-drained soils. On the more poorly drained soils, most cultivated crops will not do well except in unusually dry years. Peat soils are generally not suited to agriculture.

In the following list the soil types (not the mapping units) of the Area are grouped according to their topographic position.

Excessively drained to moderately well drained soils of the uplands and terraces:

Anchorage very fine sandy loam.
Bernice sandy loam.
Boulder Point very fine sandy loam.
Cohoe silt loam.
Island silt loam.
Kasilof silt loam.
Kenai silt loam.
Longmare silt loam.
Naptowne silt loam.
Nikishka silt loam.
Soldatna silt loam.
Tustumena silt loam.

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Imperfectly drained to very poorly drained mineral soils of the depressions and valley bottoms:

Clam Gulch silt loam.
Coal Creek silt loam.
Corea silt loam.
Foreland silt loam.
Kalifonsky silt loam.
Karluk silt loam.
Killey sandy loam.
Moose River silt loam.
Pincher silt loam.
Slikok mucky silt loam.
Torpedo Lake silt loam.

Poorly drained and very poorly drained peat soils of the muskegs:

Clunie peat.
Doroshin peat.
Nikolai silty peat.
Salamatof peat.
Starichkof peat.

Descriptions of the Soils

Each of the soils of the Kenai-Kasilof Area is described briefly in the following pages. More detailed descriptions of representative profiles of some of the soils are given in the section "Formation, Classification, and Morphology of the Soils." The location and distribution of the soils in the Area are shown on the maps in the back of this report. Table 3 gives the approximate acreage and proportionate extent of the soils.

In these descriptions, the general range of slope for each mapping unit is given a parentheses immediately following the unit name. The slope phases designated *nearly level* (0 to 3 percent), *gently sloping* (3 to 7 percent), *moderately sloping* (7 to 12 percent), and *strongly sloping* (12 to 20 percent) generally have simple slopes. The slope phases designated *rolling* (7 to 12 percent) and *hilly* (12 to 20 percent) have complex and irregular patterns of slope, and the individual short slopes fall in many directions. The phases designated *moderately steep* (20 to 30 percent) and *steep* (30 to 45 percent) have either simple slopes or complex, irregular patterns of slopes.

Anchorage series

The Anchorage series consists of excessively drained, sandy soils developed in water-laid or wind-worked material. Although some areas are nearly level or gently sloping, these soils are mostly on rolling to steep, dunelike hills near the principal streams. Good stands of white spruce, birch, and aspen cover most areas. In some places however, there is only a sparse growth of spruce and aspen.

Typical profile of Anchorage very fine sandy loam:

2 inches to 0, black mat of roots and decomposing organic materials.
0 to 2 inches, mixed gray and dark-gray coarse silt loam mottled with dark yellowish brown; weak crumb structure; friable.
2 to 5 inches, mixed brown and yellowish-red very fine sandy loam; very weak blocky structure.
5 to 10 inches, olive-brown fine sand; loose.
10 to 24 inches +, olive fine sand; loose.

These soils are strongly acid in the upper layers, but they are only moderately acid to slightly acid in the lower layers.

TABLE 3.—*Approximate acreage and proportionate extent of the soils*

Soil	Area			Extent
	Kenai-Kasilof Soil Conservation Subdistrict	Ninilchik Soil Conservation Subdistrict	Total Kenai-Kasilof Area	
	Acres	*Acres*	*Acres*	*Percent*
Anchorage very fine sandy loam, nearly level	71	170	241	0. 1
Anchorage very fine sandy loam, rolling	217	138	355	. 1
Bernice sandy loam, strongly sloping to steep	2, 737	355	3, 092	1. 3
Boulder Point very fine sandy loam, gently sloping	153	243	396	. 2
Boulder Point very fine sandy loam, rolling	259	15	274	. 1
Boulder Point very fine sandy loam, hilly to steep	1, 374	23	1, 397	. 6
Clam Gulch silt loam	1, 894	509	2, 403	1. 0
Clunie peat	2, 968	403	3, 371	1. 4
Coal Creek silt loam, nearly level	1, 596	562	2, 158	. 9
Coal Creek silt loam, gently sloping	186	69	255	. 1
Cohoe silt loam, nearly level	2, 048	5, 267	7, 315	3. 1
Cohoe silt loam, gently sloping	1, 764	2, 637	4, 401	1. 9
Cohoe silt loam, moderately sloping	881	757	1, 638	. 7
Cohoe silt loam, strongly sloping	190	431	621	. 3
Cohoe-Kenai association, rolling	56	798	854	. 4
Cohoe-Kenai association, hilly	226	221	447	. 2
Cohoe-Kenai association, moderately steep	210	647	857	. 4
Cohoe-Kenai association, steep	157	235	392	. 2
Corea silt loam	----------	31	31	(1)
Doroshin peat	3, 726	382	4, 108	1. 7
Foreland silt loam	231	----------	231	. 1
Gravelly beach (land type)	726	478	1, 204	. 5
Island silt loam, nearly level	93	179	272	. 1
Island silt loam, gently sloping	85	----------	85	(1)
Kalifonsky silt loam, nearly level	8, 047	1, 031	9, 078	3. 8
Kalifonsky silt loam, gently sloping	2, 246	129	2, 375	1. 0
Karluk silt loam	138	----------	138	. 1
Kasilof silt loam, nearly level	4, 915	95	5, 010	2. 1
Kasilof silt loam, gently sloping	254	16	270	. 1
Kenai silt loam, nearly level	1, 424	1, 804	3, 228	1. 4
Kenai silt loam, gently sloping	2, 594	1, 056	3, 650	1. 5
Kenai silt loam, moderately sloping	1, 212	664	1, 876	. 8
Kenai silt loam, rolling	374	963	1, 337	. 6
Kenai silt loam, strongly sloping	821	407	1, 228	. 5
Kenai silt loam, hilly	491	183	674	. 3
Kenai silt loam, moderately steep	1, 161	548	1, 709	. 7
Kenai silt loam, steep	633	168	801	. 3
Killey sandy loam	263	208	471	. 2
Longmare silt loam, nearly level	3, 711	228	3, 939	1. 7
Longmare silt loam, gently sloping	238	15	253	. 1
Moose River silt loam	1, 340	846	2, 186	. 9
Moose River silt loam, shallow	946	----------	946	. 4
Naptowne silt loam, nearly level	2, 716	----------	2, 716	1. 1
Naptowne silt loam, gently sloping	3, 192	503	3, 695	1. 6
Naptowne silt loam, moderately sloping	1, 101	8	1, 109	. 5
Naptowne silt loam, rolling	3, 902	169	4, 071	1. 7
Naptowne silt loam, strongly sloping	323	294	617	. 3
Naptowne silt loam, hilly	4, 631	357	4, 988	2. 1
Naptowne silt loam, moderately steep	3, 206	105	3, 311	1. 4
Naptowne silt loam, steep	2, 347	136	2, 483	1. 0
Nikishka silt loam, nearly level	294	8	302	. 1
Nikishka silt loam, gently sloping	470	----------	470	. 2
Nikishka silt loam, moderately sloping	633	24	657	. 3
Nikishka silt loam, strongly sloping	1, 241	23	1, 264	. 5
Nikishka silt loam, moderately steep	1, 060	164	1, 224	. 5
Nikishka silt loam, steep	563	225	788	. 3
Nikolai silty peat	616	54	670	. 3
Pincher silt loam	1, 665	98	1, 763	. 7
Salamatof peat	27, 106	6, 308	33, 414	14. 0
Salamatof peat, forested	10, 473	2, 407	12, 880	5. 4
Sea cliff (land type)	526	282	808	. 3
Slikok mucky silt loam	746	92	838	. 4
Soldatna silt loam, nearly level	19, 648	----------	19, 648	8. 3
Soldatna silt loam, gently sloping	7, 001	----------	7, 001	2. 9
Soldatna silt loam, moderately sloping	4, 632	----------	4, 632	1. 9
Soldatna-Nikishka association, rolling	1, 854	86	1, 940	. 8

See footnote at end of table.

TABLE 3.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Area			Extent
	Kenai-Kasilof Soil Conservation Subdistrict	Ninilchik Soil Conservation Subdistrict	Total Kenai-Kasilof Area	
	Acres	*Acres*	*Acres*	*Percent*
Soldatna-Nikishka association, hilly	8, 805	411	9, 216	3. 9
Soldatna-Nikishka association, moderately steep	2, 892	248	3, 140	1. 3
Soldatna-Nikishka association, steep	433		433	. 2
Starichkof peat	1, 404	2, 692	4, 096	1. 7
Starichkof peat, forested	136	175	311	. 1
Tidal flats	1, 149	163	1, 312	. 6
Tidal marsh	876	148	1, 024	. 4
Torpedo Lake silt loam	240	175	415	. 2
Tustumena silt loam, nearly level	17, 764	7, 928	25, 692	10. 8
Tustumena silt loam, gently sloping	4, 464	393	4, 857	2. 0
Tustumena silt loam, moderately sloping	613	24	637	. 3
Total soil area	191, 378	46, 611	237, 989	100. 0
Urban and industrial areas	259		259	
Total land area	191, 637	46, 611	238, 248	
Water (lakes and streams)	10; 986	1, 349	12, 335	
Total map area	202, 623	47, 960	250, 583	

[1] Less than 0.1 percent.

Anchorage very fine sandy loam, nearly level (0 to 7 percent slopes) (AnA).—For the most part, this nearly level to gently sloping soil is on low ridges along the borders of lakes and muskegs in the southern part of the Kenai-Kasilof Area. These ridges are probably relics of former beaches. The subsoil is a little redder than that in Anchorage very fine sandy loam, rolling, and the underlying sands are a little coarser.

Little of this soil has been cleared. Because of its coarse texture, the soil is droughty and would blow readily if the plant cover were removed. (Management group 14)

Anchorage very fine sandy loam, rolling (7 to 30 percent slopes) (AnC).—This soil is mostly on rolling to steep hills adjacent to the broad plains west of the Moose River near Sterling and in the southern part of the Kenai-Kasilof Area. These hills are probably stabilized dunes on which there are many small knobs and depressions. Some small level areas have been included.

If the forest were removed, the dunes would be likely to blow and drift again and thus harm adjacent soils of greater agricultural value. There has already been some drifting where a newly constructed road, north of Sterling, cuts through an area of this soil. (Management group 21)

Bernice series

The Bernice series consists of excessively drained, very shallow, gravelly soils on short, steep slopes bordering streams, lakes, or muskegs. These soils occur throughout the Kenai-Kasilof Area, although their total acreage is small. They support a forest in which white spruce and birch are dominant. This forest is ordinarily of the same density as that on adjacent soils on the uplands.

Typical profile of Bernice sandy loam:

1½ inches to 0, dark reddish-brown mat of roots and decomposing plant material.
0 to 3 inches, dark-gray sandy loam; very weak crumb structure; layer may contain pockets of silt loam.
3 to 7 inches, dark reddish-brown and dark yellowish-brown loamy sand that has varying proportions of gravel; loose.
7 to 18 inches +, dark yellowish-brown gravelly sand; loose; layer may contain lenses of silty and clayey material.

Bernice sandy loam, strongly sloping to steep (12 to 45 percent slopes) (BeE).—This soil is not suitable for cultivation. Because it is coarse textured and steep, it would be extremely droughty if the mat of organic material were removed. So far as is known, no cultivated crops are grown on this soil.

Included are small, irregular patches of silty soils that resemble Nikishka, Naptowne, Kenai, and Cohoe silt loams of the adjacent uplands. (Management group 21)

Boulder Point series

The Boulder Point series consists of well-drained soils developed in recently deposited, very fine sandy and silty, wind-laid materials. These soils occur along the northern coast and in the region north of Clam Gulch, where strong winds have blown material from the beaches and tidal flats to the uplands above the sea cliff. As a rule, the Boulder Point soils occur in narrow strips along the coast, but on the East Foreland promontory in the northwest, they cover an area about a mile wide. Most of the areas adjacent to the sea cliff are rough, and there are many draws and low knolls. Some areas are gently sloping to moderately sloping.

Near the coast, the vegetation consists of almost impenetrable thickets of twisted alders and devilsclub.

among which there are patches of tall grass, fireweed, and shrubs. Farther inland, large balsam poplar (cottonwood) trees are common; they are ordinarily surrounded by grassy areas. White spruce and birch are also present but are seldom as prominent as they are on most of the other well-drained soils. Particles of charcoal just below the surface indicate that many of these coastal areas have been burned over.

Typical profile of Boulder Point very fine sandy loam:

4 inches to 0, dark reddish-brown mat of roots and decomposing organic material.
0 to 3 inches, black very fine sandy loam; very weak granular structure; friable.
3 to 6 inches, dark reddish-brown very fine sandy loam; very weak blocky structure; friable.
6 to 11 inches, dark reddish-brown coarse silt loam that grades to brown with increasing depth; weak blocky structure; friable.
11 to 17 inches, brown silt loam; weak blocky structure; friable.
17 to 25 inches, dark yellowish-brown silt loam; weak blocky structure; friable.
25 to 31 inches, light olive-brown silt loam mottled with strong brown; moderate blocky structure; friable.
31 to 40 inches +, olive-gray stony silt loam mottled with yellowish brown; stones make up about 25 percent of this layer; lenses of sandy material in some places; friable.

Boulder Point very fine sandy loam, gently sloping (3 to 7 percent slopes) (BoB).—There are only a few areas of this soil. The largest is a narrow coastal strip north of Clam Gulch in the southern part of the Area. For the most part, the surface is undulating, and there are many gently sloping ridges and swales. This irregularity of the surface, however, would not be a serious deterrent to the use of this soil for agriculture. Strong winds are common along the coast. After clearing, there is a hazard of wind erosion unless cultivated areas are adequately protected by grass strips or windbreaks. (Management group 1)

Boulder Point very fine sandy loam, rolling (7 to 12 percent slopes) (BoC).—The few areas of this soil are on a complex series of low ridges and knolls. The short, uneven slopes are separated by narrow swales. The slopes are generally moderate but are so irregular that it would be difficult to carry out most farming operations. (Management group 7)

Boulder Point very fine sandy loam, hilly to steep (12 to 45 percent slopes) (BoE).—This soil is hilly, and there are many short, steep slopes and draws. It is not likely that cultivation is possible on the steep slopes. If the brush were removed, however, the soil might be suitable for permanent pasture. (Management group 15)

Clam Gulch series

The poorly drained Clam Gulch soils occur mostly in stream valleys or in low areas adjacent to lakes or muskegs in those parts of the Area where Kenai silt loam is the dominant soil of the surrounding uplands. There are many small patches of the Clam Gulch soils in the Kenai-Kasilof Area, but their total acreage is small.

These soils are almost always wet and support a forest in which black spruce and other trees and bushes characteristic of poorly drained areas are dominant. Grasses and horsetail make up much of the low understory, and a layer of moss, several inches thick, covers the ground.

Typical profile of Clam Gulch silt loam:

6 to 3 inches, live moss.
3 inches to 0, dark-brown moss peat mixed with roots and other organic material.
0 to 4 inches, dark reddish-brown silt loam; weak blocky structure; nonsticky when wet.
4 to 12 inches, dark reddish-brown silt loam; patches and streaks of brown near the bottom of layer; massive; nonsticky when wet.
12 to 24 inches +, olive silty clay loam; massive; firm and sticky; slowly permeable.

The depth to the firm underlying material ranges from a few inches to 15 inches, but it is generally 8 to 12 inches. In some places the underlying material is bluish. These soils are strongly acid, especially just below the moss.

Clam Gulch silt loam (0 to 3 percent slopes) (Ca).—Like most soils of the stream valleys and low areas, this nearly level soil contains small patches of peat similar to that in the Doroshin and Salamatof series. Also included are a few spots of soils that resemble the very poorly drained Slikok soils or the sandy Moose River soils. These spots are not large. (Management group 10)

Clunie series

The Clunie series consists of very poorly drained moss peat soils. These soils occur only on the fairly broad flats near the mouths of the Kenai and Kasilof Rivers in areas affected by the tides. In addition to moss, the plant cover includes sedges, bog birch, Labrador-tea, and other low shrubs common to muskegs.

Typical profile of Clunie peat:

0 to 25 inches, dark reddish-brown moss peat (pale brown when dry).
25 to 36 inches +, dark bluish-gray silty clay loam; massive; slightly sticky.

The thickness of the peat layer ranges from 12 to 30 inches. As a rule, the greater the distance from the stream channel, the thicker is the peat. Both the peat and the underlying material are strongly acid and low in available nutrients. The water table is always at the surface, and the peat and underlying material are saturated throughout the summer.

The Clunie soils occur at slightly higher altitudes than the land type, Tidal marsh, which is more strongly affected by the tides and does not have a surface layer of peat. Other organic soils, in the Doroshin series, are similar to the Clunie soils except that they are underlain by olive, silty lake deposits rather than tidal clays.

Clunie peat (level) (Ce).—This soil includes small patches of Tidal marsh. Clunie peat probably cannot be drained successfully. Its only agricultural use would be limited grazing. (Management group 19)

Coal Creek series

The Coal Creek soils occupy relatively small, poorly drained depressions in the uplands where the Cohoe, Kenai, and Naptowne soils are dominant. Some areas are adjacent to poorly drained soils on stream bottoms or are on the borders of muskegs. The native vegetation consists mostly of a rather sparse forest of spruce, birch, and willows. Grasses, horsetail, fireweed, and shrubs form the understory.

The Coal Creek soils developed in moderately deep, silty material that is underlain by pebbly, slightly

heavier, and firmer material. This silty cap is generally as thick as, or thicker than, that in the surrounding soils of the uplands. In most places, at least part of this silt was washed from the adjacent slopes and deposited in the depressions. The entire profile is ordinarily wet and acid.

Typical profile of Coal Creek silt loam:

2 inches to 0, dark reddish-brown mat of roots and decomposing organic material.
0 to 9 inches, very dark grayish-brown to dark-brown and dark reddish-brown silt loam; very weak platy structure; nonsticky when wet.
9 to 21 inches, olive-gray silt loam mottled with brown and dark yellowish brown; massive; nonsticky.
21 to 27 inches, dark-brown silt loam mottled with gray and dark reddish-brown; massive; nonsticky.
27 to 40 inches +, olive-gray and brown pebbly fine silt loam; massive; moderately firm.

Coal Creek silt loam, nearly level (0 to 3 percent slopes) (CkA).—Near the stream bottoms and muskegs, small patches of Kalifonsky silt loam, which has a gravelly substratum, are included in this mapping unit. In other places small areas of Clam Gulch silt loam, which has a firm, clayey substratum, are included. (Management group 10)

Coal Creek silt loam, gently sloping (3 to 7 percent slopes) (CkB).—Despite its gentle slope, this soil is as wet as Coal Creek silt loam, nearly level. There are fewer inclusions of other soils. Because it is steeper, this soil probably would be easier to drain. (Management group 10)

Cohoe series

These well-drained soils are most extensive in the southernmost part of the Kenai-Kasilof Area, but they also occur in many other parts of the Area. They developed in moderately deep to deep, wind-laid material that lies over the layered sediments of the Kenai formation or glacial till derived from this formation. The Cohoe soils range from level to strongly sloping, but they are ordinarily nearly level to gently sloping. A forest of white spruce and birch covers most areas.

Typical profile of Cohoe silt loam:

2½ inches to 0, very dark grayish-brown mat of roots and partially decomposed organic material.
0 to 2 inches, gray silt loam; a few small, brown mottles; weak granular structure; friable.
2 to 8 inches, dark-brown and grayish-brown silt loam; dark reddish-brown mottles in the upper part of the layer; weak blocky structure; friable.
8 to 15 inches, olive-brown and dark-brown silt loam; massive; friable.
15 to 23 inches, olive-brown silt loam; massive; friable.
23 to 53 inches +, olive coarse silt loam mottled with dark brown; massive but may break into blocks; lenses of sandy, silty, and clayey material are common at a greater depth.

The silty cap over the layered sediments is ordinarily 30 to 40 inches thick, but in a few places it is only 24 inches thick. These soils are strongly acid in the upper part and medium acid below. They are low in most plant nutrients. Their silty cap is generally thicker than that in other soils on the uplands. For this reason and because they are mostly level or gently sloping, the Cohoe soils are among the best agricultural soils in the Kenai Peninsula.

Cohoe silt loam, nearly level (0 to 3 percent slopes) (CoA).—This soil constitutes more than half the total acreage of the Cohoe soils. It is mostly on broad plains that either grade to rolling or hilly slopes or are edged by steep escarpments breaking to muskegs. A few smaller level areas occur as "islands" in muskegs. Patches of Kenai silt loam are included, but Cohoe silt loam, nearly level, has fewer inclusions of other soils than the more sloping phases. Mottling of the subsoil is more common than in other phases. (Management group 2)

Cohoe silt loam, gently sloping (3 to 7 percent slopes) (CoB).—There are some fairly large areas of this soil, but it is not so extensive as Cohoe silt loam, nearly level. In some places the surface is undulating and includes many relatively short, gentle slopes between depressions and low ridges. In other places the slopes are long and relatively uniform. A few areas of Coal Creek silt loam and of Salamatof and Starichkof peats are included, as well as some patches of Kenai and Naptowne silt loams. Inclusions, however, make up a very small proportion of the total acreage. (Management group 1)

Cohoe silt loam, moderately sloping (7 to 12 percent slopes) (CoC).—This soil occurs mostly along the edges of broad areas of Cohoe silt loam, nearly level, or in association with the rougher areas of Kenai and Naptowne soils. There are more small inclusions of Kenai and Naptowne soils than in Cohoe silt loam, gently sloping. (Management group 3)

Cohoe silt loam, strongly sloping (12 to 20 percent slopes) (CoD).—Small areas of this soil occur at the edges of broader areas of more gently sloping Cohoe soils. The silt cap is ordinarily more shallow than on the less sloping soils. Inclusions of Kenai and Naptowne soils are more common. (Management group 8)

Cohoe-Kenai association

In several rolling and hilly areas in the southern and eastern parts of the Kenai-Kasilof Area, Cohoe and Kenai soils occur in such close association that they could not be delineated separately. Cohoe silt loam is the dominant soil in this association, especially on the lower slopes. In some places a few small areas of Naptowne silt loam are included. Patches of Salamatof and Starichkof peats, which occur in the many small depressions, are also included.

Each of the soils in this association is described elsewhere in this section. The vegetation is the forest of white spruce, birch, and aspen typical of the region.

Cohoe-Kenai association, rolling (complex 7 to 12 percent slopes) (CpC).—In a few broad areas in the south, the Cohoe and Kenai soils occur on choppy, low hills. Their irregular topography would interfere seriously with farming operations. (Management group 7)

Cohoe-Kenai association, hilly (complex 12 to 20 percent slopes) (CpD).—These soils are on irregular hills and are steeper than the rolling phase. Otherwise, the soils are similar. (Management group 15)

Cohoe-Kenai association, moderately steep (20 to 30 percent slopes) (CpE).—These soils are generally a little more shallow than the more gently sloping phases. The proportion of Kenai silt loam in the association is greater, and there are more inclusions of Naptowne silt loam. (Management group 15)

Cohoe-Kenai association, steep (30 to 45 percent slopes) (CpF) —The characteristics of these soils are essentially the same as those of the somewhat less steep Cohoe-Kenai soils. The erosion hazard, however, is greater. (Management group 17)

Corea series

These poorly drained soils formed from silty material that was fairly high in organic matter and apparently was washed from higher, adjoining lands. The two small areas of Corea soils are on low benches near the coast in the southern part of the Kenai-Kasilof Area. They support a dense stand of tall grass, chiefly bluejoint.

Typical profile of Corea silt loam:

3 inches to 0, grass and straw litter.
0 to 9 inches, dark reddish-brown silt loam; gray and black bands and buried mats of roots and straw; massive; friable.
9 to 16 inches, dark reddish-brown silt loam; faint mottles of grayish brown; massive; friable.
16 to 22 inches, light brownish-gray silt loam mottled with dark reddish brown; massive; friable.
22 to 36 inches, dark reddish-brown mucky silt loam; thin black bands and a few spots of light brownish gray; massive; friable.
36 to 44 inches, dark reddish-brown to black mucky silt loam; massive; friable.
44 inches + gray to dark-gray silty clay loam mottled with dark reddish brown; massive; slightly plastic when wet.

Corea silt loam (level) (Cr).—This soil can be used for pasture and, in most years, for wild hay, but it is too wet for cultivation. Patches of a soil similar to Nikolai silty peat are included. (Management group 11)

Doroshin series

The Doroshin series consists of very poorly drained, shallow peat soils. They ordinarily occur along the edges of lakes and muskegs. The Doroshin soils are fairly extensive, but their total acreage is considerably less than that of the associated Salamatof peat soils. The vegetation on both peats is almost the same, chiefly moss, bog birch, dwarf willows, Labrador-tea, and other low shrubs. Along the fringes of lakes, however, there are few shrubs, and the plant cover consists of sedges and moss.

Typical profile of Doroshin peat:

0 to 6 inches, very dark grayish-brown (yellowish-brown when dry) moss peat.
6 to 19 inches, dark reddish-brown, finely divided peat.
19 to 30 inches +, dark-brown silt loam mottled with pale brown; massive; nonsticky; layer contains pockets and lenses of fine sand.

The mineral substratum is ordinarily silt loam, but it is sandy or even gravelly in a few places. In some places the substratum is bluish. The peat layer in the Doroshin soils is about as thick as that in the Clunie soils, but it is underlain by fresh-water deposits rather than by tidal deposits. The peat layer is more shallow, and, in some places, the peat is more finely divided than that in the Salamatof soils.

Doroshin peat (level) (Do).—Patches of the deeper Salamatof soils are common inclusions in this soil. It is doubtful if Doroshin peat can be drained successfully. Limited grazing would be its only agricultural use. (Management group 19)

Foreland series

The Foreland series consists of shallow, poorly drained soils. They occur only in a few seep areas on the gravelly terraces along major streams. Foreland soils support a fairly thick forest of scrubby black spruce, in which the low understory consists of grasses and sedges. A 4- to 8-inch mat of moss covers the ground. The moss and the thin silty layer are very strongly acid.

Typical profile of Foreland silt loam:

6 inches to 0, brown (pink when dry) moss peat.
0 to 4 inches, very dark brown, dark reddish-brown, and black silt loam; massive; nonsticky.
4 to 18 inches +, water-laid gravelly sand; loose.

Foreland silt loam (0 to 7 percent slopes) (Fo).—A few small, nearly level areas of this soil are on a broad terrace above the Kasilof River, adjacent to the well-drained Kasilof soils of the uplands. These nearly level areas are too wet and shallow for any agricultural use except grazing. There are some gently sloping areas on the narrow terraces that lie between the Kenai and Moose Rivers and the escarpments at the edge of adjacent uplands. These gently sloping areas are affected by seep water from the uplands. Although more extensive than the nearly level areas, they occupy only a very small part of the river terraces. They are suitable only for limited grazing. (Management group 18)

Gravelly beach

Gravelly beach (land type) (Gb.)—Along most of the coast, narrow gravelly and sandy beaches lie between Cook Inlet and the sea cliffs that border the uplands. These beaches support almost no vegetation. The lower parts are under water daily during high tide. When exposed, they are generally smooth and firm and are used as a roadway by commercial fishermen. Their upper parts are inundated by waves in stormy weather, and they are commonly loose and hummocky and have many large boulders. At the mouths of the major rivers, the beaches are interrupted by areas of Tidal marsh and Tidal flats. There are also a few silty and clayey areas in some places. Vehicles must detour around these soft spots.

These beaches have no agricultural value. (Management group 23)

Island series

This series consists of dark-colored soils in small, open depressions in the forested uplands. The soils are well drained, even though most of the depressions do not have good surface drainage. In the northern part of the Area these soils occur in association with the Soldatna soils, and in the southern part they are surrounded by the Cohoe soils.

The vegetation is principally tall grass that grows in tussocks as much as 2 feet high and 3 feet wide. In some places the very narrow troughs between the large tussocks are completely free of vegetation, and in other places they have a thin ground cover of moss. Fireweed and other forbs and shrubs are mixed with the grass in some areas. White spruce is apparently invading most of these grassed depressions. Scattered young trees are growing in many of them; these trees are larger and more closely spaced toward the edges of the depression.

In the northern part of the Area, small, completely forested, bowl-shaped depressions are common. The soils in these depressions have the hummocky surface characteristic of the Island soils, but under the influence of the forest vegetation they have taken on most of the properties of the surrounding Soldatna soils. There is little doubt that in time all the areas of Island soils will undergo a similar change.

The Island soils developed in moderately deep, silty material overlying a gravelly subsoil. It is likely that most of this silty material was washed in from surrounding slopes.

Typical profile of Island silt loam:

0 to 4 inches, dark reddish-brown silt loam; weak to moderate, fine, blocky structure; friable.
4 to 14 inches, dark-brown silt loam with patches of yellowish brown; weak to moderate blocky structure; friable.
14 to 21 inches, olive-brown silt loam; massive; friable.
21 to 25 inches, olive silt loam; moderate platy structure; friable.
25 to 31 inches, olive fine gravelly silt loam mottled with strong brown; weak platy structure; moderately firm.
31 to 42 inches +, water-laid gravelly sand; loose.

The depth to the gravelly substratum ranges from 20 inches to more than 40 inches. Lenses of very fine sand occur in the profile in some places.

Unlike the forested soils, which are strongly acid, the Island soils are only moderately acid, even at the surface. Like the forested soils, however, their natural content of available nutrients, especially phosphorus and potassium, is low. The physical properties of the Island soils are good. With adequate fertilization, they should be among the most productive in the Kenai-Kasilof Area. There are many small areas of these soils throughout the Area, but the total acreage is small.

Island silt loam, nearly level (0 to 3 percent slopes) (IaA).—This soil occurs at the bottom of bowl-shaped depressions. For the most part it is nearly level, but it has a slightly stronger slope around the edges of the bowls. In some places there are some very small wet spots in the center of the depressions. (Management group 2)

Island silt loam, gently sloping (3 to 7 percent slopes) (IaB).—This soil occurs in the few depressions where the floor is gently sloping. It is well suited to cultivated crops but is slightly susceptible to erosion. (Management group 1)

Kalifonsky series

The Kalifonsky series consists of imperfectly drained soils on the lowlands adjacent to muskegs and lakes and on the flood plains of some streams. Kalifonsky soils are extensive and occur in large and small patches in all parts of the Kenai-Kasilof Area. They are most common in the areas in which the Soldatna, Tustumena, and Naptowne soils are dominant.

In most places Kalifonsky soils are covered by a rather scrubby forest of black spruce, white spruce, birch, and balsam poplar. Grasses, sedges, and shrubs, such as bog birch, willows, Labrador-tea, and lingenberry make up the low understory. There is usually a layer of sphagnum moss on the surface. In many places the surface is very rough; tussocks of vegetation, 12 to 18 inches high, are separated by narrow troughs. During most of the summer, the ground water lies just beneath the surface in these troughs. In dry years, however, the water table may drop as much as 36 inches.

The Kalifonsky soils have developed in moderately deep, silty material underlain by a thick deposit of gravel or coarse sand. Most of this silty cap probably is windlaid, but a large part was undoubtedly washed in by slowly moving water.

Typical profile of Kalifonsky silt loam:

4 inches to 0, dark reddish-brown mat of roots, moss, and decomposing organic material.
0 to 6 inches, dark yellowish-brown, gritty silt loam; grayish-brown and very dark gray streaks; massive to granular structure; friable.
6 to 20 inches, streaked, dark yellowish-brown, dark grayish-brown, and grayish-brown silt loam; weak platy structure; nonsticky when wet.
20 to 25 inches, olive-brown silt loam; streaks of grayish brown and very dark grayish brown; massive; nonsticky when wet.
25 to 40 inches +, water-laid gravelly sand; loose.

The depth to the underlying gravelly sand or sand ranges from 15 inches to more than 30 inches. In some places there are sandy lenses in the upper part of the soil. As in the associated soils of the uplands, the upper layers are strongly acid. At a greater depth the soils are moderately acid. They are low in most plant nutrients.

Kalifonsky silt loam, nearly level (0 to 3 percent slopes) (KaA).—In places adjacent to muskegs and lakes where the water table is high, numerous small patches of Salamatof and Doroshin peats are included in this soil. In slightly higher positions, spots of Longmare, Soldatna, Tustumena, and Naptowne soils are common. In some places east of Kenai, an iron-cemented pan occurs in the gravel below the silt cap. Streams draining this area carry some of this iron and have taken on a reddish color. (Management group 9)

Kalifonsky silt loam, gently sloping (3 to 7 percent slopes) (KaB).—This soil occurs mostly in areas next to the large muskeg north of Kenai. Ordinarily this soil is wet, but it could be drained a little more easily than Kalifonsky silt loam, nearly level. Where the soil is not affected by seep water from the adjacent uplands, it is likely that drainage would be effective. Small patches of better drained soils are common inclusions, and there are a few spots of peat. (Management group 9)

Karluk series

The Karluk series consists of poorly drained soils developed in deposits of diatomaceous earth *(7)*. The soils are silty, but they are plastic when wet. They are covered by a thick stand of bluejoint, fireweed, and associated tall grasses and forbs.

Typical profile of Karluk silt loam:

2½ inches to 0, black mat of roots and decomposing organic material.
0 to 3 inches, black, very dark gray, and very dark grayish-brown silt loam; weak granular structure; friable.
3 to 8 inches, grayish-brown silt loam mottled with yellowish red and dark reddish brown; weak platy structure; friable.
8 to 16 inches, light brownish-gray fine silt loam mottled with dark reddish-brown; black, old root channels; weak platy structure; friable, but plastic when wet.

16 to 30 inches +, light brownish-gray and brown fine silt loam mottled with dark reddish brown; moderate platy structure; friable but plastic when wet; in places the soil shows patterns, independent of structure, of brown leaves and stems on a light brownish-gray matrix.

These soils are strongly acid. Thin layers of sand or of more highly organic material occur at any depth.

Karluk silt loam (level) (Kc).—This soil occurs only in a few small depressions in the northern part of the Kenai-Kasilof Area. It is associated with lakes or muskegs. It has no inclusions of other soils. (Management group 11)

Kasilof series

The Kasilof series consists of well-drained, very shallow soils underlain by a gravelly substratum. They are the principal soils of the low terraces along the Kenai and Kasilof Rivers and a few tributary streams. Some of these terraces are narrow strips along the river; others are plains as much as half a mile wide. They are separated from the river flood plains by short escarpments 10 to 30 feet high. Away from the rivers, they either grade to the adjacent higher terraces or uplands or are separated from them by another escarpment. Some of the broader terraces have several levels separated by steps a few feet high. Narrow old stream channels cut through the terraces in many places.

For the most part, these soils support a young, open stand of white spruce, birch, and aspen much like that on the Tustumena soils. In some places, however, there are good stands of mature white spruce and birch.

Typical profile of Kasilof silt loam:

3 inches to 0, dark reddish-brown and black mat of roots and decomposing organic material.
0 to 3 inches, very dark brown silt loam; patches and streaks of dark brown and very dark gray; very thin lenses of fine sand; weak granular structure; very friable.
3 to 7 inches, dark-brown coarse silt loam; patches and streaks of dark reddish brown and yellowish brown; few small pebbles; weak granular structure; very friable.
7 to 9 inches, olive-brown fine gravelly loam; weak blocky structure; friable to loose.
9 to 30 inches +, stratified gravel and sand; structureless; dark reddish-brown patches of slightly cemented material in the upper part.

The depth to the underlying gravel ranges from 4 inches to 10 inches. These soils are strongly acid at the surface but are less acid with depth.

Kasilof silt loam, nearly level (0 to 3 percent slopes) (KfA).—This soil constitutes almost all the total acreage of the Kasilof soils. Other than occasional spots of Foreland soils in places affected by seeps, there are few inclusions of other soils. In a few places the material above the gravel is very fine sandy loam rather than silt loam. The soil is almost always moist in its undisturbed condition, but it is droughty when the mat of organic material on the surface is removed. Despite this, a few gardens are located on this soil. Several areas are producing fair yields of hay. (Management group 16)

Kasilof silt loam, gently sloping (3 to 7 percent slopes) (KfB).—There are only a few areas of this soil. Despite the steeper gradient, this soil is generally as thick as Kasilof silt loam, nearly level. Its agricultural capacity is the same. (Management group 16)

Kenai series

The well-drained Kenai soils are dominant in areas underlain by fine-textured glacial deposits. These soils are extensive. They occur principally in broad zones in the southern and central parts of the Kenai-Kasilof Area and in smaller patches elsewhere in the Area. They range from nearly level to steep, but they are mostly nearly level to rolling.

The native vegetation is a forest dominated by white spruce and birch but including also a few aspens and balsam poplars. The understory consists of alder, devilsclub, other low shrubs, and ferns.

Typical profile of Kenai silt loam:

3 inches to 0, dark reddish-brown mat of roots and decomposing organic material.
0 to 2 inches, gray silt loam mottled with dark brown; weak platy structure; friable.
2 to 5 inches, brown silt loam; a thin, discontinuous, dark reddish-brown layer in the uppermost part; weak, fine, blocky structure; friable.
5 to 11 inches, dark yellowish-brown silt loam; very weak blocky structure; friable.
11 to 16 inches, olive-brown silt loam; large patches of dark yellowish brown; massive; friable.
16 to 22 inches, olive coarse silt loam; moderate platy structure; friable.
22 to 36 inches +, olive silty clay loam; somewhat pebbly; massive; firm; this is glacial till.

The depth to the underlying firm till ranges from 10 to 24 inches. The texture of the till is silt loam to silty clay loam. In many places the firm till is underlain by layers of gravelly or sandy material. These soils are strongly acid near the surface, but they are only moderately acid at a greater depth.

Because of the relatively slow permeability of the underlying glacial till, water accumulates above it in the spring. In most years, however, this water either penetrates slowly into the underlying material or moves through the soil above it to lower lying areas. In midsummer, especially in places that have been cleared and cultivated, the silty upper part of these soils may be dry. Where the compact underlying till is close to the surface, it interferes with tillage, especially tillage for potatoes.

Kenai silt loam, nearly level (0 to 3 percent slopes) (KnA).—This soil is the most extensive of the Kenai soils in the Area. It covers the broad tops of hills and ridges as well as areas at the foot of these hills, where it is adjacent to more poorly drained soils. In the southern part of the Area, the Kenai soils adjoin broad areas of the Cohoe soils. The boundary between the nearly level phases of the Kenai and Cohoe soils is not everywhere clearly defined. In these areas, inclusions of Cohoe silt loam are common. Other inclusions are Coal Creek silt loam, Clam Gulch silt loam, or one of the peats, all of which occur in depressions too small to be delineated separately. Northeast of Soldatna there are some inclusions of Naptowne and Soldatna soils. All these inclusions are small. (Management group 5)

Kenai silt loam, gently sloping (3 to 7 percent slopes) (KnB).—This soil occurs in the same general positions as Kenai silt loam, nearly level. In general, it has the same inclusions of other soils. In many places the surface is undulating, and there are numerous short, gentle slopes separated by swales or ridges instead of long, continuous slopes. (Management group 5)

Kenai silt loam, moderately sloping (7 to 12 percent slopes) (KnC).—This soil is much less extensive than either Kenai silt loam, nearly level, or Kenai silt loam, gently sloping. Patches of Cohoe silt loam or of the poorly drained Coal Creek and Clam Gulch soils are included, but there are fewer inclusions than in the less sloping Kenai soils. (Management group 12)

Kenai silt loam, rolling (complex 7 to 12 percent slopes) (KnCC).—This soil is on fairly rough and choppy topography marked by many short slopes and low ridges and knolls. Depressions that commonly contain Salamatof peat or Starichkof peat are more numerous than in Kenai silt loam, moderately sloping. In the northern part of the Area, inclusions of Soldatna and Naptowne soils are common, although these soils occur only in small, irregular patches. (Management group 7)

Kenai silt loam, strongly sloping (12 to 20 percent slopes) (KnD).—This soil makes up only a small part of the total area of the Kenai soils. On these steeper slopes, there are fewer inclusions of other soils of the uplands than in the less sloping phases, and there are almost no inclusions of poorly drained or peaty soils. As a rule on these steeper slopes, the silt cap is slightly shallower over the underlying till, but this is not invariably so. (Management group 8)

Kenai silt loam, hilly (complex 12 to 20 percent slopes) (KnDD).—In general, this soil is similar to Kenai silt loam, rolling. Its greater roughness and steepness, however, makes it unlikely that the soil can be used for anything but forest or, in places, for permanent pasture. (Management group 15)

Kenai silt loam, moderately steep (20 to 30 percent slopes) (KnE).—Most of this soil occurs in long, fairly narrow strips adjacent to broader areas of more gently sloping Kenai soils. The silty cap is commonly not so thick as in the less sloping soils, but it is ordinarily considerably more than 10 inches thick. Minor inclusions of other soils are essentially like those included in Kenai silt loam, moderately sloping. (Management group 15)

Kenai silt loam, steep (30 to 45 percent slopes) (KnF).—There are only a few areas of this soil. Apart from the steeper gradient, it is similar to Kenai silt loam, moderately steep. (Management group 17)

Killey series

The Killey series consists of imperfectly drained, sandy soils that occur on the borders of some lakes and muskegs. Their characteristics are much like those of the Kalifonsky soils, except that the Killey soils have developed in sandy rather than silty material. These soils support a forest of spruce, birch, and balsam poplar, in which the ground cover or low understory consists of willows, bog birch, Labrador-tea, horsetail, and the other plants commonly found in wet places.

Typical profile of Killey sandy loam:

4 inches to 0, dark reddish-brown mat of roots and decomposing organic material.
0 to 2 inches, dark reddish-brown loam; streaks and patches of very dark grayish brown; weak granular structure; friable.
2 to 10 inches, brown sandy loam; patches of dark brown and yellowish brown; weak blocky structure; friable to loose.
10 to 22 inches, lenses and pockets of brown sandy loam and olive-brown and dark-brown coarse silt loam; weak blocky structure and granular structure; friable.
22 to 33 inches, olive silt loam; patches of sandy loam; massive; friable.
33 to 42 inches +, olive fine sand; loose.

The arrangement and thickness of the layers vary from place to place. The water table is ordinarily high, especially in places immediately adjacent to muskegs. The entire profile is strongly acid.

Killey sandy loam (0 to 3 percent slopes) (Kg).—All areas of Killey sandy loam are nearly level. In a few places where the silty lenses and pockets are a little thicker than usual, patches of a soil that resembles Kalifonsky silt loam are included. In low places near muskegs, spots of peat are included. (Management group 9)

Longmare series

The Longmare soils occur mostly on broad, nearly level areas in regions where the Soldatna or Tustumena soils are dominant. The Longmare soils occur at slightly lower altitudes than those soils and are only moderately well drained. Like the associated soils, they developed in a wind-laid silty cap that lies over a thick deposit of gravel and coarse sand. Ordinarily, however, this silty cap is somewhat thicker in the Longmare soils. The upper part of the underlying material is cemented by iron deposited from the ground water. This indurated layer severely restricts the movement of water from the soil into the underlying gravel.

The native vegetation is the same kind of forest, dominantly white spruce and birch, that covers the Soldatna soils. Grasses, horsetails, shrubs, and mosses, however, are more common on the forest floor.

Typical profile of Longmare silt loam:

4½ inches to 0, dark reddish-brown mat of roots and decomposing organic material.
0 to 2 inches, grayish-brown silt loam mottled with dark grayish brown and dark reddish brown; very weak blocky structure; friable.
2 to 4 inches, dark reddish-brown silt loam; weak, fine, blocky structure; friable.
4 to 8 inches, dark-brown silt loam mottled with brown; weak blocky structure; friable.
8 to 21 inches, dark grayish-brown to olive-brown silt loam mottled with yellowish red; very weak blocky structure; friable.
21 to 29 inches, silt loam in irregular streaks of dark grayish brown, very dark grayish brown, and dark yellowish brown, and mottled with yellowish red; massive; friable; nonsticky when wet.
29 to 32 inches, strong-brown silt loam; massive; friable; nonsticky when wet.
32 to 48 inches, dark reddish-brown, yellowish-red, and olive sand; strongly cemented.
48 to 54 inches, gravelly sand; colors same as above; strongly cemented.
54 to 66 inches +, stratified, water-laid sand and gravel; loose.

The silty mantle is from 24 inches to more than 40 inches thick over the cemented underlying material. These soils are strongly acid in the upper part but only moderately acid at a depth of more than 8 inches.

Longmare silt loam, nearly level (0 to 3 percent slopes) (loA).—This soil is the most extensive of the Longmare soils. Large areas occur in the broad plains northwest of Kenai and northeast of Sterling; smaller areas

occur in many other parts of the Area. In recent years, a number of houses have been built on Longmare silt loam, nearly level, near Kenai. Good gardens have been established near many of these houses. Most of the other areas of Longmare silt loam, nearly level, have not been developed. (Management group 4)

Longmare silt loam, gently sloping (3 to 7 percent slopes) (LoB).—This soil occurs in a few small patches in widely scattered parts of the Kenai-Kasilof Area. Despite its steeper slope, this soil has about the same capacity for agricultural use as Longmare silt loam, nearly level. (Management group 4)

Moose River series

The Moose River series consists of coarse-grained, poorly drained soils on the flood plains of streams and rivers. Except for a fairly thin, silty surface layer, these soils are sandy or gravelly throughout. They occur along most of the secondary streams of the Kenai-Kasilof Area, including Crooked, Coal, Soldatna, and Beaver Creeks, and in places along major streams, such as the Kenai, Kasilof, and Moose Rivers.

The vegetation consists mostly of sedges, grasses, horsetail, and willows, but there are a few white spruce, black spruce, and balsam poplar. Ordinarily, the ground cover is moss.

Typical profile of Moose River silt loam:

5 inches to 0, very dark brown mat of roots, moss, and decomposing organic material.
0 to 5 inches, very dark grayish-brown silt loam; pockets and thin lenses of olive sand; very weak platy structure; nonsticky when wet.
5 to 30 inches, dark greenish-gray fine sand; thin lenses of silt loam and peat; loose.
30 inches +, dark greenish-gray gravelly sand; loose.

The surface layer is sandy loam in a few places. The depth to the underlying gravel ranges from 10 inches to more than 40 inches. These soils are moderately acid throughout.

Moose River silt loam (level) (Mo).—This soil occurs along most of the smaller streams. To a depth of more than 20 inches it is sandy and contains very little gravel. Because of its wetness, this soil has not been cultivated. The native vegetation in a few patches, however, is grazed from time to time. (Management group 10)

Moose River silt loam, shallow (level) (Ms).—This soil occurs in comparatively small patches along the major rivers where the underlying gravelly layer is only 10 inches to 20 inches below the surface. This shallow soil is less extensive than the deeper Moose River silt loam. Very few areas have been grazed. (Management group 18)

Naptowne series

The Naptowne soils of the well-drained uplands occupy almost 10 percent of the Kenai-Kasilof Area. They occur in the central and eastern parts of the Area. They range from nearly level to steep. The soils developed in moderately deep, wind-laid, silty material that lies over gravelly glacial till. This till is not so coarse or so loose as the material under the Soldatna soils, but it is much coarser and looser than the till underlying the Kenai soils. It contains sporadic layers of firm, fairly heavy material.

The Naptowne soils support good native stands of timber, dominantly white spruce, birch, and aspen. Much of their area, especially in the east, was burned over in the great fire of 1947. Many of these burned areas are now covered by thin stands of young aspen in which there are a few birches and white spruce. Other burned areas support stands of black spruce.

Typical profile of Naptowne silt loam:

2 inches to 0, dark reddish-brown mat of roots and decomposing organic material.
0 to 1½ inches, gray silt loam mottled with brown; weak, very fine, blocky structure; friable.
1½ to 5 inches, brown to dark yellowish-brown silt loam; very weak, fine, blocky structure; friable.
5 to 9 inches, olive-brown silt loam; streaks and patches of brown; very weak blocky structure; friable.
9 to 19 inches, olive silt loam; very weak platy structure; very friable.
19 to 30 inches +, olive gravelly sandy loam mottled with yellowish brown; massive; firm in place but friable if disturbed; contains several stones and boulders.

The thickness of the silty cap over the gravelly till ranges from 15 inches to 30 inches, but a thickness of less than 24 inches is most common. Layers of firm, moderately fine material occur in the underlying till in some places. These soils are strongly acid in the upper layers but only moderately acid in the lower layers.

Naptowne silt loam, nearly level (0 to 3 percent slopes) (NaA).—This soil occurs mostly in broad areas bordered by sloping Naptowne soils. A few areas, however, are adjacent to muskegs or other lower land. Inclusions of small patches of Cohoe silt loam are fairly common. There are a few spots of Kenai and Soldatna silt loams. (Management group 2)

Naptowne silt loam, gently sloping (3 to 7 percent slopes) (NaB).—As a rule, this soil is undulating, although there are also some long, smooth slopes. Inclusions of Kenai and Soldatna soils are somewhat more numerous than in Naptowne silt loam, nearly level. Other inclusions consist of small pockets of Torpedo Lake and Coal Creek soils at the foot of some slopes and of Salamatof and Doroshin peats in a few scattered depressions. Patches of Cohoe silt loam are less common than in Naptowne silt loam, nearly level. (Management group 1)

Naptowne silt loam, moderately sloping (7 to 12 percent slopes) (NaC).—There are only a few areas of this soil. Inclusions of other soils are even fewer than in Naptowne silt loam, gently sloping. Poorly drained spots are virtually absent. (Management group 3)

Naptowne silt loam, rolling (complex 7 to 12 percent slopes) (NaCC).—This soil constitutes a substantial part of the total area of the Naptowne soils. A complex pattern of low ridges and knolls dominates in these rolling areas. Slopes, although moderate, are short and uneven. Small patches of Kenai and Soldatna soils are more numerous than in areas of Naptowne silt loam, moderately sloping; inclusions of Cohoe soils, however, are rare. In the depressions in this choppy topography there are small, poorly drained areas of Torpedo Lake soils or Coal Creek soils, or small patches of Salamatof peat or Doroshin peat. There are also many lakes. (Management group 7)

Naptowne silt loam, strongly sloping (12 to 20 percent slopes) (NaD).—This soil occurs mostly in narrow

strips bordering more extensive areas of other Naptowne soils. There are few inclusions of other soils. (Management group 8)

Naptowne silt loam, hilly (complex 12 to 20 percent slopes) (NaDD).—This is the most extensive of the Naptowne soils. Its topography is much like that of Naptowne silt loam, rolling, except that the slopes are steeper and more uneven. Inclusions of other soils are the same. Most areas slope less than 20 percent, but steeper slopes are not uncommon. (Management group 15)

Naptowne silt loam, moderately steep (20 to 30 percent slopes) (NaE).—This soil is fairly extensive. It occupies both the long, narrow slopes of ridges and escarpments and broad areas of irregular ridges and knolls. Inclusions of small patches of Soldatna and Kenai soils are more common in these steeper areas, especially on the more complex topography. Poorly drained soils in small depressions are also common inclusions. (Management group 15)

Naptowne silt loam, steep (30 to 45 percent slopes) (NaF).—This soil is almost the same as Naptowne silt loam, moderately steep. The slope is steeper, however, and the topography is even rougher. (Management group 17)

Nikishka series

Nikishka soils developed in shallow, wind-laid, silty material overlying thick deposits of coarse sand and gravel. Although less extensive than many other well-drained soils of the uplands, the Nikishka soils are widely distributed on outwash plains, escarpments, and slopes in hilly areas. For the most part these soils occur in relatively small patches in regions where Soldatna soils are dominant, but they are also common in other general soil areas, particularly the Naptowne area.

The Nikishka soils support forests of white spruce, birch, and aspen typical of the well-drained uplands in the Kenai-Kasilof Area. The stands of timber on these soils are much the same as those on deeper soils.

Typical profile of Nikishka silt loam:

3½ inches to 0, dark reddish-brown mat of roots and decomposing organic material.
0 to 2 inches, dark-gray to gray silt loam; weak, very fine, blocky structure; friable.
2 to 4 inches, dark reddish-brown silt loam; weak blocky structure; friable.
4 to 8 inches, strong-brown and brown silt loam; weak blocky structure; friable.
8 to 13 inches, dark yellowish-brown silt loam; weak blocky structure; friable.
13 to 21 inches, olive-brown gravelly silt loam; massive; friable to loose.
21 to 30 inches +, gravelly sand; loose.

The thickness of the silty deposit over the coarse underlying material ranges from 8 inches to 18 inches. These soils are strongly acid near the surface, but they are only moderately acid in the lower layers.

The silty cap in the Nikishka soils is thicker than that in the Kasilof soils of the river terraces, but it is thinner than the cap in the Soldatna soils of the outwash plains and moraine hills. The Nikishka soils are more highly developed than the other soils of the uplands; the dark reddish-brown layer in the upper part of their profile is more prominent. The boundary between Nikishka and Soldatna soils commonly is not well defined.

Nikishka silt loam, nearly level (0 to 3 percent slopes) (NkA).—Small patches of this soil occur at the edges of broad plains of Soldatna or Tustumena soils. Ordinarily, these patches are adjacent to lakes or muskegs. Most of the few clearings on the Nikishka soils are on this nearly level phase. There are several good gardens, but no crops are grown for off-farm sale. (Management group 6)

Nikishka silt loam, gently sloping (3 to 7 percent slopes) (NkB).—This soil occurs mostly along the lakes and muskegs in the Soldatna and Tustumena soil areas. It is a little more susceptible to erosion than Nikishka silt loam, nearly level. (Management group 6)

Nikishka silt loam, moderately sloping (7 to 12 percent slopes) (NkC).—This soil occurs in many places in the Kenai-Kasilof Area, especially in the northern and eastern parts. It is ordinarily in strips between lakes or muskegs and the higher land. (Management group 13)

Nikishka silt loam, strongly sloping (12 to 20 percent slopes) (NkD).—This soil occurs mostly as long narrow escarpments. It and the steeper Nikishka silt loams are even shallower than the gently sloping and moderately sloping Nikishka soils. In a few places, spots of Bernice sandy loam are included. (Management group 13)

Nikishka silt loam, moderately steep (20 to 30 percent slopes) (NkE).—Some areas of this soil are on long, narrow escarpments; others are in fairly extensive patches on moderately steep hills. Although this soil occurs in many parts of the Kenai-Kasilof Area, its total area is not large. It is generally shallower than the less sloping phases. Inclusions of Bernice soils are more numerous. (Management group 15)

Nikishka silt loam, steep (30 to 45 percent slopes) (NkF).—The characteristics and limitations of this soil are much the same as those of Nikishka silt loam, moderately steep, but the hazard of erosion is greater. (Management group 17)

Nikolai series

The Nikolai series consists of poorly drained silty peat soils that occupy narrow level areas adjoining the sea cliff along Cook Inlet, mostly between the mouths of the Kasilof and Kenai Rivers. These soils grade inland to the Starichkof and Salamatof peats. The vegetation on the Nikolai soils consists largely of thick stands of tall grass, dominantly bluejoint, mixed with fireweed and other forbs. In many places, however, there are fairly open forests of white spruce, willows, and balsam poplar.

Typical profile of Nikolai silty peat:

6 to 3 inches, mat of largely undecomposed leaves and stems.
3 inches to 0, dark reddish-brown and black mat of roots and decomposing leaves and stems.
0 to 7 inches, dark reddish-brown silty peat; peat is finely divided; moderate granular structure; weakly laminated; very friable and slick.
7 to 24 inches +, dark reddish-brown and black peat made up of partly decayed leaves and stems; very finely laminated; thin lenses of brown silty material; crushes easily to very friable, slick consistence; contains patches of brown silt loam and very thin lenses of white sand grains, probably volcanic ash.

The substratum is sandy or gravelly material. The depth to this material ranges from 24 inches to more than 40 inches.

Nikolai silty peat (level) (Np).—This soil is less poorly drained than the other organic soils, although a good part of it is wet during much of the summer. The soil is very strongly acid throughout, but it has a somewhat higher content of the major plant nutrients than most soils in the Area. (Management group 11)

Pincher series

The Pincher series consists of imperfectly drained soils developed over layered, water-laid materials that are in shallow depressions and drainageways. Ordinarily, they occur in association with the Tustumena soils on the broad plains that border on major rivers. They also occur in low places in the Naptowne general soil area and, infrequently, in the Soldatna and Cohoe soil areas. Most areas of the Pincher soils are covered by grass and shrubs, but on some there are clumps of spruce, birch, and aspen.

Typical profile of Pincher silt loam:

2 inches to 0, very dark brown, decomposing organic material; black near surface where the soil has been burned.
0 to 5 inches, very dark brown silt loam; dark yellowish-brown mottles and patches of black; weak, fine, blocky structure; friable.
5 to 14 inches, olive-brown silt loam; very dark grayish-brown streaks; weak blocky structure; friable.
14 to 19 inches, olive-gray coarse silt loam; faint olive-brown mottles; massive; friable.
19 to 22 inches, olive-gray loamy sand; loose.
22 to 30 inches +, layered olive-gray fine silt loam and olive-gray sandy loam; faint olive-brown mottles; the silt loam is massive and firm; the sandy loam is massive and friable.

These soils are moderately acid to slightly acid. There is much variation in the thickness of the layers in the underlying material.

Pincher silt loam (0 to 3 percent slopes) (Pe).—The boundary between Pincher silt loam and the surrounding well-drained soils is ordinarily indistinct. Near these boundaries, small areas of Tustumena silt loam or Naptowne silt loam are included. (Management group 4)

Salamatof series

The Salamatof series consists of very poorly drained peat soils. They are the most extensive organic soils in the Kenai-Kasilof Area. They are the principal soils of the large muskegs (fig. 3) and occur in many smaller depressions in all parts of the Area.

Ordinarily, the Salamatof soils support a woody vegetation that consists of bog birch, dwarf willows, Labrador-tea, and other shrubs, among which there are grasses, sedges, and horsetails. Many areas, however, are covered by a forest of small black spruce. A mat of living sphagnum moss covers the surface of these soils.

The water table is always at or near the surface of the peat, although the surface is fairly firm in most places. Open areas of water (fig. 4), probably remnants of shallow lakes that have been mostly filled in by the peat, are common, especially in the larger muskegs.

Typical profile (fig. 5) of Salamatof peat:

0 to 6 inches, dark reddish-brown (pink when dry) moss; many roots of woody shrubs.
6 to 9 inches, dark reddish-brown mat of moss peat and roots.
9 to 48 inches +, dark reddish-brown (brown when dry) moss peat mixed with fibrous peat.

Figure 3.—**Salamatof peat in a large muskeg. Note scattering of black spruce near edge of muskeg and the white spruce and paper birch on the surrounding uplands.**

In some areas woody particles are buried in the peat, especially where the peat is forested. The peat is from 30 inches to many feet thick. Layers of fibrous peat or of more finely divided peat occur in the profile in some areas. The peat is very strongly acid near the surface, but it is less acid at a greater depth.

Salamatof peat (level) (Sa).—Most areas of this soil are either not forested or have only a few isolated clumps of black spruce. Patches of the more shallow Doroshin peat are included near the edges of some muskegs. Some patches of the more finely divided Starichkof peat are included, especially in the southern part of the Kenai-Kasilof Area. Salamatof peat cannot be drained successfully. Its only agricultural value lies in its being used for limited grazing. (Management group 19)

Salamatof peat, forested (level) (Sb).—This soil supports a forest of scrubby black spruce, among which there are some birches and willows. Ordinarily, the trees are very thin and seldom more than 20 feet high. As a rule, there are more woody particles in this forested peat than in the Salamatof peat covered by the low scrubby vegetation. This forested soil has no agricultural value. (Management group 22)

Sea cliff

Sea cliff (land type) (Sc).—There are steep sea cliffs almost everywhere along the coastline of the Kenai-Kasilof Area; they are interrupted only at the mouths of

Figure 4.—**Shallow pond in center is common feature of most muskegs. Grassy cover is bordered by a stand of black spruce.**

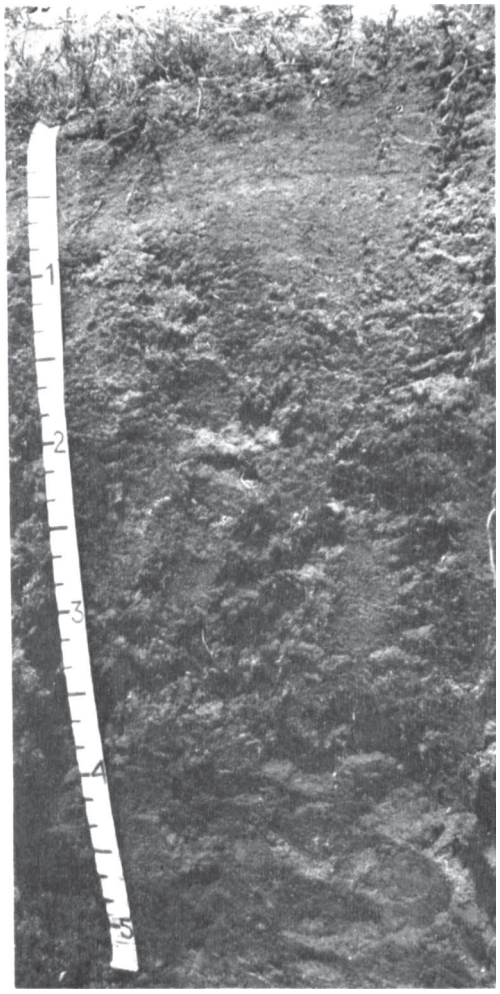

Figure 5.—**Profile of Salamatof peat exposed by erosion of sea cliff along Cook Inlet.**

the major streams. The cliffs range from only 20 feet or so to more than 100 feet above the beach; their average height is about 50 feet. The uplands behind them are hilly to nearly level. Ordinarily, clayey, silty, and sandy sediments are exposed in the lower part of the sea cliffs, and glacial till or outwash gravel makes up the upper part. In some places the sea cliffs have cut back into the organic soils of the muskegs. Coal seams are common in the sediments, especially in the southern part of the Area.

Ordinarily, this land type supports a sparse growth of shrubs and trees, mostly alder and willows. Many areas, however, are almost entirely bare. This land type cannot be used for crops or for grazing. (Management group 23)

Slikok series

The Slikok series consists of very poorly drained soils on flood plains, along minor drainageways, and on lowlands adjacent to lakes or muskegs. Although the total acreage of these soils is small, they occur in several parts of the Area, notably the flood plains of Slikok, Soldatna, and Beaver Creeks. The vegetation consists either of grass in large tussocks about 18 inches high or of forest in which black spruce and willows are dominant.

Typical profile of Clam Gulch silt loam:

2 inches to 0, dark reddish-brown mat of roots and decomposing organic material.
0 to 4 inches, black mucky silt loam; weak granular structure; nonsticky when wet.
4 to 9 inches, black mucky silt loam; weak, fine, blocky structure; nonsticky when wet.
9 to 24 inches, dark-brown silt loam; pockets of sand and angular stones; massive; nonsticky when wet.
24 to 36 inches +, dark greenish-gray gravelly fine silt loam; massive; slightly sticky when wet.

The water table is always high in these soils; it is ordinarily less than 24 inches below the surface. The upper part of these soils is strongly acid, but acidity decreases with depth.

Slikok mucky silt loam (level) (Sk).—Although its subsoil is not so heavy and firm, this soil is even more poorly drained than the Clam Gulch soils. Some patches of Clam Gulch soils are included. Similarly, small inclusions of Salamatof and Doroshin peats are fairly common. There are also some spots or strips of Moose River silt loam. All these inclusions, however, are small. (Management group 10)

Soldatna series

The Soldatna series consists of well-drained soils developed in a moderately deep to deep mantle of wind-laid, silty material over a thick deposit of gravelly sand or coarse sand. These soils are dominant in all the area north of Kenai and in several smaller areas elsewhere. They are most common on the broad outwash plains, but they also occupy the steeper land adjacent to these plains. The native vegetation is forest in which white spruce, birch, and aspen are dominant. Where the forest has been burned, thickets of alder are also present.

Typical profile of Soldatna silt loam:

4 inches to 0, dark reddish-brown mat of roots and decomposing organic material.
0 to 3 inches, gray silt loam faintly mottled with brown; weak, very fine, blocky structure; friable; fingers of this material project into the layer below.
3 to 6 inches, dark reddish-brown silt loam; patches of brown; weak blocky structure; friable.
6 to 10 inches, brown silt loam; pockets of grayish brown; weak blocky structure; friable.
10 to 18 inches, olive-brown silt loam; very weak blocky structure; friable.
18 to 25 inches, olive silt loam mottled with olive brown; streaks of yellowish brown; massive; friable.
25 to 42 inches, olive gravelly sand; lenses of silt loam; the gravelly sand is loose, but the silty lenses have a weak platy structure; this layer is not present in all places.
42 to 50 inches +, olive gravelly sand; loose.

In some places, especially near the drainageways through the outwash plains, the underlying material is coarse sand rather than gravelly sand. The depth to this material ranges from 15 inches to more than 40 inches, but a depth of 18 inches to 24 inches is most common. These soils are very strongly acid near the surface but only moderately acid in lower layers.

On the outwash plains, Soldatna soils are associated with the deep, moderately well drained Longmare soils. Along the lower course of the Kenai River, the boundary between the Soldatna and Tustumena soils is not distinct, although Soldatna soils generally occur north and east of the river, and Tustumena soils, south and west of it. Near the borders of muskegs, Soldatna soils grade to Kalifon-

sky soils. On steeper land, Soldatna soils are associated with the shallower, well-drained Nikishka soils.

Soldatna silt loam, nearly level (0 to 3 percent slopes) (SlA).—This soil constitutes about two-thirds of the total area of Soldatna soils. The largest single area is north of Kenai (fig. 6), on a broad plain that covers more than 20 square miles. Another large area lies northeast of the Kenai River at Soldatna. Many lakes and muskegs, most of them surrounded by short, steep slopes, interrupt these plains. In the northern part of the Area, there are some inclusions of Island soils that occur in a few small, bowl-like depressions. Also included are small areas of Longmare soils, especially near the coast, and of Kalifonsky soils near lakes and muskegs. Near the edges of the escarpments bordering depressions and on the terraces of the Kenai River near Soldatna, areas of Nikishka soils are included. In the main, however, there is little variation in this soil throughout the plains. (Management group 2)

Soldatna silt loam, gently sloping (3 to 7 percent slopes) (SlB).—This soil makes up a substantial part of the total area of the Soldatna soils. It occurs mostly at the edges of the broad, nearly level plains north of Kenai or on gentle rises within these plains. There are also some small strips along the lakes or muskegs in the plains. The inclusions of other soils in this mapping unit are much the same as those in the nearly level phase, except that there are fewer patches of Longmare silt loam. (Management group 1)

Soldatna silt loam, moderately sloping (7 to 12 percent slopes) (SlC).—This soil is less extensive than the gently sloping phase. It occupies essentially the same positions as Soldatna silt loam, gently sloping, but inclusions of small areas of Nikishka silt loam are a little more common. There are almost no inclusions of Longmare or Kalifonsky soils. (Management group 3)

Soldatna-Nikishka association

This complex association of Soldatna soils and Nikishka soils occurs on rolling to steep hills, mostly in the northern part of the Kenai-Kasilof Area. Soldatna soils, which are more extensive, occur principally in the lower and more gently sloping areas. Nikishka soils, which are more shallow, occupy the steeper areas and the tops of knolls and ridges. Included in this association are patches of Naptowne soils and Kenai soils, each of which makes up about 5 percent of the total area of the association. Small spots of Bernice sandy loam and of Salamatof and Doroshin peats are also included. Each of these soils is described individually elsewhere in this section. All these soils, except the peats, are covered by forests of white spruce, birch, and aspen.

***Figure 6.*—Soldatna silt loam, nearly level, along a gravel-surfaced road northeast of Kenai. Bordering forest is mainly white spruce in a stand about 100 years old.**

Soldatna-Nikishka association, rolling (complex 7 to 12 percent slopes) (SnC).—This mapping unit constitutes a relatively small part of the Soldatna-Nikishka association. The proportion of Nikishka soils is lower in these rolling areas than on the steeper hills. (Management group 7)

Soldatna-Nikishka association, hilly (complex 12 to 20 percent slopes) (SnD).—More than half of the total area of the Soldatna-Nikishka association is in this hilly phase. The proportion of Nikishka soils is somewhat higher than in Soldatna-Nikishka association, rolling. (Management group 15)

Soldatna-Nikishka association, moderately steep (20 to 30 percent slopes) (SnE).—For the most part, the soils in this mapping unit occur in rough, choppy topography where many short, irregular slopes are separated by steep ridges or knolls. There are more inclusions of Nikishka and Bernice soils and the proportion of Kenai and Naptowne soils is larger in this mapping unit than in the rolling or hilly phases. (Management group 15)

Soldatna-Nikishka association, steep (30 to 45 percent slopes) (SnF).—This phase constitutes only a very small part of the association. It is much like Soldatna-Nikishka association, moderately steep, but the soils are more steeply sloping. (Management group 17)

Starichkof series

The Starichkof series consists of deep, finely divided peats. These peat soils occur in large muskegs, principally in the southern part of the Kenai-Kasilof Area. They are much less extensive than the Salamatof soils. In most places, the Starichkof soils are wet throughout and support a thick cover of bog birch, dwarf willows, Laborador-tea, and other shrubs. Sphagnum moss completely covers the ground. Along some escarpments above the Kasilof River, however, the soils are not so wet and are covered by tall grass or a dense forest of black spruce.

Typical profile of Starichkof peat:

2 inches to 0, dark reddish-brown living moss.
0 to 3 inches, black, coarse moss peat.
3 to 8 inches, dark reddish-brown, coarse moss peat.
8 to 36 inches, dark reddish-brown, finely divided peat; a few thin lenses of dark-brown silt loam.

The layers of coarse moss peat vary a good deal in thickness. In some places they occur near the surface, in other places, deeper in the profile.

Starichkof peat (level) (Sr).—All but a very small part of Starichkof peat is covered by low, brushy plants or by grass. There are a few isolated trees and small clumps of black spruce in some places, however, usually near the perimeters of the muskegs. In many places Starichkof

peat grades to Salamatof peat within the same muskeg, and there are pockets of the coarser Salamatof peat in the Starichkof area. North of the Kasilof River, Starichkof peat grades to Nikolai silty peat, which occurs in strips along the coast. Some patches of the laminated Nikolai silty peat are included in this mapping unit. (Management group 19)

Starichkof peat, forested (level) (St).—This phase of Starichkof peat is covered by a dense forest of thin black spruce. Only a few trees are more than 20 feet high. Starichkof peat, forested, occurs mostly on benches above the Kasilof River. It is a little drier than Starichkof peat, but it is still too wet for any agricultural use. (Management group 22)

Tidal flats

Tidal flats (Ta).—These are fairly large areas at the mouths of the Kenai and Kasilof Rivers that are inundated every day at high tide. They consist chiefly of layers of clayey and sandy material, and they support no vegetation. Tidal flats border on areas of Tidal marsh, from which they are ordinarily separated by a low escarpment. They have no potential value either for crops or for grazing. (Management group 23)

Tidal marsh

Tidal marsh (level) (Tm).—This land type consists of fine-textured materials deposited by tidal waters on low, poorly drained flats near the mouths of the major rivers. Most areas are subject to fresh-water overflow from streams as well as to occasional tidal inundation. Layers of peat and, in some places, layers of sand occur at any depth in the fine-textured material. The water table is almost always within a few inches of the surface. Because the ground water has a high content of minerals, this land type differs from the soils in the Area in that it is nearly neutral in reaction rather than acid.

On the seaward side, Tidal marsh adjoins Tidal flats, which are inundated every day and have no plant cover. Inland, at slightly higher altitudes along the lower courses of the Kenai and Kasilof Rivers, Tidal marsh grades to Clunie peat, which has a fairly thick mat of moss peat over tidal deposits.

Tidal marsh supports a cover of sedges, horsetail, beach ryegrass, and other plants of the coastal meadows. In many places there is also a thin mat of moss on the surface. The native vegetation makes good pasture. In a few higher areas, it can be cut for hay or silage. Most areas of Tidal marsh are too wet for any other crop. (Management group 20)

Torpedo Lake series

The Torpedo Lake series consists of poorly drained soils of depressions and secondary drainageways. Tussocks of bluejoint as much as 3 feet high and 5 to 6 feet across cover most areas, and there are scattered clumps of black spruce. Between the tussocks, in many places, there are circular pits as much as 2 feet in diameter. These pits are filled with large, angular stones. There are fewer stones in the soils adjacent to these pits. Torpedo Lake soils are strongly acid throughout.

Typical profile of Torpedo Lake silt loam:

4 inches to 0, very dark brown mat of roots and decomposing organic material.
0 to 7 inches, dark reddish-brown silt loam streaked with black; weak platy structure; nonsticky when wet.
7 to 15 inches, very dark grayish-brown and dark reddish-brown stony silt loam; weak blocky structure; nonsticky when wet.
15 to 26 inches, dark greenish-gray silt loam; moderate platy structure; nonsticky.
26 to 36 inches +, greenish-gray clay loam mottled with pale olive; layer contains angular pebbles; massive; firm; becomes firmer and stonier with depth.

Torpedo Lake silt loam (level) (To).—This soil occurs in only a few places in the Kenai-Kasilof Area, mostly in the eastern part where it is associated with the Naptowne soils. Some small wet spots are included. (Management group 10)

Tustumena series

The Tustumena series consists of well-drained soils developed in a moderately deep deposit of wind-laid silty material underlain by water-worked sand and gravel or, in places, by coarse sand. The boundary between the silty material and the underlying sand and gravel is abrupt.

Tustumena soils occupy broad terraces along the Kenai and Kasilof Rivers. For the most part, they support a sparse, young forest of aspen and white spruce, among which there are a few scattered birches. Most areas of these soils have been burned over in the past, and there are many stumps of trees on the ground. These stumps, together with the grassy tussocks and the many low shrubs, make for an uneven surface (fig. 7) much like that of some of the imperfectly and poorly drained soils.

Typical profile of Tustumena silt loam:

2 inches to 0, black mat of roots and decomposing organic material.
0 to 2 inches, very dark brown silt loam; weak, very fine, blocky structure; friable.

Figure 7.—**Hummocky surface of forest floor on a wide terrace near the mouth of the Kasilof River. Some old stumps are about 3 feet high. Soil is a Tustumena silt loam.**

2 to 12 inches, brown silt loam; patches of dark brown; faint mottles of olive brown; streaks of yellowish brown; weak blocky structure; friable.
12 to 16 inches, olive silt loam; weak platy structure; friable.
16 to 30 inches +, water-laid gravelly sand; loose.

A thin gray layer occurs immediately beneath the surface mat in some places. The surface layer is strongly acid, but lower layers are only moderately acid. The depth to the coarse underlying material ranges from 15 inches to 24 inches. In some places this material is coarse sand rather than gravelly sand.

The Tustumena soils occur on terraces at slightly lower altitudes than those on which the Soldatna soils occur. The Tustumena soils resemble the Soldatna soils in many respects, but they are not so highly developed. Near Soldatna, the boundary between the Tustumena soils and the Soldatna soils is gradual. In the area south and west of the Kenai River, the Tustumena soils are dominant but inclusions of the Soldatna soils are fairly common. Near the coast the Tustumena soils are bordered by broad areas of muskeg.

Tustumena silt loam, nearly level (0 to 3 percent slopes) (TuA).—This nearly level soil constitutes more than 80 percent of the total acreage of Tustumena soils in the Area. It occurs on the wide terrace plains along the Kenai River near Sterling and Soldatna and along the Kasilof River below Moosehead Rapids. Ordinarily, there are strips of Kasilof soils on the slightly lower terraces that lie between these plains and the rivers. Near the borders of muskegs, patches of Kalifonsky soils are included. Other inclusions are small areas of Pincher soils that occur in swales on the plains. For the most part, however, this soil is nearly uniform; it varies only slightly in the thickness of the silty mantle above the coarse underlying material. (Management group 2)

Tustumena silt loam, gently sloping (3 to 7 percent slopes) (TuB).—There are many small areas of this gently sloping soil throughout the Tustumena soil area, but the total acreage is relatively small. There are fewer inclusions of other soils than in Tustumena silt loam, nearly level. (Management group 1)

Tustumena silt loam, moderately sloping (7 to 12 percent slopes) (TuC).—The few small areas of this soil occur mostly in long, narrow strips bordering on broad areas of gently sloping and nearly level Tustumena soils. There are very few inclusions of other soils. (Management group 3)

Use and Management of the Soils

In this section the principal problems in using the soils of the Kenai-Kasilof Area are outlined. Methods of land clearing, the fertilizer requirements, and the suitable crops are discussed briefly. The capability classification system, in which soils are grouped according to the characteristics that determine their uses and limitations, is explained. Each of the 23 management groups in the Area is described, and the best use and the principal management requirements for each group are outlined.

Land Clearing

Land can be cleared at any time of the year after the merchantable timber is harvested. When the soil is frozen, the top growth can be sheared off by a bulldozer and piled in windrows without disturbing the soil. Later in spring or in summer, the stumps and large roots can be moved to the windrows either by a scarifier blade (fig. 8) fitted to the bulldozer or by a heavy breaking plow. The windrows are usually burned when they are dry. When the soil is not frozen, a scarifier blade can be used for the entire clearing operation. By using this kind of blade, it is possible to remove the top growth and the large roots in one operation with little loss of organic matter from the soil.

In the undisturbed soils of the uplands, the organic material is usually concentrated in a mat, 2 to 4 inches thick, on the surface of the soil. In clearing the land of trees or brush, it is important that some of this material be allowed to remain on the ground. This organic matter mixed with the underlying mineral soil is effective in maintaining good tilth and in promoting the rapid infiltration of water.

After clearing, it is ordinarily necessary to break up the fine mat of roots by plowing with either a breaking plow or heavy disk plow and by harrowing several times. As a rule, the best first crop on newly cleared land consists of oats and peas for hay, silage, or, if desired, green manure.

Fertilizer Requirements

Most of the soils of the Kenai-Kasilof Area are not naturally fertile. The productivity of most of the well drained and moderately well drained soils for climatically suited crops can be brought to a relatively high level by proper fertilization. The amount of fertilizer required varies from field to field, depending in large part on the previous treatment of the soil. Newly cleared soils usually need fairly heavy applications of a complete fertilizer—one that contains nitrogen, phosphorus, and potassium. The need for nitrogen is especially high on newly cleared soils, because so much is used by bacteria in decomposing the native organic material. Under continued cultivation there is a tendency for the natural structure of the soil to break down; hence, periodic additions of manure or other organic matter help to

Figure 8.—Scarifier blade used in clearing land.

maintain tilth. Applications of lime would also be beneficial to these acid soils, but the present cost is prohibitive.

The requirements for fertilizer are about the same for the imperfectly drained and the poorly drained mineral soils as for the well-drained soils. Few of these soils are suitable for crops, however, without artificial drainage. The very poorly drained peat soils are unsuited to crops.

Suitable Crops

The final report (*2*) of the branch of the Alaska Agricultural Experiment Station at Kenai, which was made in 1908, noted that in this Area (1) hardy vegetables, such as potatoes, turnips, kale, and cabbage, and some berries grow well; (2) grain cannot be matured in most years; (3) cattle can be raised successfully but can be pastured only 5 months in the year; and (4) hay can be made from the native grasses and from oats.

Until recently little additional information concerning the yields of crops was available. It is now known that, with additions of fertilizer, acre yields of as much as 10 tons of potatoes (fig. 9), 2½ tons of bromegrass hay, 2 tons of oat-pea hay, and about 7 tons of grass or oat-pea silage have been obtained on the well-drained soils. A climatically adapted variety of red clover has been developed by the Alaska Agricultural Experiment Station, but a suitable variety of alfalfa is not yet available.

In addition to potatoes, the vegetables that have been grown successfully in the Area, and the acre yields obtained under good management, include cabbage, 8 tons; carrots, 5 tons; squash, 3 tons; lettuce, 7 tons; beets, 4 tons; cauliflower, 6 tons; broccoli, 4 tons. Onions, garden peas, radishes, and turnips are also grown. Other vegetables, especially the root and leafy vegetables, are probably also suitable. Tomatoes can be grown safely only in greenhouses. Corn is not suited to the Area.

Although small grains have not been grown successfully in the past, recent experiments indicate that it may be feasible to grow winter rye and winter wheat. It may be possible to grow barley in the more favorable interior part of the Area, but it is likely that it would need to be dried artificially in most years, as is done in the Matanuska Valley farther north.

Figure 9.—Potatoes growing on Kenai silt loam, near Soldatna.

Small fruits native to the Area include lingenberries, mooseberries (highbush cranberries), raspberries, currants, blueberries, and rose hips. Strawberries have been grown also, mostly in home gardens. With the exception of Siberian crabapple, fruit trees have not been grown successfully.

Capability Groups of Soils

The capability classification is a grouping that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on the 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 soils are grouped at three levels—the capability class, the subclass, and the 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 land forms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, grazing, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be as many as 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 interferes 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* indicates that the chief limitation is climate 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 susceptibility to erosion but have other limitations that limit their use largely to pasture, range, woodland, or wildlife habitats.

Within the subclasses are the capability units, which are equivalent to the management groups in this report. These are groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to be similar in productivity and other responses to management. Thus, the capability unit is a convenient grouping of soils that permits making many statements about their management. Capability units are generally identified by numbers assigned locally, for example, IIe–1 or IIIs–2.

In the subsection "Descriptions of the Management Groups" in this report, the capability class and subclass for each of the management groups is given in parentheses after the group number, and the groups in each subclass are numbered, for example, IIe–1. The capability class and subclass are tentative until further studies are made on the limitations of climate on cultivation in this Area.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their

permanent limitations, but without consideration of major and generally expensive land-forming that would change the slope, depth, or other characteristics of the soil, and without consideration of possible but unlikely major reclamation projects.

The eight classes in the capability system, the subclasses, and the management groups in the Kenai-Kasilof Area, are described in the list that follows.

Class I. Soils that have few limitations that restrict their use.
(No class I soils in the Kenai-Kasilof Area.)

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.
- Subclass IIe. Gently sloping soils that will erode if not protected.
  - Management group 1. Moderately deep, gently sloping, well-drained soils underlain by coarse material.
- Subclass IIc. Soils limited as to choice of crops only by climatic factors, principally by low summer temperatures and a short growing season.
  - Management group 2. Moderately deep, nearly level, well-drained soils underlain by coarse material.

Class III. Soils that have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Subclass IIIe. Soils severely limited by the risk of erosion if they are cultivated and not protected.
  - Management group 3. Moderately deep, moderately sloping, well-drained soils underlain by coarse material.
- Subclass IIIw. Soils severely limited by excess water.
  - Management group 4. Moderately deep to deep, nearly level to gently sloping, imperfectly drained or moderately well drained soils.
- Subclass IIIs. Soils severely limited by a slowly permeable or excessively permeable substratum.
  - Management group 5. Shallow to moderately deep, nearly level to gently sloping, well-drained soils underlain by slowly permeable material.
  - Management group 6. Shallow, nearly level to gently sloping, well-drained soils underlain by coarse material.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.
- Subclass IVe. Soils very severely limited by risk of erosion if they are cultivated and not protected.
  - Management group 7. Moderately deep, rolling, well-drained soils.
  - Management group 8. Moderately deep, strongly sloping, well-drained soils.
- Subclass IVw. Soils very severely limited by excess water.
  - Management group 9. Moderately deep to deep, level to gently sloping, imperfectly drained soils.
  - Management group 10. Poorly drained mineral soils on flood plains and in upland depressions.
  - Management group 11. Poorly drained soils high in organic-matter content.
- Subclass IVs. Soils very severely limited by a slowly permeable or excessively permeable substratum.
  - Management group 12. Shallow to moderately deep, moderately sloping, well-drained soils underlain by slowly permeable material.
  - Management group 13. Shallow, moderately sloping to strongly sloping, well-drained soils underlain by coarse material.
  - Management group 14. Nearly level, excessively drained soils.

Class V. Soils that have little or no susceptibility to erosion but have other limitations that are impractical to remove without major reclamation and that limit their use largely to pasture, range, woodland, or wildlife food and cover.
(No class V soils in the Kenai-Kasilof Area.)

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture, range, woodland, or wildlife food and cover.
- Subclass VIe. Soils severely limited by risk of erosion if cover is not maintained.
  - Management group 15. Shallow to moderately deep, hilly to steep, well-drained soils
- Subclass VIs. Soils severely limited by shallowness and droughtiness.
  - Management group 16. Very shallow, nearly level to gently sloping, well-drained soils underlain by coarse material.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation and restrict their use largely to grazing, woodland, or wildlife habitats.
- Subclass VIIe. Soils very severely limited by risk of erosion if cover is not maintained.
  - Management group 17. Shallow to moderately deep, steep, well-drained soils.
- Subclass VIIw. Soils very severely limited by excess water.
  - Management group 18. Shallow, poorly drained soils over a gravelly substratum.
  - Management group 19. Peat soils in unforested muskegs.
  - Management group 20. Poorly drained land types on flood plains near the mouths of the principal streams.
- Subclass VIIs. Soils very severely limited by shallowness and droughtiness.
  - Management group 21. Rolling to hilly, excessively drained soils.

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 habitats, or esthetic purposes.
- Subclass VIIIw. Peat soils not suitable for grazing.
  - Management group 22. Peat soils of forested muskegs.
- Subclass VIIIs. Land types that have little capacity for the production of vegetation.
  - Management group 23. Areas that have no true soil.

Descriptions of the Management Groups

In the following pages each management group is described briefly; the soils in each group are listed, and some suggestions on management and on conservation practices are made. No specific recommendations are made for the kind and amount of fertilizer, the varieties of crops, or the rate of seeding. These change from time to time as new information is obtained and new crop varieties are developed. Up-to-date information and general recommendations can be obtained from publications of the Alaska Agricultural Experiment Station. Soil samples from individual fields can be mailed to the Experiment Station at Palmer for laboratory tests and specific fertilizer recommendations. For help in applying the generally recommended practices on a particular field or farm, consult your local extension agent and Soil Conservation Service technician.

Management group 1 (IIe–1)

Moderately deep, gently sloping, well-drained soils underlain by coarse material

Boulder Point very fine sandy loam, gently sloping.
Cohoe silt loam, gently sloping.
Island silt loam, gently sloping.
Naptowne silt loam, gently sloping.
Soldatna silt loam, gently sloping.
Tustumena silt loam, gently sloping.

These medium-textured soils are moderately permeable and have a fairly high water-holding capacity. They are low in all major plant nutrients, and the upper layers are strongly acid. As a rule, soil structure is only weakly developed. If adequately fertilized, these soils will produce good yields of all climatically adapted crops. It is important to improve and to maintain tilth by adding organic matter and by growing a grass crop in a regular rotation. Good tilth increases infiltration of water and thus reduces runoff and erosion. Although these gently sloping soils are subject to erosion, the hazard is not serious, chiefly because there are seldom any heavy showers in the Area and the snow does not melt rapidly in spring. Nevertheless, simple erosion control measures, such as contour cultivation, would be desirable to reduce even further the rate of erosion. In areas near the coast where strong winds are common, windbreaks or strips of grass are needed to protect cultivated fields against blowing.

Management group 2 (IIc–1)

Moderately deep, nearly level, well-drained soils underlain by coarse material

Cohoe silt loam, nearly level.
Island silt loam, nearly level.
Naptowne silt loam, nearly level.
Soldatna silt loam, nearly level.
Tustumena silt loam, nearly level.

These medium-textured soils are moderately permeable and have a fairly high water-holding capacity. They are low in all major nutrients, however, and the upper layers are strongly acid. Soil structure is only weakly developed. There is no danger of soil loss from water erosion on these nearly level soils, but soil blowing is a hazard near the coast where there are strong winds. Strips of forest 100 feet wide should be left at intervals of about one-eighth of a mile to protect the soils against this hazard.

Management group 3 (IIIe–1)

Moderately deep, moderately sloping, well-drained soils underlain by coarse material

Cohoe silt loam, moderately sloping.
Naptowne silt loam, moderately sloping.
Soldatna silt loam, moderately sloping.
Tustumena silt loam, moderately sloping.

Except for slope, these soils are essentially the same as those in management groups 1 and 2. If properly fertilized, any climatically suited crop can be grown successfully. Runoff during prolonged rains and in the snow-melting period in spring may result in some loss of soil in cultivated fields. Contour cultivation, which is necessary at all times, and other simple measures, such as stripcropping, will control erosion on these sloping soils. Terracing is not required. To maintain tilth and thus reduce runoff, grass crops should be a part of the regular rotation.

Management group 4 (IIIw–1)

Moderately deep to deep, nearly level to gently sloping, imperfectly drained or moderately well drained soils

Longmare silt loam, nearly level.
Longmare silt loam, gently sloping.
Pincher silt loam.

The physical characteristics of these soils are very similar to those of the nearly level soils in management group 2. Internal drainage however, is restricted by the slowly permeable layer in the substratum. These soils dry out later in spring than the associated well-drained soils. As a result, planting is delayed and the danger of frost damage to full-season crops, such as potatoes, at the end of the growing season is increased. These soils produce good crops of other vegetables and grasses. Fertilizer requirements are like those of the soils on the uplands. On the gently sloping soils of this unit, contour cultivation is needed to control erosion.

Management group 5 (IIIs–1)

Shallow to moderately deep, nearly level to gently sloping, well-drained soils underlain by slowly permeable material

Kenai silt loam, nearly level.
Kenai silt loam, gently sloping.

The upper part of these soils is similar to that of soils underlain by coarse material. With the proper fertilization and tillage, good yields of all the climatically suited crops can be obtained. Because of the relatively slow permeability of the underlying material, the soils are commonly wet later in spring than the other soils on the uplands. In midsummer, especially in years of low rainfall, crops may lack moisture. There is no serious hazard of erosion on the nearly level soil. Cultivated fields of the gently sloping soil will wash during the snow-melting period or during prolonged rains unless they are cultivated on the contour and stripcropped.

Management group 6 (IIIs–2)

Shallow, nearly level to gently sloping, well-drained soils underlain by coarse material

Nikishka silt loam, nearly level.
Nikishka silt loam, gently sloping.

Except for being more shallow, these soils are much like the soils in management groups 1 and 2, but they are commonly even more acid and have a smaller supply of most of the plant nutrients. If they are adequately fertilized, most climatically suited crops can be grown, but crops are more likely to be affected by droughtiness than crops grown on deeper soils. The underlying gravel is likely to interfere with the production of potatoes, but these soils are deep enough for most of the other vegetables and for grass crops. Contour cultivation is needed to control erosion on the gently sloping soil.

Management group 7 (IVe–1)

Moderately deep, rolling, well-drained soils

Boulder Point very fine sandy loam, rolling.
Cohoe-Kenai association, rolling.
Kenai silt loam, rolling.
Naptowne silt loam, rolling.
Soldatna-Nikishka association, rolling.

The physical properties of these soils are generally like those of the soils in management groups 1 and 2, but in some of these soils the underlying material is slowly permeable. Although the gradient is moderate, the slopes are short and uneven and there are many intervening ridges, knolls, swales, and undrained depressions. This irregular topography would interfere seriously with ordinary farming operations. It would be difficult, if not impossible, to apply the necessary erosion control measures, such as contour cultivation and stripcropping, in most of the cleared fields. It would be feasible, however, to plant gardens or to cultivate small fields on the uniformly sloping areas. These should be treated as those on the soils in management group 3. The more irregular rolling areas, if cleared, would be best suited to grass crops. If necessary, small plots could be cultivated occasionally, but it would not be desirable to do this regularly.

Management group 8 (IVe–2)

Moderately deep, strongly sloping, well-drained soils

Cohoe silt loam, strongly sloping.
Kenai silt loam, strongly sloping.
Naptowne silt loam, strongly sloping.

Except for slope, these soils are much like those in management groups 1 and 2. In some of the soils, however, the underlying material is slowly permeable. Although the rains in the Kenai-Kasilof Area are gentle, there would be a serious hazard of erosion if these strongly sloping soils were cleared and cultivated. The best crop would be grass. These soils probably could be cultivated occasionally without any appreciable loss of soil, but not more often than once in every 3 or 4 years. Even then, they should be cultivated on the contour, and strips of grass should be left at fairly close intervals.

Management group 9 (IVw–1)

Moderately deep to deep, level to gently sloping, imperfectly drained soils

Kalifonsky silt loam, nearly level.
Kalifonsky silt loam, gently sloping.
Killey sandy loam.

Where drainage is feasible, these soils are in capability class IV; elsewhere, in class VI (VIw–1). These soils generally occupy the transitional zone between muskegs or lakes and higher well-drained land. The upper layers are either silty or sandy. Permeability is moderate to rapid, and the water-holding capacity is medium to high. These soils are acid and low in all plant nutrients; hence, heavy fertilization would be required for all crops. The water table is high, especially early in summer, and the soils are ordinarily wet. They could support good permanent stands of grass, but because of their wetness, they will produce good yields of other crops only in years of unusually low rainfall. The gently sloping soil probably could be drained successfully, but it is doubtful if it would be dry early enough for potatoes to be harvested before the first killing frost. Most likely the benefits obtained from artificial drainage would not justify the expense involved.

Management group 10 (IVw–2)

Poorly drained mineral soils on flood plains and in upland depressions

Clam Gulch silt loam.
Coal Creek silt loam, nearly level.
Coal Creek silt loam, gently sloping.
Moose River silt loam.
Slikok mucky silt loam.
Torpedo Lake silt loam.

Where drainage is feasible, these soils are in capability class IV; elsewhere, in class VI (VIw–2). Most of these soils are fine textured, but Moose River silt loam is sandy and gravelly. The substratum in most of the soils is firm and slowly permeable. The water table is close to the surface, and the soils are almost always wet. Most areas could be drained only with difficulty. The soils that could be drained more easily probably would not dry out early enough to grow full-season crops, such as potatoes. The danger of frost damage to crops is considerably greater in these low-lying areas than on the uplands. If cropped, the soils would need to be fertilized as heavily as the well-drained soils of the uplands. These soils are mostly covered by forest or shrubs, but grass is generally plentiful on the forest floor. Large patches of open grassland are common. Cultivated crops could be produced only with artificial drainage, but many areas would make good native pasture. In years with less than normal rainfall, wild hay can be harvested in the open grassy areas.

Management group 11 (IVw–3)

Poorly drained soils high in organic-matter content

Corea silt loam.
Karluk silt loam.
Nikolai silty peat.

These soils occupy low-lying areas or strips bordering on muskegs, generally along the coast. They are covered

mostly by a dense growth of tall grasses and forbs, but there are some scattered clumps of forest. Although the soils are ordinarily wet, the water table is fairly low during much of the summer. Because of this, these soils are suitable for grass crops or for pasture. Artificial drainage would be necessary before any cultivated crops could be grown.

Management group 12 (IVs–1)

Shallow to moderately deep, moderately sloping, well-drained soils underlain by slowly permeable material

Kenai silt loam, moderately sloping.

Except for the slope, this soil is similar to those in management group 5. It is more likely to erode than the moderately sloping soils underlain by coarse material (management group 13). The slowly permeable substratum reduces the capacity of the soil to absorb moisture, and during prolonged rains much of the water runs off. If this soil is cleared, it should be under grass most of the time. If it is cultivated occasionally, strips of grass should be left at fairly close intervals.

Management group 13 (IVs–2)

Shallow, moderately sloping to strongly sloping, well-drained soils underlain by coarse material

Nikishka silt loam, moderately sloping.
Nikishka silt loam, strongly sloping.

These soils have many of the same physical characteristics as the soils in management groups 1 and 2, but they are more shallow and much more sloping. Except for steeper gradients, they are the same as those in management group 6. On these shallow soils even a small loss of soil material would be serious. Any cleared areas, therefore, should be in grass most of the time to protect against such losses. It is even more important than it is on the deeper soils that all cultivation be on the contour and that strips of grass be left at close intervals.

Management group 14 (IVs–3)

Nearly level, excessively drained soils

Anchorage very fine sandy loam, nearly level.

This sandy soil is strongly acid and infertile. Its water-holding capacity is low. It is droughty and would require very heavy applications of fertilizer for adequate production of cultivated crops. Once the protective forest cover is removed, the soil drifts or blows readily. If cleared, it should be kept in grass almost all the time.

Management group 15 (VIe–1)

Shallow to moderately deep, hilly to steep, well-drained soils

Boulder Point very fine sandy loam, hilly to steep.
Cohoe-Kenai association, hilly.
Cohoe-Kenai association, moderately steep.
Kenai silt loam, hilly.
Kenai silt loam, moderately steep.
Naptowne silt loam, hilly.
Naptowne silt loam, moderately steep.
Nikishka silt loam, moderately steep.
Soldatna-Nikishka association, hilly.
Soldatna-Nikishka association, moderately steep.

The physical properties of these soils are like those of the soils in management groups 1 and 2. Some of the soils (Kenai soils and the Kenai member of the Cohoe-Kenai association), however, are underlain by slowly permeable material. The topography is mostly very irregular; short smooth slopes are interspersed with ridges, knolls, swales, and undrained depressions. Other areas consist of isolated ridges and the short steep slopes of escarpments. None of these soils is suited to any intensive cultivation because of the difficulty in carrying out ordinary farming operations and the severe hazard of erosion. If cleared, these soils would be suitable for grass crops or for pasture. In general, however, it would be best for them to remain in forest.

Management group 16 (VIs–1)

Very shallow, nearly level to gently sloping, well-drained soils underlain by coarse material

Kasilof silt loam, nearly level.
Kasilof silt loam, gently sloping.

Although the upper part of these soils is medium textured, they would be droughty in midsummer if they were cleared. Plowing is not feasible because of the gravelly substratum. The soils are too shallow for deep-rooted crops, but, if adequately fertilized and watered, they could produce some garden vegetables. There is little hazard of erosion, but the gently sloping soil should always be cultivated on the contour. Apart from forest, the best use for these soils is grass crops or pasture.

Management group 17 (VIIe–1)

Shallow to moderately deep, steep, well-drained soils

Cohoe-Kenai association, steep.
Kenai silt loam, steep.
Naptowne silt loam, steep.
Nikishka silt loam, steep.
Soldatna-Nikishka association, steep.

The physical properties of these soils generally are like those of the soils in management groups 1 and 2. The removal of the natural vegetation from these sloping soils would result in a severe hazard of erosion. Although they could be used for permanent pasture if they were cleared, these soils are best left in forest.

Management group 18 (VIIw–1)

Shallow, poorly drained soils over a gravelly substratum

Foreland silt loam.
Moose River silt loam, shallow.

These soils occur on low-lying, narrow flood plains and terraces along the major streams, and they are always wet. Artificial drainage would not be feasible, because the soils are so shallow. These soils are not suitable for cultivated crops of any kind. They have little capacity for use as pasture, but some isolated patches of native grass may be grazed.

Management group 19 (VIIw–2)

Peat soils in unforested muskegs

Clunie peat.
Doroshin peat.
Salamatof peat.
Starichkof peat.

These soils are waterlogged at all times. As a rule, drainage is not feasible because of their position in depressions. Even in the few isolated spots where artificial drainage is possible, it is unlikely that satisfactory crops could be produced. The peat is ordinarily strongly acid and very infertile, and it would require much heavier applications of fertilizer than the nearby soils of the uplands. Limited grazing of the sedges and grasses growing naturally in the muskegs is possible, but the total yield of forage suitable for farm animals is usually quite low.

Management group 20 (VIIw–3)

Poorly drained land types on flood plains near the mouths of the principal streams

Tidal marsh.

The water table is close to the surface, and this land type is always wet. It is subject both to stream overflow and to tidal inundation. Because of its position, it cannot be drained artificially. The native vegetation consists of sedges, grasses, and other plants that can be used for grazing and for wild hay.

Management group 21 (VIIs–1)

Rolling to hilly, excessively drained soils

Anchorage very fine sandy loam, rolling.
Bernice sandy loam, strongly sloping to steep.

These sandy and gravelly soils are too shallow and droughty to be suitable for cultivated crops. If cleared, they would be subject to severe wind erosion. It would be difficult to maintain a satisfactory cover of grass on these soils because they are so infertile. They are best left in native forest.

Management group 22 (VIIIw–1)

Peat soils of forested muskegs

Salamatof peat, forested.
Starichkof peat, forested.

These soils are as wet as the peat soils in management group 19. They are not suitable for even limited grazing. They are best used as wildlife habitats.

Management group 23 (VIIIs–1)

Areas that have no true soil

Gravelly beach (land type).
Sea cliff (land type).
Tidal flats.

Except for shrubs on the sea cliffs, these land types support little vegetation. They have no agricultural use.

Engineering Applications

The information in this section, together with the soil map and the descriptions of soils given elsewhere in this report, can be used to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Estimate soil properties that are significant in planning work 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 is important to recognize that the information in this report is somewhat generalized; it will not eliminate the need for detailed tests and surveys at the actual site of proposed construction.

Some of the terms used in this report have one meaning in agricultural soil science and another meaning in soil mechanics. Some of these terms and their current meaning in soil science in the United States are given in the following paragraphs.

Soil.—The natural medium for the growth of land plants, composed of organic or mineral materials, or both. Deep, unconsolidated material not affected by soil-forming processes other than mechanical weathering, and below the reach of plant roots, is not normally considered soil.

Texture.—The relative proportions of mineral particles of different size classes—clay, silt, sand, and gravel—in the soil mass. Coarse-textured (or coarse-grained) soils have a relatively high proportion of sand; fine-grained soils are high in clay.

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

Sand.—(1) Individual mineral soil particles ranging in diameter from 2.0 millimeters (No. 10 sieve) to 0.05 millimeter. (2) A textural class that includes soil material that is 85 percent or more sand and in which the percentage of silt plus 1½ 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.

Silt.—(1) Individual mineral soil particles 0.05 millimeter to 0.002 millimeter in diameter. (2) A textural class that includes soil material that is 80 percent or more silt and less than 12 percent clay.

Clay.—(1) Individual mineral soil particles 0.002 millimeter or less in diameter. (2) A textural class that includes soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Loam.—A textural class that includes soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. The word "loam" is also used as part of other textural class names; for example, silt loam,

a class name that indicates textural properties between those of a loam and those of a soil of the silt class.

Definitions of other terms, including definitions of other textural classes, are given in the Soil Survey Manual (*10*).

Engineering Classification Systems

Most engineers classify soil materials in accordance with 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, consisting of gravelly soils of high bearing capacity, to A-7, consisting of clay soils having low strength when wet. Within each of the principal groups, the relative engineering value of the soil materials may be indicated by group index numbers. These numbers range from 0 for the best materials to 20 for the poorest. The group index number for a given soil is shown in parentheses following the soil group symbol.

Some engineers prefer to use the Unified soil classification system (*11*). In this system, soil materials are identified as coarse grained (8 classes), fine grained (6 classes), or highly organic.

Both classification systems are explained in the PCA Soil Primer (*8*).

Engineering Test Data

Samples from three profiles each of six of the most extensive soils in the Kenai-Kasilof Area were tested according to standard soil mechanics laboratory procedures (*1*). The samples were chosen to represent the range in physical properties in the soils of each series. As a rule, the modal, or typical, soil of each series is represented by only one of the profiles sampled. The other two, though within the range permitted in the series, differ from the modal profile in texture, consistence, or some other property significant in engineering.

The test data for these soil samples are presented in table 4. The last two columns of the table give the engineering classification of each of the samples tested, according to the AASHO system and according to the Unified system.

Estimated Physical Properties of the Soils

Table 5 gives brief descriptions of all the soils and land types in the Kenai-Kasilof Area, estimates of some of the physical properties significant in engineering, and the probable classification of each soil, according to the AASHO system and according to the Unified system.

Engineering Interpretations of the Soils

Specific characteristics of soils that may affect engineering practices and estimates of the suitability of soils for various uses are given in table 6.

A major problem in engineering in the Kenai-Kasilof Area is frost action. Although no precise correlation has been established, it is believed that in this Area only soils containing less than 6 percent of material fine enough to pass through the No. 200 sieve (0.074 millimeter) are not susceptible to frost heaving. Because of the difficulty of maintaining the proper moisture content for compaction when soils are frozen, it is not advisable to construct embankments and other earthworks in frost-susceptible material during winter.

Most of the uplands in the Kenai-Kasilof Area are covered with a mantle of loess, or wind-laid silty material. This mantle ranges in thickness from only a few inches in the Kasilof soils to more than 40 inches in some profiles of the Cohoe series, but it is most commonly between 10 and 24 inches thick. The loess is highly susceptible to frost action and is, in general, not good material for construction work. It is soft and slippery when wet and may not support repeated passes of heavy equipment; it is very dusty when dry.

Several different kinds of material underlie the loess in the well-drained soils of the uplands and high river terraces. In the Soldatna, Nikishka, Longmare, Tustumena, and Kasilof soils, the substratum is well-graded gravel or, in a few places, uniformly graded coarse sand. In the Naptowne soils, it is gravelly glacial till that is somewhat higher in silt and contains a few lenses or pockets of fine-grained material. In the Kenai soils, the substratum is compact and fine grained. In the Cohoe soils the loess is comparatively thick, and the substratum consists of layered fine-grained and coarse-grained sediments.

The highly permeable coarse material beneath the Soldatna, Tustumena, and associated soils is not susceptible to frost action. The deposits are many feet thick, and the water table is generally more than 6 feet below the surface. Gravel pits can be located almost anywhere in areas of these soils. All the gravel is rounded, and almost all is less than 3 inches in diameter.

The properties of the other principal soils of the uplands are less favorable for engineering. Frost heaving may be a greater problem in the Naptowne soils because of the lenses and pockets of fine-grained material in the substratum. There are, however, many suitable sites for gravel pits in areas of these soils. Pebbles less than 3 inches in diameter predominate, but cobblestones and boulders are not uncommon. The Kenai and Cohoe soils are more susceptible to frost action than the soils that have a gravelly substratum. Deposits of sand and gravel can be located within areas of these soils but are not common.

Most soils in upland depressions and on flood plains are wet throughout the summer and are highly susceptible to frost action in the spring. They can be traversed in summer only by vehicles designed to operate in wet areas. The Island soils are exceptions; they normally are not wet in summer and are less severely affected by frost heaving than other soils in depressions. Most of the low-lying soils have a fairly thick layer of peaty material on the surface. Several of them—the Kalifonsky and Killey soils in areas bordering lakes and muskegs, the Moose River soils on stream flood plains, and the inextensive Foreland soils in depressions on river terraces—have a sandy or gravelly substratum but, because the water table is usually high, are not satisfactory sources of sand and gravel.

TABLE 4.—*Engineering*

[Tests performed by the Bureau of Public Roads in accordance

Soil type and location of sample	Parent material	Bureau of Public Roads report number	Depth	Horizon	Moisture-density [1]		Percentage larger than 3 inches discarded in field sampling (estimate)
					Maximum dry density	Optimum moisture	
			Inches		*Pounds per cubic foot*	*Percent*	
Cohoe silt loam:							
SE¼NW¼ sec. 18, T. 1 N., R. 12 W. (modal profile).	Loess over layered sediments.	S 33097	0–1.5	A_2	70	37	
		S 33098	1.5–7	B_2	74	37	
		S 33099	16–30	C_1	100	17	
		S 33100	39–50+	D	131	10	
NW¼SE¼ sec. 12, T. 4 N., R. 11 W. (deep sandy subsoil).	Loess over layered sediments.	S 33101	0–2	A_2	67	42	
		S 33102	2–6	B_2	78	36	
		S 33103	10–19	C_1	101	19	
		S 33104	19–48	C_2	101	19	
SE¼NW¼ sec. 28, T. 2 N., R. 12 W. (shallower).	Loess over layered sediments.	S 33105	1.5–11	B_2	66	44	
		S 33106	11–22	B_3	87	28	
		S 33107	29–40+	D	118	14	
Kalifonsky silt loam:							
SW¼NE¼ sec. 22, T. 3 N., R. 12 W. (modal profile).	Loess over coarse-grained substratum.	S 33108	0–6	A_1	78	34	
		S 33109	6–20	C_1	85	28	
		S 33110	25–40+	D	121	11	
SW¼SW¼ sec. 28, T. 6 N., R. 11 W. (sandy substratum).	Loess over coarse-grained substratum.	S 33111	0–2	A_1	56	57	
		S 33112	2–11	C_1	86	29	
		S 33113	24–42+	D	102	15	
NE¼NE¼ sec. 10, T. 5 N., R. 11 W. (coarser textured).	Loess over coarse-grained substratum.	S 33114	0–7	C	51	61	
		S 33115	7–22	$C–D_1$	70	40	
		S 33116	22–36	D_2	125	12	
Kenai silt loam:							
NW¼SW¼, sec. 17, T. 5 N., R. 10 W. (modal profile).	Loess over compact till.	S 33117	2–5	B_2	76	35	
		S 33118	11–16	C_1	98	21	
		S 33119	22–36+	D	124	13	
SE¼ SW¼ sec. 1, T. 2 N., R. 12 W. (coarser textured).	Loess over compact till.	S 33120	0–3	A_2	58	52	
		S 33121	3–6	B_2	68	42	
		S 33122	10–15	C–D	113	15	
		S 33123	18–30+	D_2	119	14	
SW¼NE¼ sec. 28, T. 5 N., R. 10 W. (shallower).	Loess over compact till.	S 33124	0–2	A_2	62	47	
		S 33125	2–6	B_2	77	36	
		S 33126	9–24	D	118	13	
Naptowne silt loam:							
SE¼NE¼ sec. 13, T. 5 N., R. 8 W. (modal profile).	Loess over gravelly till.	S 33127	0–1.5	A_2	66	41	
		S 33128	1.5–5	B_2	79	33	
		S 33129	9–19	C	101	18	
		S 33130	19–30+	D	124	10	
SE¼SE¼ sec. 17, T. 5 N., R. 9 W. (coarser textured).	Loess over gravelly till.	S 33131	0–3	A_2	74	35	
		S 33132	3–9	B_2	79	34	
		S 33133	14–21	C	106	17	
		S 33134	21–33+	D	122	10	5
SW¼NE¼ sec. 19, T. 5 N., R. 9 W. (sandy textured).	Loess over gravelly till.	S 33135	0–2	A_2	66	41	
		S 33136	2–7	B_2	88	27	
		S 33137	12–17	C	106	17	
		S 33138	30–42+	D_2	123	12	
Soldatna silt loam:							
SW¼SE¼ sec. 35, T. 7 N., R. 12 W. (modal profile).	Loess over glacial outwash.	S 33139	0–3	A_2	63	45	
		S 33140	3–6	B_{21}	66	46	
		S 33141	18–25	C	105	18	
		S 33142	42–50+	D_2	133	8	
SW¼NE¼ sec. 33, T. 8 N., R. 11 W. (finer textured).	Loess over glacial outwash.	S 33143	0–2	A_2	70	38	
		S 33144	2–7	B_2	63	49	
		S 33145	12–18	C	98	21	
		S 33146	18–36	D	122	10	

See footnotes at end of table.

test data

with standard procedures of the AASHO]

Mechanical analysis [2]																Liquid limit [4]	Plasticity index [4]	Classification	
Percentage passing sieve [3]—											Percentage smaller than [3]—								
3-in.	2-in.	1½-in.	1-in.	¾-in.	⅜-in.	No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.250 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.			AASHO [5]	Unified [6]
							100	98	91	74	69	39	14	9	NP	NP	A-4(8)	ML.
							100	98	92	80	73	43	16	10	NP	NP	A-4(8)	ML.
								100	99	93	80	38	9	5	NP	NP	A-4(8)	ML.
	100	98	98	97	95	93	89	79	69	42	36	25	14	8	15	3	A-4(1)	SM.
							100	98	92	72	66	35	12	8	NP	NP	A-4(7)	ML.
							100	97	93	79	72	42	14	7	NP	NP	A-4(8)	ML.
								100	99	93	83	45	13	8	NP	NP	A-4(8)	ML.
							100	99	98	86	77	33	8	3	NP	NP	A-4(8)	ML.
							100	98	94	79	73	52	16	9	NP	NP	A-4(8)	ML.
							100	99	97	87	82	54	20	10	NP	NP	A-4(8)	ML.
		100	99	98	97	95	93	87	82	66	60	48	35	24	25	7	A-4(6)	ML-CL.
		100	99	98	94	92	90	87	79	52	48	32	14	8	NP	NP	A-4(3)	ML.
		100	99	99	98	98	97	94	88	67	60	38	14	7	NP	NP	A-4(6)	ML.
100	99	94	84	76	57	43	32	21	14	4	4	3	2	1	NP	NP	A-1-a(0)	GP.
							100	94	87	71	65	38	10	7	NP	NP	A-4(7)	ML.
							100	99	96	83	76	47	16	9	NP	NP	A-4(8)	ML.
				100	99	98	97	80	27	4	4	3	2	2	NP	NP	A-3(0)	SP.
		100	99	98	97	97	97	96	88	70	65	46	16	10	NP	NP	A-4(7)	ML.
	100	98	93	81	64	54	50	46	41	30	27	19	8	4	NP	NP	A-2-4(0)	GM.
	100	97	86	74	51	36	25	9	5	2	2	1	1	1	NP	NP	A-1-a(0)	GW.
							100	96	90	75	69	39	14	9	NP	NP	A-4(8)	ML.
							100	98	94	82	74	42	13	7	NP	NP	A-4(8)	ML.
				100	99	98	96	91	86	66	58	43	27	17	21	6	A-4(6)	ML-CL.
							100	93	81	63	59	42	15	9	NP	NP	A-4(6)	ML.
					100	99	98	93	85	64	58	38	17	8	NP	NP	A-4(6)	ML.
		100	98	97	95	93	91	86	81	57	52	38	24	13	21	2	A-4(4)	ML.
							100	99	98	65	61	52	41	30	25	8	A-4(6)	CL.
							100	97	90	67	62	39	11	6	NP	NP	A-4(6)	ML.
							100	93	88	70	64	39	16	8	NP	NP	A-4(7)	ML.
		100	99	99	99	99	99	98	96	85	78	58	36	24	25	7	A-4(8)	ML-CL.
							100	97	92	75	70	40	14	7	NP	NP	A-4(8)	ML.
				100	99	98	97	94	89	71	66	38	15	8	NP	NP	A-4(7)	ML.
100	96	93	90	89	87	86	85	83	82	78	75	42	9	5	NP	NP	A-4(8)	ML.
100	96	94	87	83	74	66	58	50	45	31	27	17	8	5	NP	NP	A-2-4(0)	SM.
							100	97	91	74	68	43	14	9	NP	NP	A-4(8)	ML.
							100	98	91	71	64	41	15	7	NP	NP	A-4(7)	ML.
							100	98	95	85	79	44	12	6	NP	NP	A-4(8)	ML.
	95	91	89	87	78	70	62	56	48	21	14	8	5	4	NP	NP	A-2-4(0)	SM.
							100	96	88	69	63	35	12	8	NP	NP	A-4(7)	ML.
							100	96	89	64	57	34	14	9	NP	NP	A-4(6)	ML.
							100	98	91	73	65	36	12	5	NP	NP	A-4(8)	ML.
					100	99	97	93	85	68	64	52	33	21	21	6	A-4(7)	ML-CL.
							100	99	91	73	69	50	18	10	NP	NP	A-4(8)	ML.
							100	97	93	75	70	48	19	11	NP	NP	A-4(8)	ML.
	100	99	99	98	94	88	84	80	76	70	65	34	10	5	NP	NP	A-4(7)	ML.
	100	99	96	90	68	39	25	17	11	6	6	4	2	1	NP	NP	A-1-a(0)	GP-GM.
							100	96	86	66	59	38	18	7	NP	NP	A-4(6)	ML.
				100	99	99	99	95	89	62	56	39	11	8	NP	NP	A-4(5)	ML.
				100	99	97	95	92	89	79	73	48	18	11	31	3	A-4(8)	ML.
100	98	96	93	90	85	79	73	66	61	47	39	21	10	4	NP	NP	A-4(2)	SM.

TABLE 4.—*Engineering*

[Tests performed by the Bureau of Public Roads in accordance

Soil type and location of sample	Parent material	Bureau of Public Roads report number	Depth	Horizon	Moisture-density [1]		Percentage larger than 3 inches discarded in field sampling (estimate)
					Maximum dry density	Optimum moisture	
			Inches		*Pounds per cubic foot*	*Percent*	
SW¼NW¼ sec. 8, T. 5 N., R. 10 W. (sandy substratum).	Loess over glacial outwash.	S 33147	0–3	A_2	63	46	
		S 33148	3–7	B_2	76	37	
		S 33149	12–23	C	105	17	
		S 33150	40–56+	D_2	102	18	
Tustumena silt loam:							
NE¼NW¼ sec. 11, T. 3 N., R. 12 W. (modal profile).	Loess over terrace deposits.	S 33151	0–2	A_1	55	59	
		S 33152	2–12	B	78	34	
		S 33153	16–30+	D	125	10	
NW¼NW¼ sec. 6, T. 2 N., R. 11 W. (finer textured).	Loess over terrace deposits.	S 33154	0–3	A_1	65	42	
		S 33155	8–15	B_{22}	94	24	
		S 33156	32–40+	D_2	120	11	15
NE¼NW¼ sec. 22, T. 5 N., R. 9 W. (sandy substratum).	Loess over terrace deposits.	S 33157	0–2	A_1	54	59	
		S 33158	2–8	B	79	32	
		S 33159	8–23	C	104	17	
		S 33160	23–36+	D	111	17	

[1] Based on AASHO Designation: T 99–57, Method A, Standard Method of Test for the Compaction and Density of Soils (*1*).

[2] Mechanical analyses according to AASHO Designation: T 88–54, Standard Methods of Mechanical Analysis of Soils (*1*). Results by this procedure frequently differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO 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 that coarser than 2 mm. in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 mm. in diameter is ex-

TABLE 5.—*Brief description of soils*

Map symbol	Soil	Depth to seasonally high water table	Brief description of soil and site	Depth from surface (typical profile)	Classification
					USDA textural class
				Inches	
AnA	Anchorage very fine sandy loam, nearly level.	Deep	Stabilized dunes and beach ridges	0 to 5	Silt loam and very fine sandy loam.
AnC	Anchorage very fine sandy loam, rolling.			5 to 30+	Fine sand
BeE	Bernice sandy loam, strongly sloping to steep.	Deep	Gravelly soils on short, steep escarpments bordering streams, lakes, and muskegs.	0 to 7	Sandy loam and loamy sand.
				7 to 24+	Gravelly sand
BoB	Boulder Point very fine sandy loam, gently sloping.	Deep	Recently deposited fine sandy and silty materials over stony, silty, or sandy glacial till.	0 to 6	Very fine sandy loam.
BoC	Boulder Point very fine sandy loam, rolling.			6 to 31	Silt loam
BoE	Boulder Point very fine sandy loam, hilly to steep.			31 to 40+	Stony silt loam
Ca	Clam Gulch silt loam	Less than 1 foot.	Fine-grained alluvium on flood plains of secondary streams.	0 to 12	Silt loam
				12 to 24+	Silt loam
Ce	Clunie peat	0	Coarse peat over tidal deposits	0 to 25	Peat
				25 to 36+	Silty clay loam
CkA	Coal Creek silt loam, nearly level	2 feet	Silty colluvium in upland depressions, over a firm, pebbly substratum.	0 to 27	Silt loam
CkB	Coal Creek silt loam, gently sloping.			27 to 40+	Silt loam

See footnotes at end of table.

test data—Continued

with standard procedures of the AASHO]

Mechanical analysis [2]																Liquid limit [4]	Plasticity index [4]	Classification	
Percentage passing sieve [3]—											Percentage smaller than [3]—								
3-in.	2-in.	1½-in.	1-in.	¾-in.	⅜-in.	No. 4 (4.76 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.250 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				AASHO [5]	Unified [6]
							100	97	89	71	65	36	13	6	NP	NP		A–4(7)	ML.
							100	97	91	69	60	37	16	7	NP	NP		A–4(7)	ML.
								100	99	91	81	41	12	6	NP	NP		A–4(8)	ML.
				100	99	98	97	90	44	12	2	1	1	1	NP	NP		A–2–4(0)	SP–SM.
							100	88	76	57	50	33	11	8	NP	NP		A–4(4)	ML.
							100	99	96	81	72	43	14	7	NP	NP		A–4(8)	ML.
100	95	89	69	63	51	42	35	21	11	6	5	4	2	1	NP	NP		A–1–a(0)	GP–GM.
							100	93	81	63	57	35	14	9	NP	NP		A–4(6)	ML.
							100	99	95	83	77	51	20	12	NP	NP		A–4(8)	ML.
85	81	75	63	54	40	31	26	26	8	3	2	2	1	1	NP	NP		A–1–a(0)	GP.
							100	96	89	70	66	39	11	7	NP	NP		A–4(7)	ML.
							100	99	95	81	75	45	13	7	NP	NP		A–4(8)	ML.
							100	99	97	91	80	38	9	5	NP	NP		A–4(8)	ML.
	100	99	99	97	94	92	88	56	21	9	6	5	4	4	NP	NP		A–3(0)	SW–SM.

cluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.

[3] Based on total material. Laboratory test data corrected for amount discarded in field sampling.

[4] NP=nonplastic.

[5] Based on AASHO Designation: M 145–49, Standard Recommended Practice for the Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes (*1*).

[6] Based on The Unified Soil Classification System (*11*).

and their estimated physical properties

Classification—Continued		Percentage passing—			Permeability	Available water	pH	Dispersion	Shrink-swell potential
Unified	AASHO	No. 4 sieve	No. 10 sieve	No. 200 sieve					
					Inches per hour	*Inches per foot of depth*			
ML	A–4	100	100	60 to 80	0.6 to 2.0	2.5 to 3.5	4.5 to 5.5	Low	Moderate.
SP or SP–SM.	A–3	100	95 to 100	5 to 10	2.0 to 6.0	0.5 to 1.0	6.0 to 6.5	Low	Low.
SM	A–2–4	90 to 100	80 to 90	15 to 30	2.0 to 6.0	(1)	4.5 to 5.0	Low	Low.
GW or GP	A–1 or A–3	60 to 75	50 to 60	5 to 10	More than 6.0	0.25 to 0.75	5.0 to 5.5	Low	Low.
ML	A–4	100	100	65 to 75	0.6 to 2.0	(1)	5.0 to 5.5	Moderate	Low.
ML	A–4	100	100	70 to 80	0.6 to 2.0	3.0 to 4.0	5.5 to 6.0	High	Moderate.
ML	A–4	70 to 80	60 to 70	50 to 60	0.6 to 2.0	3.0 to 4.0	5.5 to 6.0	High	Moderate.
ML	A–4	100	100	70 to 80	0.6 to 2.0	3.0 to 4.0	4.5 to 5.5	Moderate	Moderate.
CL	A–6	95 to 100	85 to 95	75 to 85	0.2 to 0.6	(1)	5.5 to 6.0	High	High.
Pt							5.0 to 5.5		
CH	A–7	100	100	95 to 100	0.2 to 0.6	(1)	5.0 to 5.5	Moderate	High.
ML	A–4	100	100	75 to 85	0.6 to 2.0	3.0 to 4.0	5.5 to 6.0	High	Moderate.
CL	A–6	90 to 95	80 to 90	50 to 60	0.2 to 0.6	(1)	5.5 to 6.0	Moderate	High.

TABLE 5.—*Brief description of soils and*

Map symbol	Soil	Depth to seasonally high water table	Brief description of soil and site	Depth from surface (typical profile)	Classification: USDA textural class
				Inches	
CoA	Cohoe silt loam, nearly level	Deep	Moderately deep loess over layered fine and coarse material, on uplands.	0 to 30	Silt loam
CoB	Cohoe silt loam, gently sloping.			30 to 50+	Layered fine sand, silt loam, and clay loam.
CoC	Cohoe silt loam, moderately sloping.				
CoD	Cohoe silt loam, strongly sloping.				
CpC	Cohoe-Kenai association, rolling		Refer to descriptions of Cohoe and Kenai soils.		
CpD	Cohoe-Kenai association, hilly.				
CpE	Cohoe-Kenai association, moderately steep.				
CpF	Cohoe-Kenai association, steep.				
Cr	Corea silt loam	3 feet	Colluvium on low benches along sea cliff.	0 to 22	Silt loam
				22 to 44	Mucky silt loam.
Do	Doroshin peat	0	Coarse peat over lacustrine deposits.	0 to 19	Peat
				19 to 30+	Silt loam
Fo	Foreland silt loam	Less than 1 foot.	Very shallow loess over coarse sand and gravel, in shallow depressions on terraces.	0 to 4	Silt loam
				4 to 18+	Gravelly sand
Gb	Gravelly beach (land type)	Less than 1 foot to 3 feet.	Narrow beaches at foot of sea cliff	0 to 36+	Gravelly sand
IaA	Island silt loam, nearly level	Deep	Silty colluvium over coarse sand and gravel, in upland depressions.	0 to 25	Silt loam
IaB	Island silt loam, gently sloping.			25 to 42+	Gravelly sand
KaA	Kalifonsky silt loam, nearly level	1 foot	Moderately deep loess and silty colluvium over coarse sand and gravel, in low areas bordering lakes and muskegs.	0 to 25	Silt loam
KaB	Kalifonsky silt loam, gently sloping.			25 to 40+	Gravelly sand
Kc	Karluk silt loam	2 feet	Silty colluvium over diatomaceous earth, in depressions.[3]	0 to 8	Silt loam
				8 to 30+	Silt loam
KfA	Kasilof silt loam, nearly level	Deep	Very shallow loess over coarse sand and gravel, on terraces.	0 to 6	Silt loam
KfB	Kasilof silt loam, gently sloping.			6 to 24+	Gravelly sand
KnA	Kenai silt loam, nearly level	Deep	Moderately deep to shallow loess over firm, pebbly substratum, on uplands.	0 to 22	Silt loam
KnB	Kenai silt loam, gently sloping.			22 to 36+	Silty clay loam
KnC	Kenai silt loam, moderately sloping.				
KnCC	Kenai silt loam, rolling.				
KnD	Kenai silt loam, strongly sloping.				
KnDD	Kenai silt loam, hilly.				
KnE	Kenai silt loam, moderately steep.				
KnF	Kenai silt loam, steep.				
Kg	Killey sandy loam	1 foot	Dominantly sandy colluvium in areas bordering lakes and muskegs.	0 to 33	Sandy loam
				33 to 42+	Fine sand
LoA	Longmare silt loam, nearly level	Deep	Moderately deep loess over coarse sand and gravel; iron-cemented just beneath the loess; on upland plains.	0 to 32	Silt loam
LoB	Longmare silt loam, gently sloping.			32 to 54	Sand and gravelly sand.
				54 to 66+	Gravelly sand
Mo	Moose River silt loam	Less than 1 foot.	Coarse-grained alluvium on flood plains of secondary streams. In shallow phase, gravelly material is less than 20 inches below the surface.	0 to 5	Silt loam
Ms	Moose River silt loam, shallow.			5 to 30	Fine sand
				30 to 40+	Gravelly sand
NaA	Naptowne silt loam, nearly level	Deep	Moderately deep to shallow loess over coarse-grained substratum, on uplands.	0 to 19	Silt loam
NaB	Naptowne silt loam, gently sloping.			19 to 30+	Gravelly sandy loam.
NaC	Naptowne silt loam, moderately sloping.				
NaCC	Naptowne silt loam, rolling.				
NaD	Naptowne silt loam, strongly sloping.				

See footnotes at end of table.

their estimated physical properties—Continued

Classification—Continued		Percentage passing—			Permeability	Available water	pH	Dispersion	Shrink-swell potential
Unified	AASHO	No. 4 sieve	No. 10 sieve	No. 200 sieve	*Inches per hour*	*Inches per foot of depth*			
ML	A-4	100	100	75 to 85	0.6 to 2.0	3.0 to 4.0	4.5 to 5.5	High	Moderate.
SP, ML, CL	A-3, A-4, A-6.	90 to 100	Variable	Variable	0.2 to 2.0	(1)	5.5 to 6.5	Variable	Variable.
ML	A-4	100	100	90 to 100	0.6 to 2.0	3.5 to 4.5	(2)	(2)	Moderate.
OL	A-5	100	100	90 to 100	0.6 to 2.0	(1)	(2)	(2)	Moderate.
Pt							5.0 to 5.5		
ML	A-4	100	100	80 to 90	0.6 to 2.0	(1)	5.0 to 5.5	High	Moderate.
ML or OL	A-4	90 to 100	80 to 90	60 to 70	0.6 to 2.0	3.0 to 4.0	5.0 to 5.5	High	Moderate.
GW or GP	A-1 or A-3	60 to 75	50 to 60	5 to 10	More than 6.0	0.25 to 0.75	5.5 to 6.0	Low	Low.
GP or SP	A-1 or A-3	50 to 60	40 to 50	5 to 10	More than 6.0	(1)	(2)	Low	Low.
ML	A-4	100	100	70 to 80	0.6 to 2.0	3.0 to 4.0	5.5 to 6.0	Moderate	Moderate.
GW or GP	A-1	60 to 75	50 to 60	5 to 10	More than 6.0	0.25 to 0.75	5.5 to 6.0	Low	Low.
ML	A-4	90 to 100	80 to 90	60 to 70	0.6 to 2.0	3.0 to 4.0	5.0 to 6.0	High	Moderate.
GW or GP	A-1 or A-3	60 to 75	50 to 60	5 to 10	More than 6.0	0.25 to 0.75	5.5 to 6.0	Low	Low.
ML	A-4	100	100	75 to 85	0.6 to 2.0	(1)	5.0 to 5.5	High	Moderate.
MH	A-7-5	100	100	80 to 90	0.2 to 0.6	(1)	5.5 to 6.0	High	High.
ML	A-4	100	100	75 to 85	0.6 to 2.0	3.0 to 4.0	4.5 to 5.5	High	Moderate.
GW or GP	A-1 or A-3	60 to 75	50 to 60	5 to 10	More than 6.0	0.25 to 0.75	5.5 to 6.0	Low	Low.
ML	A-4	100	100	75 to 85	0.6 to 2.0	3.0 to 4.0	4.5 to 6.0	High	Moderate.
CL	A-4	90 to 95	80 to 90	50 to 60	0.2 to 0.6	(1)	6.0 to 6.5	Moderate	High.
SM	A-2-4	100	80 to 90	20 to 35	2.0 to 6.0	(1)	4.5 to 5.5	Low	Low.
SP	A-3	100	80 to 90	0 to 5	2.0 to 6.0	(1)	5.5 to 6.0	Low	Low.
ML	A-4	100	100	75 to 85	0.6 to 2.0	3.0 to 4.0	4.5 to 5.5	High	Moderate.
SP, GW	A-3, A-1	60 to 95	50 to 90	5 to 10	0.2 to 0.6	(1)	5.5 to 6.0	Low	Low.
GW or GP	A-1 or A-3	60 to 75	50 to 60	5 to 10	More than 6.0.	0.25 to 0.75	5.5 to 6.0	Low	Low.
ML	A-4	100	100	60 to 70	0.6 to 2.0	(1)	5.5 to 6.0	High	Moderate.
SP-SM	A-3	100	80 to 90	5 to 10	More than 6.0	(1)	5.5 to 6.0	Low	Low.
GW or GP	A-1	60 to 75	50 to 60	5 to 10	More than 6.0	(1)	5.5 to 6.0	Low	Low.
ML	A-4	100	100	75 to 85	0.6 to 2.0	3.0 to 4.0	5.0 to 6.0	High	Moderate.
GM or SM	A-2-4 or A-1	60 to 75	50 to 60	25 to 35	2.0 to 6.0	(1)	6.0 to 6.5	Moderate	Low.

See footnotes at end of table.

TABLE 5.—*Brief description of soils and*

Map symbol	Soil	Depth to seasonally high water table	Brief description of soil and site	Depth from surface (typical profile)	Classification: USDA textural class
				Inches	
NaDD	Naptowne silt loam, hilly	See Naptowne silt loams, pages 34 and 35			
NaE	Naptowne silt loam, moderately steep.				
NaF	Naptowne silt loam, steep.				
NkA	Nikishka silt loam, nearly level	Deep	Shallow loess over coarse sand and gravel, on uplands.	0 to 13 13 to 30+	Silt loam Gravelly sand
NkB	Nikisha silt loam, gently sloping.				
NkC	Nikishka silt loam, moderately sloping.				
NkD	Nikishka silt loam, strongly sloping.				
NkE	Nikishka silt loam, moderately steep.				
NkF	Nikishka silt loam, steep.				
Np	Nikolai silty peat	1 foot	Laminated peat, containing thin lenses of silty material, over sand or gravel.	0 to 36 36 to 48+	Silty peat Sand
Pe	Pincher silt loam	3 feet or more.	Silty alluvium over layered coarse and fine material, in shallow depressions.	0 to 19 19 to 30+	Silt loam Silt loam and sandy loam.
Sa	Salamatof peat	0	Deep, coarse peat, in muskegs	0 to 48+	Peat
Sb	Salamatof peat, forested.				
Sc	Sea cliff (land type)	Deep	Steep cliffs along coast; exposures of glacial drift and sandy, silty, and clayey sediments.		
Sk	Slikok mucky silt loam	2 feet	Silty alluvium, high in organic matter, on flood plains of secondary streams.	0 to 9 9 to 24 24 to 36+	Mucky silt loam Silt loam Silt loam
SlA	Soldatna silt loam, nearly level	Deep	Moderately deep loess over coarse sand and gravel, on uplands.	0 to 25 25 to 50+	Silt loam Gravelly sand or sand.
SlB	Soldatna silt loam, gently sloping.				
SlC	Soldatna silt loam, moderately sloping.				
SnC	Soldatna-Nikishka association, rolling.		Refer to descriptions of Nikishka and Soldatna soils.		
SnD	Soldatna-Nikishka association, hilly.				
SnE	Soldatna-Nikishka association, moderately steep.				
SnF	Soldatna-Nikishka association, steep.				
Sr	Starichkof peat	0	Deep, finely divided peat, in muskegs	0 to 48+	Peat
St	Starichkof peat, forested.				
Ta	Tidal flats	0	Fine-grained and coarse-grained tidal deposits, inundated daily.		
Tm	Tidal marsh	Less than 1 foot.	Tidal deposits at mouths of major rivers.	0 to 42+	Silty clay loam
To	Torpedo Lake silt loam	2 feet	Fine-grained colluvium, in depressions on uplands.	0 to 26 26 to 36+	Silt loam Clay loam
TuA	Tustumena silt loam, nearly level	Deep	Moderately deep loess over coarse sand and gravel, on terraces.	0 to 16 16 to 30+	Silt loam Gravelly sand or sand.
TuB	Tustumena silt loam, gently sloping.				
TuC	Tustumena silt loam, moderately sloping.				

[1] Insufficient information to make estimate.

[2] No data available.

their estimated physical properties—Continued

Classification—Continued		Percentage passing—			Permeability	Available water	pH	Dispersion	Shrink-swell potential
Unified	AASHO	No. 4 sieve	No. 10 sieve	No. 200 sieve					
					Inches per hour	*Inches per foot of depth*			
ML	A–4	100	100	75 to 85	0.6 to 2.0	3.0 to 4.0	4.5 to 6.0	High	Moderate.
GW or GP	A–1 or A–3	60 to 75	50 to 60	5 to 10	More than 6.0	0.25 to 0.75	5.5 to 6.0	Low	Low.
Pt							4.5 to 5.0		
GP or SP	A–1 or A–3	90 to 95	80 to 90	10 to 20	More than 6.0	(1)	4.5 to 5.0	Low	Low.
ML	A–4	100	100	70 to 80	0.6 to 2.0	(1)	5.0 to 6.0	High	Moderate.
CL, SM	A–4, A–2–4	90 to 100	Variable	Variable	0.2 to 0.6	(1)	6.0 to 6.5	Variable	Variable.
Pt							4.5 to 6.0		
OL	A–4 or A–5	90 to 95	80 to 90	60 to 75	0.6 to 2.0	(1)	5.0 to 5.5	Moderate	Moderate.
ML	A–4	85 to 95	80 to 90	50 to 60	0.6 to 2.0	(1)	5.5 to 6.0	High	Moderate.
CL	A–6	85 to 90	70 to 80	50 to 60	0.6 to 2.0	(1)	5.5 to 6.0	Moderate	High.
ML	A–4	100	100	75 to 85	0.6 to 2.0	3.0 to 4.0	4.5 to 6.0	High	Moderate.
GW, GP, or SP.	A–1 or A–3	60 to 75	50 to 60	5 to 10	More than 6.0	0.25 to 0.75	6.0 to 6.5	Low	Low.
Pt							4.5 to 5.0		
CL	A–7–6	100	100	95 to 100	0.2 to 0.6	(1)	6.5 to 7.0	Moderate	High.
ML	A–4	80 to 90	70 to 80	60 to 70	0.6 to 2.0	(1)	5.0 to 5.5	High	Moderate.
CL	A–6	85 to 95	75 to 85	65 to 75	0.2 to 0.6	(1)	5.0 to 5.5	Moderate	High.
ML	A–4	100	100	75 to 85	0.6 to 2.0	3.0 to 4.0	5.0 to 6.0	High	Moderate.
GW, GP, or SP.	A–1 or A–3	60 to 75	50 to 60	5 to 10	More than 0.6	0.25 to 0.75	5.5 to 6.0	Low	Low.

[3] Information on diatomaceous earth as a construction material may be obtained in U.S. Geological Survey Bulletin 1039–B *(7)*.

TABLE 6.—*Engineering*

[Dashes indicate the practice is not

Soil type	Susceptibility to frost action	Suitability as material for—		Suitability as a source of—		Properties significant in vertical alinement of highways	
		Road subgrade (undisturbed material)	Road fill (disturbed material)	Topsoil	Sand and gravel	Material	Drainage
Anchorage very fine sandy loam.	Moderate	Fair	Good	Poor	Good for fine sand without gravel.	Deep sand	Deep to water table.
Bernice sandy loam.	Low	Good	Good	Poor	Good; gravel throughout.	Deep gravel	Deep to water table.
Boulder Point very fine sandy loam.	High in uppermost 2 to 3 feet; low at greater depth.	Fair to poor in uppermost 2 to 3 feet; good at greater depth.	Poor in uppermost 2 to 3 feet; good at greater depth.	Good	Fair; gravel mixed with silt in substratum.	Silty in uppermost 2 to 3 feet; gravel mixed with silt at greater depth.	Deep to water table.
Clam Gulch silt loam.	High	Fair to poor	Poor	Surface layer good but usually wet.	Unsuitable	Fine-grained material.	High water table.
Clunie peat	High	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Peat over clayey substratum.	Always wet to surface.
Coal Creek silt loam.	High to moderate.	Fair to poor	Poor	Good	Unsuitable	Silty in uppermost 2 feet; clayey at greater depth.	Seasonally high water table.
Cohoe silt loam	High	Fair to poor	Poor	Good	Generally unsuitable but has gravel substratum in a few places.	Silty in uppermost 2 to 3 feet; stratified at greater depth.	Deep to water table.
Corea silt loam	High	Poor	Poor	Good	Unsuitable	Silty material high in organic matter.	Seasonally high water table.
Doroshin peat	High	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Peat over silty or sandy substratum.	Always wet to surface.
Foreland silt loam	High[1]	Fair to poor in uppermost few inches; good at greater depth.	Poor in uppermost few inches; good at greater depth.	Surface layer good.	Poor; substratum is gravel but is ordinarily below the water table.	Silty in uppermost few inches; gravel at greater depth.	High water table.
Gravelly beach (land type).	Low	Good	Good	Unsuitable	Good; sand or gravel throughout.	Sand or gravel.	High water table in lowest areas.

See footnotes at end of table.

interpretations of soils

applicable to the particular soil or land type]

Properties that affect suitability for—					Properties that affect agricultural drainage	Remarks
Farm ponds		Terraces and diversions	Waterways	Irrigation		
Reservoir area	Embankment					
Very permeable.	Fair stability; permeable.	Very permeable.	Moderately erodible.	Low water-holding capacity.	----------	
----------	Good stability; permeable.	Very permeable.	----------	Low water-holding capacity.	----------	Occurs only on steep escarpments.
Moderately permeable.	Fair stability; moderately permeable.	Stony at depth of more than 2 or 3 feet.	Erodible.	Moderately high water-holding capacity.	----------	
Slowly permeable substratum.	Fair stability; usually too wet for compaction in natural state.	----------	----------	----------	High water table; slowly permeable substratum.	
----------	----------	----------	----------	----------	Water table at surface.	Peat must be removed before embankments can be constructed.
Slowly permeable substratum.	Silty material unstable; clayey substratum has moderate stability.	----------	----------	----------	Seasonally high water table; slowly permeable substratum.	
Sandy lenses in substratum.	Silty material unstable; substratum stable and moderately permeable.	Stone-free substratum.	Erodible.	Moderately high water-holding capacity.	----------	Thickness of substratum variable.
Moderately permeable.	Unstable.	----------	----------	----------	Seasonally high water table.	
----------	----------	----------	----------	----------	Water table at surface.	Peat must be removed before embankments can be constructed.
Highly permeable substratum.	Gravel has good stability and is permeable; usually wet in natural state.	----------	----------	----------	High water table; highly permeable substratum.	
----------	----------	----------	----------	----------	----------	Includes gravelly and sandy areas and a few patches of fine-grained material.

TABLE 6.—*Engineering*

Soil type	Susceptibility to frost action	Suitability as material for—		Suitability as a source of—		Properties significant in vertical alinement of highways	
		Road subgrade (undisturbed material)	Road fill (disturbed material)	Topsoil	Sand and gravel	Material	Drainage
Island silt loam	High	Fair to poor	Poor	Good	Good to fair; gravel substratum below a depth of 2 to 3 feet.	Silty in uppermost 2 to 3 feet; gravel at greater depth.	Deep to water table.
Kalifonsky silt loam.	High	Fair to poor in uppermost 1 to 2 feet; good at greater depth.	Poor in uppermost 1 to 2 feet; good at greater depth.	Fair	Poor; substratum is gravel or sand but is ordinarily below the water table.	Silty in uppermost 1 to 2 feet; well-graded gravel at greater depth.	High water table.
Karluk silt loam	High	Unsuitable	Unsuitable	Good	Unsuitable	Diatomaceous earth.	Seasonally high water table.
Kasilof silt loam	High in uppermost few inches; low at greater depth.	Fair to poor in uppermost few inches; good at greater depth.	Poor in uppermost few inches; good at greater depth.	Poor	Good; gravel substratum.	Silty in uppermost few inches; gravel at greater depth.	Deep to water table.
Kenai silt loam	High in uppermost 1 to 2 feet; moderate at greater depth.	Fair to poor	Poor in uppermost 1 to 2 feet; good at greater depth.	Good	Unsuitable	Silty in uppermost 1 to 2 feet; clayey and compact below.	Deep to water table; substratum is slowly permeable.
Killey sandy loam	Moderate	Fair	Fair	Fair to poor	Poor; substratum is sand but is ordinarily below the water table.	Sand mixed with silt in uppermost 3 feet.	Seasonally high water table.
Longmare silt loam	High	Fair to poor in uppermost 2 to 3 feet; good at greater depth.	Poor in uppermost 2 to 3 feet; good at greater depth.	Good	Good; gravel substratum.	Silty in uppermost 2 to 3 feet; gravel at greater depth, but indurated in upper part.	Indurated layer may restrict drainage.
Moose River silt loam.	High [1]	Good to fair	Good	Poor	Poor; fine sand and gravel but ordinarily below water table.	Silty in uppermost few inches; fine sand and gravel at greater depth.	High water table.
Naptowne silt loam.	High in uppermost 1 to 2 feet; moderate at greater depth.	Fair to poor in uppermost 1 to 2 feet; good at greater depth.	Poor in uppermost 1 to 2 feet; good at greater depth.	Good	Fair; gravel mixed with silt in substratum.	Silty in uppermost 1 to 2 feet; gravel mixed with silt at greater depth.	Deep to water table.
Nikishka silt loam	High in uppermost 1 foot; low at greater depth.	Fair to poor in uppermost 1 foot; good at greater depth.	Poor in uppermost 1 foot; good at greater depth.	Good	Good; gravel substratum.	Silty in uppermost 1 foot; gravel at greater depth.	Deep to water table.

See footnotes at end of table.

interpretations of soils—Continued

Properties that affect suitability for—					Properties that affect agricultural drainage	Remarks
Farm ponds		Terraces and diversions	Waterways	Irrigation		
Reservoir area	Embankment					
Highly permeable substratum.	Silty material unstable; gravel has good stability and is permeable.	----------	----------	Moderately high water-holding capacity.	----------	
Highly permeable substratum.	Silty material unstable; gravel has good stability and is permeable; usually wet in natural state.	----------	----------	----------	High water table; highly permeable substratum.	
Slowly permeable.	Unstable----------	----------	----------	High water-holding capacity.	Seasonally high water table; slowly permeable soil.	
Highly permeable substratum.	Silty material unstable; gravel has good stability and is permeable.	Very shallow over gravel substratum.	----------	Low water-holding capacity.	Highly permeable substratum.	
Slowly permeable substratum.	Silty material unstable; substratum fairly stable.	Compact, slowly permeable substratum.	Erodible----------	Water-holding capacity restricted by substratum.	Slowly permeable substratum.	Thickness of silty material over substratum may be as little as 1 foot.
Permeable material.	Fair stability; permeable.	----------	----------	----------	Seasonally high water table; permeable soil.	Silty lenses and pockets in upper part of profile.
Permeable substratum.	Silty material unstable; gravel has good stability and is permeable.	----------	----------	Moderately high water-holding capacity.	Moderately permeable soil; seasonally, water may perch on indurated layer.	
Highly permeable substratum.	Sand and gravel have good stability and are permeable; usually wet in natural state.	----------	----------	----------	High water table; highly permeable soil.	
Permeable substratum.	Silty material unstable; gravelly substratum has good stability and is permeable.	Gravelly substratum; few boulders.	Erodible----------	Moderately high water-holding capacity.	----------	
Highly permeable substratum.	Silty material unstable; gravel has good stability and is permeable.	Shallow over gravel substratum.	Erodible----------	Fairly low water-holding capacity.	----------	

TABLE 6.—*Engineering*

Soil type	Susceptibility to frost action	Suitability as material for—		Suitability as a source of—		Properties significant in vertical alinement of highways	
		Road subgrade (undisturbed material)	Road fill (disturbed material)	Topsoil	Sand and gravel	Material	Drainage
Nikolai silty peat	High	Unsuitable	Unsuitable	Good	Unsuitable	Silty peat over sandy substratum.	Seasonally high water table.
Pincher silt loam	High	Fair to poor	Poor	Good	Unsuitable	Silty in uppermost 1 to 2 feet; stratified at greater depth.	Seasonally high water table.
Salamatof peat	High	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Peat over silty or sandy substratum.	Always wet to surface.
Sea cliff (land type).							
Slikok mucky silt loam.	High	Poor	Poor	Good	Unsuitable	Silty material, high in organic matter.	High water table.
Soldatna silt loam	High in uppermost 1 to 2 feet; low at greater depth.	Fair to poor in uppermost 1 to 2 feet; good at greater depth.	Poor in uppermost 1 to 2 feet; good at greater depth.	Good	Good; gravel or sand substratum.	Silty in uppermost 1 to 2 feet; gravel or sand at greater depth.	Deep to water table.
Starichkof peat	High	Unsuitable	Unsuitable	Unsuitable	Unsuitable	Peat over silty or sandy substratum.	Always wet to surface.
Tidal flats							
Tidal marsh	Moderate	Poor	Fair	Poor	Unsuitable	Fine-grained material.	High water table.
Torpedo Lake silt loam.	High to moderate.	Fair to poor	Poor in uppermost 2 feet; fair at greater depth.	Good	Unsuitable	Silty in uppermost 2 feet; clayey at greater depth.	Seasonally high water table.
Tustumena silt loam.	High in uppermost 1 to 2 feet; low at greater depth.	Fair to poor in uppermost 1 to 2 feet; good at greater depth.	Poor in uppermost 1 to 2 feet; good at greater depth.	Good	Good; gravel or sand substratum.	Silty in uppermost 1 to 2 feet; gravel or sand at greater depth.	Deep to water table.

[1] These soils have a gravelly or sandy substratum but are always wet and are consequently susceptible to frost action.

interpretations of soils—Continued

Properties that affect suitability for—					Properties that affect agricultural drainage	Remarks
Farm ponds		Terraces and diversions	Waterways	Irrigation		
Reservoir area	Embankment					
Permeable substratum.	Peaty material unstable.			High water-holding capacity.	Seasonally high water table; permeable substratum.	Depth to underlying sand varies from 2 to more than 4 feet.
Sandy lenses in substratum.	Silty material unstable; mixed material in substratum stable; moderately permeable.			Moderately high water-holding capacity.	Seasonally high water table.	
					Water table at surface.	Peat must be removed before embankments can be constructed.
						May be source of construction material.
Moderately permeable.	Unstable				High water table	
Highly permeable substratum.	Silty material unstable; gravel and sand have good stability and are permeable.	Gravel or sand substratum.	Erodible	Moderately high water-holding capacity.		Gravel substratum more common than sand; sand occurs principally along secondary streams.
					Water table at surface.	Peat must be removed before embankments can be constructed.
						Fine-grained and coarse-grained tidal deposits that are inundated daily.
Slowly permeable.	Fair stability; usually too wet for compaction in natural state.				High water table; slowly permeable material.	May have peat lenses in profile.
Slowly permeable substratum.	Silty material unstable; clayey substratum moderately stable.				Seasonally high water table; slowly permeable substratum.	Stony layers common.
Highly permeable substratum.	Silty material unstable; gravel and sand have good stability and are permeable.	Gravel or sand substratum.	Erodible	Moderately high water-holding capacity.		Gravel substratum more common than sand.

Peat soils in muskegs cover much of the Kenai-Kasilof Area. These soils, except for those of the Nikolai series, are always wet to the surface. The peat has little value as a construction material or as a foundation. Embankments for roads through muskegs may rest directly on the underlying mineral soil or, where the peat is more than 5 feet thick, may be "floated" on logs.

It is likely that simple measures, like contour cultivation, stripcropping, and grassed waterways, can provide adequate control of erosion in all but the steeply sloping parts of the Kenai-Kasilof Area. Heavy showers and resulting concentrations of runoff water are virtually unknown, so terraces, dams, and similar structures are not likely to be needed unless steep slopes are cleared and farmed.

Draining some of the wet soils for agricultural purposes probably would be feasible, but drainage is not likely to be a widespread practice or to be economically practical until a much greater proportion of the uplands is cleared. Drainage of peat soils, with the possible exception of Nikolai silty peat, is not recommended.

Native Vegetation

Forests cover most of the Kenai-Kasilof Area. White spruce, Kenai paper birch, and quaking aspen are the most important trees of well-drained uplands. In slightly wetter sites and in some well-drained places along the coast, balsam poplar (cottonwood), willows, and alder are dominant. Black spruce occurs in some muskegs and other very wet areas; it is prominent also in upland areas that have been severely burned.

The principal treeless areas are the muskegs, which support only a dense cover of low shrubs and sphagnum moss. Several small areas near the mouths of the principal streams are covered by meadows of sedges, grasses, and forbs.

Forest Types [3]

The climax forest community on the well-drained soils of the uplands in the Area is the white spruce type. Once established, this forest type is self-perpetuating and continues virtually unchanged until it is destroyed by fire or cutting. A few birch and aspen trees may occur in the stand, but these trees die out in time. Although seedlings of paper birch and Sitka alder are common in the understory, they seldom live to maturity. In a mature stand of white spruce, some trees are more than 200 years old and reach a height of 100 feet and a diameter at breast height of more than 20 inches. On the average, however, the trees are 50 to 60 feet tall and 8 to 12 inches in diameter. Lutz (*5*) estimates that at 160 years the better stands of white spruce would yield 3,900 cubic feet or 15,500 board feet per acre.

The plants that, in addition to tree seedlings, make up the major part of the subordinate vegetation in stands of white spruce in the Area are given in the following list. Asterisks indicate the most common plants.

Shrubs

Scientific Name	Common Name
**Cornus canadensis*	Bunchberry dogwood.
Empetrum nigrum	Crowberry.
Menziesia ferruginea	Rusty menziesia, buckbrush.
**Ribes triste*	American red currant.
**Rosa acicularis*	Prickly rose, wild rose.
**Rubus pedatus*	Fiveleaf bramble, trailing raspberry.
Sorbus scopulina	Greenes mountain-ash.
**Vaccinium vitis-idaea*	Lingenberry, lowbush cranberry.
**Viburnum edule*	Mooseberry viburnum, highbush cranberry.

Forbs

Arenaria lateriflora	Bluntleaf sandwort.
**Comandra livida*	Northern comandra.
Dryopteris austriaca	Spreading woodfern.
**Dryopteris disjuncta*	Oakfern.
**Epilobium angustifolium*	Fireweed.
**Equisetum arvense*	Field horsetail.
Equisetum pratense	Meadow horsetail.
**Goodyera repens* var. *ophioides*	Creeping rattlesnake plantain.
Habenaria obtusata	Bluntleaf habenaria.
**Linnaea borealis* var. *americana*	American twinflower.
**Listera cordata*	Northern listera.
**Lycopodium annotinum*	Bristly clubmoss.
**Pyrola asarifolia* var. *incarnata*	Alpine pyrola.
**Pyrola secunda*	Sidebells pyrola.
Pyrola virens (syn. *P. chlorantha*)	Green pyrola.
Streptopus amplexifolius	Claspleaf twistedstalk.
**Trientalis europaea* ssp. *arctica*	Arctic starflower.

Grass

Calamagrostis canadensis	Bluejoint reedgrass.

Mosses

Dicranum fuscescens.
Drepanocladus uncinatus.
**Hylocomium splendens.*
**Hypnum crista-castrensis* (syn. *Ptilium crista-castrensis*).
**Pleurozium schreberi.*
**Polytrichum commune.*

Lichens

**Peltigera aphthosa* var. *typica.*
**Peltigera membranacea.*

The roots of most of these plants, including those of the trees, are in the thin mat of forest litter, mosses, lichens, and fungal mycelia on the surface of the soil. Because most of the trees have shallow roots, there is a moderate windthrow hazard in partially opened stands, especially in those near the coast.

White spruce as much as 150 years old appear to have few defects caused by disease. Some spruce, however, have been lost in recent years because of damage from the Alaska spruce beetle (*Dendroctonus borealis*). The increase in the number of insects in trees damaged in the extensive fire of 1947 is believed to be at least partly responsible for these losses.

Although the white spruce type is the climax forest in the Area, white spruce-Kenai paper birch and white spruce-quaking aspen forests are more common on the uplands. There are also some relatively pure stands of birch, aspen, and black spruce. All these forest types represent stages in the forest succession after a fire or an

[3] This section is based largely on the work of Lutz (*5*) and on other information supplied by R. F. Taylor of the Alaska Forest Research Center, U.S. Forest Service, Juneau, Alaska.

open cutting. Shortly after a fire, seedlings of white spruce, black spruce, paper birch, quaking aspen, balsam poplar (cottonwood), Sitka alder, and willows (mostly Bebb willow, Barclay willow, and Scouler willow) appear. Ordinarily, two factors determine the kind of reproduction that takes place after a fire: the source of viable seed and exposure of the mineral soil. The kind of trees that grew in the area will determine the seed supply. Tree seedlings as a rule take root only where the mat of organic matter has been burned and the mineral soil exposed. This suggests that a moderate problem in natural regeneration can be expected after logging. Willows and aspen, however, may reproduce by sprouting or from root suckers; willows are especially abundant after fires. Bunchberry dogwood, wild rose, lingenberry, bluejoint, and fireweed are also abundant immediately after a fire. The first trees to appear are generally aspen and paper birch. In the eastern part of the Kenai-Kasilof Area, however, where there have been repeated fires, black spruce usually is dominant in the new growth.

Probably the most common forest type in the Area is a mixture of white spruce and Kenai paper birch. Quaking aspen is also present in many stands. The proportion of each species in a stand varies from place to place, and there are many pure stands. Willows, balsam poplar, and Sitka alder may occur in the understory. In stands more than 80 to 100 years old, the birch and aspen begin to decay, and white spruce then becomes the dominant tree. The subordinate growth in the white spruce-paper birch forest type is generally like that in the white spruce type. The most abundant shrubs are bunchberry dogwood, wild rose, lingenberry, and mooseberry viburnum. Northern comandra, fireweed, creeping rattlesnake-plantain, American twinflower, bristly clubmoss, sidebells pyrola, and arctic starflower are the common forbs. Other plants that occur only in older stands (those more than 120 to 140 years old) are trailing raspberry, rusty menziesia, mountain-ash, oakfern, field horsetail, northern listera, and alpine pyrola.

Quaking aspen and quaking aspen-white spruce forest types occur principally in areas that have been burned fairly recently, mostly on the Tustumena and Kasilof soils on the broad terraces along the principal rivers of the Area. Here, few trees are more than 25 feet tall or more than 5 inches in diameter. As in the white spruce-paper birch forest type, spruce becomes dominant as the stand ages. The understory includes many young willows and aspen, which are heavily browsed by moose. There are also several plants not commonly found in older stands: bog birch (*Betula glandulosa*), sprawling crystal-tea ledum (*Ledum palustre* ssp. *decumbens*), nootka lupine (*Lupinus nootkatensis*), and arctic yarrow (*Achillea borealis*). Bluejoint and fireweed are abundant, as are mosses (*Hylocomium* spp. and *Polytrichum* spp.) and lichens (*Cladonia* spp. and *Peltigera aphthosa*).

In 1947 fire destroyed much of the forest east of Soldatna. In many places in this part of the Area, particularly near Sterling, forests of black spruce occur on the uplands that have been burned repeatedly (fig. 10). Ordinarily there are, in addition to black spruce, many seedlings of willows and aspen, mostly on deeply burned spots where the mineral soil is exposed. Fireweed, wild rose, lingenberry, and bunchberry dogwood are prominent in the understory. Mosses and lichens cover the ground.

***Figure 10.*—Black spruce is the principal tree in forest on this recently burned area. Soil is Naptowne silt loam; forest has been burned repeatedly over period of several centuries.**

In several places along the coast some of the well-drained soils, especially the Boulder Point soils in the vicinity of East Foreland, are covered by dense thickets of alder and devilsclub (*Oplopanax horridus*). These thickets are interspersed with more open, grassy areas and scattered balsam poplar trees. The principal grass is bluejoint; mixed with it are red fescue (*Festuca rubra*), foxtail barley (*Hordeum jubatum*), some bluegrass, fireweed, and lupine. These grasses, especially bluejoint, also occur in open areas in the forests.

Except in muskegs, black spruce, willows, and balsam poplar are the principal trees on the poorly drained soils. There are also some scattered white spruce and paper birch. Here the forest is more open, and tall grasses, sedges, field horsetail, fireweed, bog birch, Labrador-tea (*Ledum palustre* ssp. *groenlandicum*), and other shrubs form a dense ground mat. In many places there are only a few trees, and tussocks of grass form the principal vegetation. A mat of moss, a few inches to 12 inches thick, covers the surface in most poorly drained areas.

Unforested Areas

The principal vegetation in muskegs is sphagnum moss. On the moss, however, there is a dense woody growth that consists chiefly of bog birch, dwarf willows, Labrador-tea, crowberry, bog blueberry (*Vaccinium uliginosum*), and cloudberry (*Rubus chamaemorus*). Sedges (*Carex* spp.) and cottongrass (*Eriophorum angustifolium*) also occur in places. Black spruce grows in many of these muskegs, as isolated small trees, in dense clumps surrounded by open muskeg, or in a forest that covers many acres of muskeg. Although some of these trees are more

than 200 years old, they are seldom more than a few inches in diameter or more than 15 to 20 feet tall.

The vegetation on Tidal marsh, the land type near the mouths of the Kenai, Kasilof, and Swanson Rivers, consists of sedges, beach ryegrass (*Elymus mollis*), field horsetail, lupine, goose-tongue (*Plantago maritima*), common marshmarigold (*Caltha palustris*), black lily (*Fritillaria camtschatcensis*), and other plants of the coastal meadows. Tidal flats and the beaches ordinarily have no plant cover.

Formation, Classification, and Morphology of the Soils

The soil is the natural, three-dimensional body that covers most of the surface of the earth. Its characteristics at any one spot result from the combined influence of the five genetic factors of the natural environment—climate, living matter, parent material, relief, and time—plus the effects of the cultural environment and man's use of the soil (*4*). Its properties are strongly influenced by characteristics of the climate, such as temperature and the amount, kind, and distribution of rainfall. To a considerable extent, these climatic factors also determine the kind of vegetation that will grow in any particular area. The vegetation, in turn, has a profound influence on the characteristics of the soil. The extent of the modification of the parent material or rock by climatic and biologic forces and the degree of soil development depend, in large part, on the length of time over which the soil-forming processes have been active. Local variations in topography also affect the nature and intensity of soil development. In low-lying areas, for example, a permanently high water table may create conditions that result in soils very different from those that develop on the well-drained uplands of the same general region.

Factors of Soil Formation

Parent material.—The soils of the Area have developed in several different kinds of material. Most of the soils of the uplands formed in silty, wind-laid material, called loess, that was deposited over gravelly glacial outwash, glacial till, or sediments of the Kenai formation of Tertiary (Eocene) age. The thickness of this loess deposit ranges from only a few inches to more than 40 inches. The glacial till consists primarily of loose sand and gravel much like the glacial outwash, but in some places it consists of compact, slowly permeable, fine-textured material. The Kenai formation consists mostly of strata of poorly consolidated sands and silts and thin beds of lignite. On the alluvial plains and in many of the upland depressions, the soils have formed in materials deposited by streams or washed in from the surrounding slopes. Most of these soils are silty, but the soils in several narrow valleys are coarse textured. Peat soils, formed mostly from the accumulated remains of mosses and other small plants, fill many depressions. These peat bogs, or muskegs, range in size from less than an acre to many square miles. The peat soils differ from one another in the kind of peat, in the thickness of the deposit, and in the degree of decomposition.

Climate.—The Area is characterized by cool summers and moderately cold winters. The rates of evaporation and transpiration are comparatively low; consequently, a large proportion of the moisture that falls percolates through the soil and is effective in leaching. Under the native vegetation, the well-drained soils are cool and moist during most of the summer.

Living matter.—In this climate, the soils of the uplands for the most part support a forest of white spruce and birch. A more open forest of willow, balsam poplar, and black spruce, in which there are many grassy areas, covers most of the imperfectly drained and poorly drained soils of the alluvial plains and upland depressions. Low shrubs and black spruce occur in the muskegs. A more detailed description of the vegetation of the Area is given in the section "Native Vegetation."

Relief.—In this area of comparatively young soils, the effect of relief and topographic position, although considerable, is not so great as in older areas. Ordinarily the loess mantle is somewhat thinner on steep slopes than it is on level areas, but this is not always so. Soil development is generally as far advanced on the steep uplands as it is on the more gently sloping or nearly level uplands. Most of the depressions, however, are not well drained, and the soils in them ordinarily exhibit characteristics associated with wet conditions.

Time.—All the soils have developed in the relatively short time that has elapsed since the ice sheet that formerly covered most of the Kenai-Kasilof Area receded. Horizon differentiation is fairly well advanced in most of the soils of the uplands. Wet soils, however, show little profile development.

Classification and Morphology of the Soils

In the comprehensive system of soil classification currently followed in the United States (*9*), soils are placed in six categories. Beginning with the highest, the six categories are the order, suborder, great soil group, family, series, and type.

In the highest category, all soils are grouped into three orders, whereas thousands of soil types are recognized in the lowest category. The categories of suborder and family have never been fully developed and thus have been little used. For the purpose of this survey, attention has been given mainly to the classification of soils into types and series and to the subsequent grouping of series into great soil groups.

Six great soil groups are represented in the Kenai-Kasilof Area. Table 7 shows the classification of the soils by great soil groups and gives the parent material, the position in the landscape, and the drainage characteristics of each soil series.

Podzols

Most of the well-drained soils in the Area are in the Podzol great soil group. Podzols are soils in which organic acids formed in the mat of decomposing plant materials on the surface of the soil and iron and aluminum oxides from the uppermost few inches of mineral soil have been leached to a lower horizon. This process results in a soil profile that has a gray eluvial layer immediately below the organic mat and a reddish or

TABLE 7.—*Soil series of the Kenai-Kasilof Area, arranged according to great soil group, physiography, drainage class, and parent material*

Great soil group and series	Physiography	Drainage class	Parent material
Podzols:			
Bernice	Steep escarpments in uplands	Excessively drained	Coarse sand and gravel.
Cohoe	Upland hills and plains	Well drained	Moderately deep loess over layered fine and coarse materials.
Soldatna	Upland hills and plains	Well drained	Moderately deep loess over coarse sand and gravel.
Naptowne	Upland hills and plains	Well drained	Moderately deep to shallow loess over dominantly coarse-grained till.
Kenai	Upland hills and plains	Well drained	Moderately deep to shallow loess over fine-grained till.
Nikishka	Upland hills and plains	Well drained	Shallow loess over coarse sand and gravel.
Longmare	Low plains in uplands	Moderately well drained	Moderately deep loess over coarse sand and gravel.
Anchorage	Stabilized dunes and beach ridges.	Well drained	Sandy, wind-worked material.
Brown Podzolic soils:			
Tustumena	Terraces along major rivers	Well drained	Moderately deep loess over coarse sand and gravel.
Kasilof	Terraces along major rivers	Well drained	Very shallow loess over coarse sand and gravel.
Boulder Point	Uplands along coast	Well drained	Recent wind-laid sands and silt over glacial drift.
Regosols:			
Island	Depressions in uplands	Well drained	Silty colluvium over coarse sand and gravel.
Low-Humic Gley soils:			
Killey	Borders of lakes and muskegs	Imperfectly drained	Dominantly sandy colluvium.
Kalifonsky	Borders of lakes and muskegs	Imperfectly drained	Moderately deep loess and silty colluvium over coarse sand and gravel.
Karluk	Depressions in uplands	Poorly drained	Colluvium over diatomaceous earth.
Humic Gley soils:			
Coal Creek	Depressions in uplands	Poorly drained	Silty colluvium over fine-grained till.
Torpedo Lake	Depressions in uplands	Poorly drained	Stony, fine-grained colluvium.
Corea	Depressions in uplands	Poorly drained	Layered muck and colluvium.
Pincher	Shallow depressions and drainageways.	Imperfectly drained	Layered silty and sandy alluvium.
Foreland	Gravelly terraces	Poorly drained	Very shallow loess over coarse sand and gravel.
Moose River	Flood plains	Poorly drained	Coarse-grained alluvium.
Clam Gulch	Flood plains	Poorly drained	Fine-grained alluvium.
Slikok	Flood plains	Very poorly drained	Fine-grained alluvium.
Bog soils:			
Nikolai	Border of muskegs	Poorly drained	Layered (laminated) peat with thin silty lenses.
Salamatof	Muskegs	Very poorly drained	Deep, coarse peat.
Doroshin	Muskegs	Very poorly drained	Moderately deep to shallow, coarse peat over lacustrine sediments.
Clunie	Muskegs	Very poorly drained	Moderately deep to shallow, coarse peat over tidal deposits.
Starichkof	Muskegs	Very poorly drained	Deep, finely divided peat.

brownish illuvial horizon below the eluvial horizon. As a rule, the entire solum, which also includes a transitional horizon between the main illuvial horizon and the unaltered parent material, is less than 16 inches thick. During the process of podzolization, most basic cations have been replaced by hydrogen ions. As a result the solum has become strongly acid.

The soils in the Kenai-Kasilof Area are comparatively young, and the parent material of most soils is silty rather than sandy. Hence, the Podzols in this Area are not so highly developed as Podzols in parts of the northeastern and north-central United States. The illuvial horizon, or B horizon, in many of these soils is brown rather than reddish brown. There are no concretions of iron oxide in the B horizon of any of the Podzols of the Area. The silty parent material, or C horizon, that lies beneath the solum is only slightly acid to moderately acid in most places.

In most of the Podzols in this Area, the C horizon is olive, a color normally associated with poor or imperfect drainage. In this Area, however, olive was apparently the color of the original loess deposit. In time, with increasing oxidation, it is probable that this material will take on a brownish cast.

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The strongest degree of podzolization in the Area is in soils of the Soldatna series and in those of the associated Nikishka and Longmare series.

Profile of Soldatna silt loam in the SW¼SE¼ sec. 35, T. 7 N., R. 12 W., Seward Meridian:

A_{00} 4 to 3 inches, litter of leaves, needles, and twigs; abrupt, smooth boundary.

A_0 3 inches to 0, dark reddish-brown (5YR 2/2) mat of roots, decaying leaves, and moss; mycelia; very strongly acid; abrupt, smooth boundary; layer is 2 to 3 inches thick.

A_2 0 to 3 inches, gray (5Y 5/1) silt loam; few, fine, faint mottles of brown in lower part of horizon; weak, very fine, subangular blocky structure; friable; roots plentiful; charcoal particles; very strongly acid; abrupt, irregular boundary; layer is 1 to 5 inches thick.

B_{21} 3 to 6 inches, dark reddish-brown (5YR 3/4) silt loam; patches of brown (7.5YR 4/4); weak, fine to medium, subangular blocky structure; friable; roots plentiful; some mycelia; strongly acid to medium acid; clear, wavy boundary; layer is 2 to 4 inches thick.

B_{22} 6 to 10 inches, brown (7.5YR 4/4) silt loam; pockets of grayish brown; weak, fine to medium, subangular blocky structure; friable; roots plentiful; medium acid; clear, wavy boundary; layer is 3 to 5 inches thick.

B_3 10 to 18 inches, olive-brown (2.5Y 4/4) silt loam; massive to very weak, medium, subangular blocky structure; friable; few roots; few (about 5 percent) rounded pebbles up to 3 inches in diameter; medium acid; gradual boundary; layer is 6 to 10 inches thick.

C 18 to 25 inches, olive (5Y 4/3) silt loam; common, coarse, faint mottles of olive brown; few yellowish-brown streaks at bottom of horizon; a few rounded pebbles, as in horizon above; few roots; massive; friable; medium acid; abrupt, wavy boundary; layer is 5 to 12 inches thick.

D_1 25 to 42 inches, olive (5Y 4/3) gravelly sand; loose; massive to weak platy lenses of silt loam; dark-red mottles in silt-loam lenses; no roots; medium acid; layer is either lacking or thin to about 24 inches thick.

D_2 42 to 50 inches +, olive (5Y 4/3) gravelly sand; structureless; loose in place; pebbles rounded; slightly acid to medium acid; many feet thick.

The Nikishka soils are similar to the Soldatna soils, except that they have developed in shallower loess.

Profile of Nikishka silt loam in the NW¼SW¼ sec. 15, T. 7 N., R. 12 W., Seward Meridian:

A_{00} 3½ to 3 inches, forest litter.

A_0 3 inches to 0, dark reddish-brown (5YR 2/2) mat of roots and decaying organic material; many white and yellow mycelia; many small, white grains the size of sand, especially in the lower part of the horizon; very strongly acid to extremely acid; abrupt, smooth boundary; layer is 2 to 3 inches thick.

A_2 0 to 2 inches, dark-gray (5Y 4/1) to gray (5Y 5/1) coarse silt loam; weak, very fine, subangular blocky structure; friable; roots plentiful; very strongly acid to extremely acid; abrupt, irregular boundary; layer is 1 to 3 inches thick.

B_2 2 to 4 inches, dark reddish-brown (5YR 3/3) coarse silt loam; weak, fine to medium, subangular blocky structure; friable; roots plentiful; strongly acid; abrupt, irregular boundary; layer is 1½ to 3 inches thick.

B_3 4 to 8 inches, mixed strong-brown (7.5YR 5/6) and brown (10YR 4/3) silt loam; massive to weak, medium to coarse, subangular blocky structure; friable; roots plentiful to few; medium acid to slightly acid; clear, wavy boundary; layer is 3 to 5 inches thick.

C 8 to 13 inches, dark yellowish-brown (10YR 4/4) silt loam; massive to weak, coarse, subangular blocky structure; friable; few roots; slightly acid to medium acid; clear, wavy boundary; layer is 3 to 10 inches thick.

C–D 13 to 21 inches, olive-brown (2.5Y 4/4) gravelly silt loam; massive; friable to loose; few roots; medium acid to slightly acid; abrupt, wavy boundary; layer is 0 to 12 inches thick.

D 21 to 30 inches +, gravelly sand; color varies with individual grains; pebbles rounded; loose; few to no roots; medium acid; many feet thick.

Soils in the Longmare series are only moderately well drained. The upper part of the gravelly base material is a hardpan indurated by iron deposited from ground water.

Profile of Longmare silt loam in the SE¼SE¼ sec. 25, T. 6 N., R. 12 W., Seward Meridian:

A_{00} 4½ to 4 inches, forest litter.

A_0 4 inches to 0, dark reddish-brown (5YR 3/2) mat of roots and decomposing parts of plants; very strongly acid; abrupt, smooth boundary; layer is 3 to 4 inches thick.

A_2 0 to 2 inches, grayish-brown (10YR 5/2) silt loam; common, medium, faint mottles of dark grayish brown and few, fine, distinct mottles of dark reddish brown; very weak, very fine, subangular blocky structure; friable; roots plentiful; very strongly acid; abrupt, irregular boundary; layer is ½ to 3 inches thick.

B_2 2 to 4 inches, dark reddish-brown (2.5YR 2/4 and 5YR 3/4) silt loam; weak, fine, subangular blocky structure; friable; roots plentiful; strongly acid; clear, irregular boundary; layer is 1 to 2 inches thick.

B_3 4 to 8 inches, dark-brown (10YR 3/3) silt loam; common, medium, faint, brown mottles; weak, medium, subangular blocky structure; friable; roots plentiful; strongly acid; gradual boundary; layer is 3 to 6 inches thick.

C_1 8 to 21 inches, dark grayish-brown (2.5Y 4/2) to olive-brown (2.5Y 4/4) silt loam; common, medium, prominent mottles of yellowish red; very weak, medium, subangular blocky structure crushing to fine granules; friable; few roots; few pebbles; strongly acid to medium acid; clear, wavy boundary.

C_2 21 to 29 inches, silt loam in irregular streaks of dark grayish-brown (10YR 4/2 and 2.5Y 4/2), dark yellowish-brown (10YR 4/4), and very dark grayish-brown (2.5Y 3/2); common, small, distinct mottles of yellowish red; massive; nonsticky; friable; few roots; medium acid; abrupt, smooth boundary.

C_3 29 to 32 inches, strong-brown (7.5YR 5/8) silt loam; streaks of dark grayish brown; massive; nonsticky; friable; very few roots; few pebbles; medium acid to strongly acid; abrupt, smooth boundary.

D_1 32 to 48 inches, mixed dark reddish-brown (2.5YR 2/4), yellowish-red (5YR 5/8), and olive (5Y 4/3) sand; strongly cemented; no roots; medium acid; abrupt, smooth boundary; layer is 6 to 20 inches thick.

D_2 48 to 54 inches, gravelly sand, same colors as D_1; strongly cemented; medium acid; abrupt, smooth boundary; layer is 6 to 20 inches thick.

D_3 54 to 66 inches +, olive (5Y 4/3) stratified sand and gravel; pebbles rounded; structureless; loose in place; medium acid; many feet thick.

The other extensive Podzols in the Kenai-Kasilof Area—the Cohoe, Kenai, and Naptowne soils—are less highly developed. In these soils the dark reddish colors caused by the migration and deposition of iron oxide and organic matter are confined to very thin, discontinuous bands immediately beneath the gray, leached horizon of eluviation. Brown colors are dominant in the B horizon. It is likely that these colors are caused largely by iron oxide released in place by the weathering of the parent material. Nevertheless, these profiles have most of the properties of Podzols—a mat of relatively undecomposed organic material, a gray horizon of eluviation, an incipient horizon of illuviation, and a strongly acid reaction in the solum. The Cohoe soils, which developed in moderately deep loess that is underlain by sediments of the Kenai formation, are typical of these less highly developed Podzols.

Profile of Cohoe silt loam in the NW¼ sec. 18, T. 1 N., R. 12. W., Seward Meridian:

A_{00} 2¼ to 2 inches, litter of needles and twigs; particles of charcoal; discontinuous cover of moss.
A_0 2 inches to 0, very dark grayish-brown (10YR 3/2) mat of partially decomposed organic material; mycelia, some of which extend to the A_2 and B_{21} horizons; abrupt, smooth boundary.
A_2 0 to 2 inches, gray (5Y 5/1) silt loam; few, fine, brown mottles; weak, very fine, granular structure; friable; roots plentiful; a few white sand grains (possibly volcanic ash), mostly near the top of the horizon; abrupt, irregular boundary.
B_{21} 2 to 5 inches, mixed dark-brown (7.5YR 4/4) and grayish-brown (10YR 5/2) silt loam mottled with dark reddish brown, mostly in the upper part of the horizon; dark brown is the dominant color; weak, fine, subangular blocky structure; friable; few roots; clear, wavy boundary.
B_{22} 5 to 8 inches, mixed grayish-brown (2.5Y 5/2) and dark-brown (7.5YR 4/4) silt loam; grayish brown is the dominant color; very weak, medium, subangular blocky structure; friable; few roots; clear, wavy boundary.
B_3 8 to 15 inches, mixed olive-brown (2.5Y 4/4) and dark-brown (10YR 4/3) silt loam; massive; friable; few roots but many fine pores; gradual boundary.
C 15 to 23 inches, olive-brown (2.5Y 4/4) silt loam; massive; friable; fewer fine pores than in B_3 horizon; abrupt, wavy boundary.
D_1 23 to 53 inches, olive (5Y 4/3) coarse silt; few, fine mottles of dark brown, mostly along fine vesicles; massive but breaks into fine, subangular blocky particles when crushed; friable.
D_2 53 inches +, olive (5Y 4/3), firm silty clay loam.

Results of physical and chemical analyses of samples from this profile are given in tables 8 and 9.

Mineralogical analyses indicate that this soil is high in allophane, an apparently amorphous alumino-silicate. Because soils containing this clay mineral are not normally dispersed completely by standard procedures, it is likely that the actual percentages of clay in this soil are higher than those indicated in table 8. This, together with the fairly high content of organic carbon, probably accounts for the high base-exchange capacities in the soil.

The Naptowne and Kenai soils differ from the Cohoe soils in the character of the material underlying the loess and probably are not so high in allophane. The Naptowne soils developed in loess underlain by gravelly material of the glacial moraines.

Profile of Naptowne silt loam in the SE¼NE¼ sec. 13, T. 5 N., R. 8 W., Seward Meridian:

A_{00} 2 to 1½ inches, forest litter.
A_0 1½ inches to 0, dark reddish-brown (5YR 2/2) mat of roots, moss, and decomposing parts of plants; mycelia; layer of white grains the size of sand at the bottom of the horizon; medium acid; abrupt, smooth boundary; layer is 1 to 3 inches thick.
A_2 0 to 1½ inches, gray (10YR 5/1) silt loam; common, medium, distinct, brown mottles; weak, very fine, subangular blocky structure; friable; abundant roots; charcoal particles; very strongly acid; abrupt, wavy boundary; layer is ½ to 2 inches thick.
B_2 1½ to 5 inches, brown (7.5YR 4/4) to dark yellowish-brown (10YR 4/4) silt loam; very weak, fine, subangular blocky structure; friable; roots plentiful; strongly acid; clear, wavy boundary; layer is 3 to 5 inches thick.
B_3 5 to 9 inches, olive-brown (2.5Y 4/4) silt loam; streaks and patches of brown; very weak, medium, subangular blocky structure; friable; few roots; vesicular; few rounded pebbles; medium acid; clear, wavy boundary; layer is 3 to 6 inches thick.
C 9 to 19 inches, olive (5Y 4/3) silt loam; very weak, thick, platy structure; very friable; few roots; rounded pebbles up to 2 inches in diameter; medium acid; abrupt, wavy boundary; layer is 6 to 15 inches thick.
D 19 to 30 inches +, olive (5Y 4/3) gravelly sandy loam; common, medium, distinct mottles of yellowish brown; massive breaking to weak, fine, angular blocks; firm in place but friable when disturbed; few roots; contains several boulders; strongly acid to medium acid; many feet thick.

The Kenai soils formed in loess overlying fine-grained, compact glacial till.

Profile of Kenai silt loam in the NW¼SW¼ sec. 17, T. 5 N., R. 10 W., Seward Meridian:

A_{00} 3 to 2½ inches, forest litter; abrupt, smooth boundary.
A_0 2½ inches to 0, dark reddish-brown (5YR 2/2) mat of roots and decomposing parts of plants; white and yellow mycelia; charcoal in lower part of the horizon; pockets of white grains the size of sand; very strongly acid; abrupt, smooth boundary; layer is 2 to 3 inches thick.

TABLE 8.—*Physical properties of a profile of Cohoe silt loam*

[Analyses by Soil Survey Laboratory, Lincoln, Nebraska]

Horizon	Depth	Particle-size distribution							Textural class	Moisture tension at—		
		Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Silt (0.05–0.002 mm.)	Clay (less than 0.002 mm.)		1/10 atmosphere	1/3 atmosphere	15 atmosphere
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*		*Percent*	*Percent*	*Percent*
A_2	0 to 2	0. 4	4. 0	6. 3	10. 6	14. 3	58. 8	5. 6	Silt loam	61. 0	35. 0	12. 1
B_{21}	2 to 5	. 1	4. 2	9. 6	6. 6	13. 5	61. 1	4. 9	Silt loam	54. 3	33. 7	13. 0
B_{22}	5 to 8	. 2	2. 5	4. 0	6. 2	15. 5	66. 3	5. 3	Silt loam	58. 8	33. 8	11. 2
B_3	8 to 15	. 2	3. 4	4. 1	7. 4	13. 8	64. 9	6. 2	Silt loam	56. 3	31. 2	8. 3
C	15 to 23	. 1	1. 1	1. 6	4. 1	11. 9	77. 2	4. 0	Silt loam	52. 6	29. 6	7. 6
D	23 to 53			. 1	. 8	14. 3	83. 1	1. 7	Silt	32. 0	14. 3	2. 8

TABLE 9.—*Chemical properties of a profile of Cohoe silt loam*

[Analyses by Soil Survey Laboratory, Lincoln, Nebraska]

Horizon	Depth	Reaction (1:1)	Organic carbon	Nitrogen	C/N	Free iron oxide (Fe_2O_3)	Exchangeable cations						Ca/Mg	Degree of base saturation
							Sum	Ca	Mg	Na	K	H		
	Inches	*pH*	*Percent*	*Percent*		*Percent*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*		*Percent*
A_2	0 to 2	[1] 4. 2	7. 43	0. 304	24. 4	0. 4	21. 7	2. 8	1. 2	0. 1	0. 7	16. 9	2. 3	22
B_{21}	2 to 5	4. 7	6. 35	. 226	28. 1	1. 9	39. 3	2. 7	. 8	. 1	. 6	35. 1	3. 4	11
B_{22}	5 to 8	5. 2	3. 68	. 151	24. 4	2. 0	29. 4	3. 9	1. 0	. 1	. 5	23. 9	3. 9	19
B_3	8 to 15	5. 3	2. 09	. 122	17. 1	2. 2	23. 3	3. 4	. 5	. 2	. 2	19. 0	6. 8	18
C	15 to 23	5. 4	1. 53	. 119	12. 8	1. 9	22. 4	2. 5	. 9	. 2	. 2	18. 6	2. 8	17
D	23 to 53	5. 4	. 26	. 023	11. 3	. 6	7. 2	1. 4	. 8	. 1	. 1	4. 8	1. 8	33

[1] On 1:5 rather than 1:1 soil-water mixture.

A_2 0 to 2 inches, gray (5Y 5/1) silt loam; common, medium, distinct, dark-brown mottles; weak, very thin, platy structure; friable; roots plentiful; very strongly acid; abrupt, irregular boundary; layer is 1 to 4 inches thick.

B_2 2 to 5 inches, brown (10YR 4/3) silt loam; thin layer of dark reddish-brown (5YR 3/4) at upper edge of horizon; weak, fine, subangular blocky structure; friable; roots plentiful; strongly acid; clear, wavy boundary; layer is 3 to 5 inches thick.

B_3 5 to 11 inches, dark yellowish-brown (10YR 4/4) silt loam; massive to very weak, medium, subangular blocky structure; friable; roots plentiful in upper part of horizon, few below; medium acid; clear, wavy boundary; layer is 4 to 8 inches thick.

C_1 11 to 16 inches, olive-brown (2.5Y 4/4) silt loam; large patches of dark yellowish brown; massive; friable; few roots; vesicular; medium acid to slightly acid; gradual boundary; layer is 4 to 12 inches thick.

C_2 16 to 22 inches, olive (5Y 4/3) coarse silt loam; moderate, thin, platy structure; friable; few roots; medium acid; abrupt, wavy boundary; layer is 0 to 8 inches thick.

D 22 to 36 inches +, olive (5Y 4/3) silty clay loam; somewhat pebbly; massive; firm; no roots; slightly acid; many feet thick.

The D horizon is firm when moist and very firm when dry. In many profiles, faint clay films can be seen along pores and cracks in this horizon, which appears to have many of the properties of a fragipan.

The Anchorage series consists of Podzols that have formed in sandy, dunelike deposits in a few places bordering on stream valleys and lakes.

Profile of Anchorage very fine sandy loam in the NW¼SW¼ sec. 1, T. 5 N., R. 9 W., Seward Meridian:

A_0 2 inches to 0, black (5YR 2/1) mat of roots and decomposing parts of plants; many small, white particles the size of sand; yellow mycelia plentiful; thin litter of undecomposed leaves and needles on the surface; strongly acid; abrupt, smooth boundary; layer is 1 to 3 inches thick.

A_2 0 to 2 inches, mixed gray (10YR 5/1) and dark-gray (10YR 4/1) coarse silt loam; common, small, distinct mottles of dark yellowish brown; weak, very fine, crumb structure; friable; roots plentiful; particles of charcoal; very strongly acid; abrupt, wavy boundary; layer is ½ to 2½ inches thick.

B_2 2 to 5 inches, mixed brown (7.5YR 4/4) and yellowish-red (5YR 4/6) very fine sandy loam; very weak, fine, subangular blocky structure; friable; roots plentiful; medium acid; clear, wavy boundary; layer is 2 to 3 inches thick.

B_3 5 to 10 inches, olive-brown (2.5Y 4/4) fine sand; structureless; loose in place; slightly acid; gradual boundary; layer is 4 to 7 inches thick.

C 10 to 24 inches +, olive (5Y 4/3) fine sand; structureless; loose in place; slightly acid; many feet thick.

The Bernice series consists of Podzols developed in coarse sand and gravel on steep, wooded escarpments bordering on streams, lakes, and muskegs.

Profile of Bernice sandy loam in the SE¼NE¼ sec. 21, T. 7 N., R. 12 W., Seward Meridian:

A_0 1½ inches to 0, dark reddish-brown (5YR 2/2) mat of roots and decomposing parts of plants; thin litter of undecomposed material on the surface; strongly acid.

A_2 0 to 3 inches, dark-gray (5Y 4/1) sandy loam, gray (5Y 5/1) when dry; very weak, fine, crumb structure; friable; roots plentiful; pockets of silt loam near the surface; very strongly acid; abrupt, irregular boundary; layer is 2 to 5 inches thick.

B_2 3 to 7 inches, dark reddish-brown (5YR 3/3) loamy sand, brown (7.5YR 4/4) when dry; pockets of dark yellowish-brown (10YR 4/4), light yellowish-brown (10YR 6/4) when dry; some gravel; structureless; loose in place; roots plentiful; strongly acid; clear, irregular boundary; layer is 2 to 6 inches thick.

C 7 to 18 inches +, dark yellowish-brown (10YR 3/4) gravelly sand, yellowish-brown (10YR 5/4) when dry; structureless; loose in place; roots plentiful in upper 6 inches, few below; reddish coating on some pebbles; pebbles rounded; strongly acid; many feet thick.

Brown Podzolic soils

Brown Podzolic soils are similar to Podzols in that they are formed by the same processes, but they are not so highly developed as Podzols. The gray, leached layer below the surface mat of organic material is thin, if it is present at all, and the horizon of accumulation of iron, aluminum, and organic matter is less distinct. Nevertheless, the soils are acid. In the Kenai-Kasilof Area, Brown Podzolic soils occur chiefly on the lower terraces of the principal rivers. Most of these areas have been burned over. This burning and the likelihood that the loess on these terraces was deposited at a slightly later time than the loess on higher areas may account for the lack of more strongly podzolized profiles in these soils.

Soils in the Tustumena, Kasilof, and Boulder Point series are Brown Podzolic soils. The Tustumena soils have developed in moderately deep loess on gravelly terraces along the Kenai and Kasilof Rivers.

Profile of Tustumena silt loam in the NE¼NW¼ sec. 11, T. 3 N., R. 12 W., Seward Meridian:

A_0 2 inches to 0, black (5YR 2/1) mat of roots and decomposing parts of plants; mycelia; much charcoal; very strongly acid to strongly acid; abrupt, smooth boundary; layer is 1 to 3 inches thick.

A_1 0 to 2 inches, very dark brown (10YR 2/2) silt loam; weak, very fine, subangular blocky structure; friable; roots plentiful; much charcoal; strongly acid; abrupt, highly irregular boundary; tongues project along old root channels several inches into B horizon; layer is ½ to 6 inches thick.

B 2 to 12 inches, brown (10YR 4/3) silt loam; patches of dark-brown (7.5YR 3/2), mostly in upper part of horizon; few, fine, faint mottles of olive brown; few streaks of yellowish brown; weak, fine to medium, subangular blocky structure; friable; few roots; medium acid; gradual boundary; layer is 8 to 15 inches thick.

C 12 to 16 inches, olive (5Y 4/3) silt loam; few rounded pebbles less than 2 inches in diameter; weak, thick, platy structure; friable; few roots; medium acid; abrupt, wavy boundary; layer is 3 to 6 inches thick.

D 16 to 30 inches +, gravelly sand; color varies with individual grains, but olive is overall color when moist; structureless; loose in place; few roots; medium acid; pebbles are rounded; many feet thick.

The Kasilof soils have developed in very shallow loess on very recent terraces of the principal streams. These terraces are lower than those on which the Tustumena soils occur. In many places rapid percolation of water through the soils has resulted in slightly stronger profile development.

Profile of Kasilof silt loam in the NE¼NW¼ sec. 31, T. 3 N., R. 11 W., Seward Meridian:

A_{00} 3 to 2½ inches, loose forest litter.

A_0 2½ inches to 0, dark reddish-brown (5YR 3/2) and black (5YR 2/1) mat of decomposing organic material; mycelia; many roots; charcoal fragments; few white sand grains; abrupt, smooth boundary.

A_1 0 to 3 inches, very dark brown (10YR 2/2) silt loam; patches and streaks of dark brown and very dark gray; very thin lenses of fine sand; weak, fine, granular structure; very friable; many roots; many charcoal fragments; abrupt, wavy boundary.

B 3 to 7 inches, dark-brown (7.5YR 4/4) coarse silt loam; patches and streaks of dark reddish brown and yellowish brown; few small pebbles; weak, medium, granular structure; very friable; roots common; clear, wavy boundary.

C–D 7 to 9 inches, olive-brown (2.5Y 4/4) fine gravelly loam; weak, fine, subangular blocky structure; friable to loose; roots common; abrupt, wavy boundary.

D_1 9 to 16 inches, patches and streaks of yellowish-brown (10YR 5/4) and dark reddish-brown (5YR 3/2) gravelly very coarse sand; structureless; loose except for slight cementation in the dark reddish-brown patches; few roots; abrupt, smooth boundary.

D_2 16 to 22 inches, mixed olive (5Y 4/3) and dark yellowish-brown (10YR 3/4) fine sand; structureless; loose; few roots; abrupt, smooth boundary.

D_3 22 to 30 inches +, gravel and coarse sand.

The Boulder Point soils, which occur along certain parts of the sea cliffs in relatively recently deposited, wind-laid material, are only slightly podzolized, and they retain many of the properties of the parent material. They are included in the great soil group of Brown Podzolic soils, although they are probably intermediate between Brown Podzolic soils and Regosols.

Profile of Boulder Point very fine sandy loam in the NW¼NW¼ sec. 2, T. 7 N., R. 12 W., Seward Meridian:

A_{00} 4 to 3 inches, litter of leaves of grass, trees, and shrubs and of woody parts of plants.

A_0 3 inches to 0, dark reddish-brown (5YR 2/2) mat of roots and decomposing parts of plants; medium acid; abrupt, smooth boundary; layer is 2 to 3 inches thick.

A_1 0 to 3 inches, black (10YR 2/1) very fine sandy loam; very weak, fine, granular structure; friable; abundant roots; strongly acid; clear, wavy boundary; layer is 2 to 4 inches thick.

B_{21} 3 to 6 inches, dark reddish-brown (5YR 2/2) very fine sandy loam; very weak, fine, subangular blocky structure; friable; abundant roots; strongly acid; clear, wavy boundary; layer is 2 to 4 inches thick.

B_{22} 6 to 11 inches, dark reddish-brown (5YR 3/4) coarse silt loam grading to brown (7.5YR 4/4) in lower part of horizon; weak, medium, subangular blocky structure; friable; roots plentiful; strongly acid; clear, wavy boundary; layer is 4 to 7 inches thick.

C_1 11 to 17 inches, brown (10YR 4/3) silt loam; weak, medium, subangular blocky structure; friable; few roots; vesicular; strongly acid; gradual boundary.

C_2 17 to 25 inches, dark yellowish-brown (10YR 4/4) silt loam; weak, medium to coarse, subangular blocky structure; friable; few roots; vesicular; strongly acid; clear, wavy boundary.

C_3 25 to 31 inches, light olive-brown (2.5Y 5/4) silt loam; common, medium, distinct mottles of strong brown; moderate, coarse, subangular blocky structure; friable; few roots; highly vesicular; strongly acid; abrupt, wavy boundary.

D 31 to 40 inches +, olive-gray (5Y 5/2) stony silt loam; common, coarse, distinct mottles of yellowish brown; about 25 percent of horizon consists of subangular stones larger than 3 inches; silt loam fraction is friable; thin lens of gravelly sandy loam at top of horizon; medium acid; many feet thick.

Regosols

Regosols are soils that consist of deep, unconsolidated mineral material in which few, if any, clearly expressed soil characteristics have developed. Soils in the Island series belong to this great soil group, but they also have some characteristics of the Ando great soil group. Soils of that group typically are high in organic-matter content, are strongly acid, have a low degree of base saturation, and have allophane as the dominant clay mineral.

The Island soils occur in shallow depressions in the forested uplands. Their principal vegetation, however, consists of tussocks of grass rather than forest, and the soil surface is very hummocky. The soils are well drained despite their position. It is likely that these soils formerly were not so well drained as they now are, and that the hummocky surface developed as a result of soil heaving during that time. In many places spruce is invading areas of Island soils, and the soils are degrading to Podzols.

Profile of Island silt loam in the SW¼SE¼ sec. 2, T. 7 N., R. 12 W., Seward Meridian:

A_1 0 to 4 inches, dark reddish-brown (5YR 2/2) silt loam; weak to moderate, fine, subangular blocky structure; friable; roots plentiful; medium acid; clear, wavy boundary; layer is 4 to 5 inches thick.

A_3 4 to 14 inches, dark-brown (10YR 3/3) silt loam; patches of yellowish brown; weak to moderate, medium, subangular blocky structure; friable; roots plentiful to few; medium acid; clear, wavy boundary; layer is 6 to 12 inches thick.

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AC 14 to 21 inches, olive-brown (2.5Y 4/4) silt loam; massive; friable; few roots; vesicular; medium acid; gradual boundary; layer is 5 to 8 inches thick.

C 21 to 25 inches, olive (5Y 4/3) silt loam; moderate, thin, platy structure; friable; few roots; medium acid; clear, wavy boundary; layer is 4 to 8 inches thick.

D_1 25 to 31 inches, olive (5Y 4/3) fine gravelly silt loam; common, medium, prominent mottles of strong brown; mottling more prevalent toward bottom of horizon; massive to weak, medium, platy structure; moderately firm; few roots; medium acid; abrupt, wavy boundary; layer is 2 to 10 inches thick.

D_2 31 to 42 inches +, gravelly sand; various colors but dominantly brown; structureless; loose in place; pebbles are rounded; medium acid to slightly acid; many feet thick.

Low-Humic Gley soils

In the Low-Humic Gley soils, which occur in areas with poor drainage or imperfect drainage, there is little differentiation of horizons within the soil profile. Beneath a thin mat of organic material and a weakly developed A_1 horizon the soil is mottled or streaked, commonly with shades of brown. Ordinarily, the dominant color throughout the profile is olive, but the wetter soils are bluish.

The vegetation on these soils consists of a forest of black spruce, white spruce, birch, willow, and balsam poplar. Ordinarily, the ground cover is grassy, and open areas of grass and forbs are common. In many places, however, the ground cover consists entirely of moss and low shrubs, such as Labrador-tea, bog birch, and lingenberry.

The most extensive Low-Humic Gley soils in the Kenai-Kasilof Area are soils in the Kalifonsky series, which ordinarily border on muskegs and lakes.

Profile of Kalifonsky silt loam in the SW¼SW¼ sec. 28, T. 6 N., R. 11 W., Seward Meridian:

A_{00} 4 to 3 inches, forest litter.

A_0 3 inches to 0, dark reddish-brown (5YR 2/2) mat of roots, moss, and decomposing parts of plants; white and yellow mycelia plentiful; many small, white particles of the size of sand; abrupt, smooth boundary.

A_1 0 to 2 inches, black (N 2/0) and dark reddish-brown (5YR 2/2) silt loam; weak, very fine, granular structure; friable; roots plentiful; abrupt, wavy boundary.

C_1 2 to 11 inches, mixed olive-brown (2.5Y 4/4) and dark grayish-brown (2.5Y 4/2) silt loam; common, medium, faint mottles of dark yellowish brown; massive breaking to weak, coarse, angular blocks; friable; few roots; clear, wavy boundary.

C_2 11 to 24 inches, olive-gray (5Y 5/2) silt loam; many, coarse, distinct mottles of dark yellowish brown (centers of mottles are yellowish red); broad streaks of olive brown; massive breaking to weak, coarse, angular blocks; friable; few roots; abrupt, smooth boundary.

D 24 to 42 inches +, olive (5Y 4/3) coarse sand; few pebbles; structureless; loose in place; many feet thick.

Tables 10 and 11 give the results of analyses of samples taken from this profile. This profile differs from most other profiles of Kalifonsky silt loam in that the substratum is sandy rather than gravelly.

The Killey soils, which are much less extensive than the Kalifonsky soils, occupy similar positions but formed in sandy rather than silty material.

Profile of Killey sandy loam in the SW¼SW¼ sec. 14, T. 2 N., R. 12 W., Seward Meridian:

A_{00} 4 to 3 inches, forest litter.

A_0 3 inches to 0, dark reddish-brown (5YR 2/2) mat of roots and decomposing parts of plants; mycelia; very strongly acid; abrupt, smooth boundary; layer is 2 to 4 inches thick.

A_1 0 to 2 inches, dark reddish-brown (5YR 2/2) loam; irregular streaks and patches of very dark grayish brown; streaks of charcoal; weak, fine, granular structure; friable; abundant roots; very strongly acid; abrupt, wavy boundary; layer is 1 to 1½ inches thick.

AC 2 to 10 inches, brown (7.5YR 4/4 and 10YR 4/3) sandy loam; very dark brown (10YR 2/2) tongues projecting downward from A_1; few patches of yellowish brown; weak, medium, subangular blocky structure; friable to loose; roots plentiful; strongly acid to very strongly acid; clear, wavy boundary; layer is 6 to 12 inches thick.

C 10 to 22 inches, lenses and pockets of brown (7.5YR 4/4) sandy loam and mixed olive-brown (2.5Y 4/4) and dark-brown (10YR 3/3) coarse silt loam; sandy loam has weak, coarse, subangular blocky structure; silt loam has weak, very fine, granular structure; friable; few roots; medium acid to strongly acid; gradual boundary.

D_1 22 to 33 inches, olive (5Y 4/3) silt loam; massive crushing to weak, very fine granules; friable; few roots; few patches of sandy loam; strongly acid; abrupt, wavy boundary; layer is 3 to 15 inches thick.

D_2 33 to 42 inches +, olive (5Y 4/4) fine sand; structureless; loose in place; medium acid to strongly acid; many feet thick.

Included in the Low-Humic Gley great soil group are soils in the Karluk series, which formed in deposits of diatomaceous earth (7). These soils are heavier and more plastic than the other imperfectly drained soils and are grayish rather than olive in color. The vegetation is dominantly grass and forbs rather than forest.

TABLE 10.—*Particle-size distribution in a profile of Kalifonsky silt loam*

[Analyses by Soil Survey Laboratory, Lincoln, Nebraska]

Horizon	Depth	Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Silt (0.05–0.002 mm.)	Clay (less than 0.002 mm.)	Textural class
	Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
A_1	0 to 2	4. 7	4. 4	5. 2	9. 5	9. 1	59. 8	7. 3	Silt loam.
C_1	2 to 11	. 1	1. 3	3. 5	5. 4	12. 3	74. 7	2. 7	Silt loam.
C_2	11 to 24	<. 1	1. 2	2. 9	4. 8	12. 7	75. 2	3. 2	Silt loam.
D	24 to 42	. 6	15. 5	59. 7	22. 5	. 6	. 7	. 4	Sand.

TABLE 11.—*Chemical properties of a profile of Kalifonsky silt loam*

[Analyses by Soil Survey Laboratory, Lincoln, Nebraska]

Horizon	Depth	Reaction (1:1)	Organic carbon	Nitrogen	C/N	Free iron oxide (Fe_2O_3)	Exchangeable cations						Ca/Mg	Degree of base saturation
							Sum	Ca	Mg	Na	K	H		
	Inches	*pH*	*Percent*	*Percent*		*Percent*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*	*Meq./100 gm.*		*Percent*
A_0	3 to 0	[1] 3. 9	37. 74	1. 071	35. 2									
A_1	0 to 2	4. 3	21. 22	. 606	35. 0	1. 4	68. 1	3. 3	0. 8	0. 1	0. 3	63. 6	4. 1	7
C_1	2 to 11	5. 4	2. 36	. 123	19. 2	1. 9	23. 4	. 5	. 4	. 1	. 1	22. 3	1. 2	5
C_2	11 to 24	5. 5	1. 40	. 070	20. 0	1. 6	16. 1	. 5	. 4	. 1	. 2	14. 9	1. 2	7
D	24 to 42	5. 6	. 07			. 3	3. 0	. 1	. 4	<. 1	. 1	2. 4	1. 2	20

[1] On 1:3 rather than 1:1 soil-water mixture.

Profile of Karluk silt loam in the SW¼NE¼ sec. 21, T. 7 N., R. 12 W., Seward Meridian:

A_0 2½ inches to 0, black (10YR 2/1) mat of roots and decomposing leaves of grasses, forbs, and shrubs; strongly acid to medium acid; abrupt, smooth boundary; layer is 2 to 4 inches thick.

A_1 0 to 3 inches, mixed black (10YR 2/1), very dark gray (10YR 3/1), and very dark grayish-brown (10YR 3/2) silt loam; weak, very fine, granular structure; friable; abundant roots; strongly acid to very strongly acid; abrupt, wavy boundary; layer is 2 to 4 inches thick.

AC_g 3 to 8 inches, grayish-brown (10YR 5/2) silt loam; many, medium, distinct mottles of yellowish red and dark reddish brown; weak, thin, platy structure; friable; roots plentiful; strongly acid; clear, wavy boundary; layer is 4 to 8 inches thick.

C_{1g} 8 to 16 inches, light brownish-gray (10YR 6/2) fine silt loam; common, medium, distinct mottles of dark reddish brown; many black, old root channels; weak, thin, platy structure; friable; plastic; roots plentiful; strongly acid; clear, wavy boundary; layer is 5 to 10 inches thick.

C_{2g} 16 to 30 inches +, mixed light brownish-gray (10YR 6/2) and brown (10YR 5/3) fine silt loam; common, medium, distinct mottles of dark reddish brown; moderate, very thin, platy structure; friable; plastic; few roots; medium acid to strongly acid; in places, soil shows patterns, independent of structure, of leaves and stems in brown on a matrix of light brownish gray; many feet thick.

Humic Gley soils

In the Humic Gley soils, most of which are poorly drained, a moderately thick, dark-colored horizon of mixed mineral and organic matter has formed immediately beneath a surface mat of moss and decomposing parts of plants. Most of the soil profile, however, consists of highly mottled, olive or, in some places, bluish mineral matter.

These soils are almost always wet. They support forests of black spruce, willow, and, in some places, balsam poplar. Grasses and forbs make up much of the ground cover, but shrubs common to wet areas are also prominent. There are many open, unforested places, ordinarily in the wetter areas.

The Humic Gley soils recognized in the Kenai-Kasilof Area are distinguished from each other by the texture and degree of development of the dark-colored surface horizon. The most extensive Humic Gley soils of the depressions in the uplands are those of the Coal Creek series.

Profile of Coal Creek silt loam in the NW¼SE¼ sec. 29, T. 2 N., R. 12 W., Seward Meridian:

A_0 2 inches to 0, dark reddish-brown (5YR 2/2) mat of roots and decomposing parts of plants; mycelia; strongly acid; abrupt, smooth boundary; layer is 2 to 3 inches thick.

A_{11} 0 to 4 inches, very dark grayish-brown (10YR 3/2) silt loam; common, medium, faint mottles of grayish brown and few, medium, distinct mottles of dark reddish brown; very weak, thick, platy structure breaking to weak, very fine, subangular blocky; nonsticky; roots plentiful; strongly acid; gradual boundary; layer is 4 to 5 inches thick.

A_{12g} 4 to 9 inches, dark-brown (10YR 3/3) silt loam; common, medium, distinct mottles of dark reddish brown, mostly along old root channels; massive; nonsticky; roots plentiful; strongly acid; clear, smooth boundary; layer is 4 to 5 inches thick.

C_{1g} 9 to 16 inches, olive-gray (5Y 4/2) silt loam; many, large, distinct, brown mottles; massive; nonsticky; few roots; medium acid; clear, smooth boundary.

C_{2g} 16 to 21 inches, olive-gray (5Y 4/2) silt loam; few, medium, distinct mottles of dark yellowish brown; massive; nonsticky; medium acid; clear, wavy boundary.

C_{3g} 21 to 27 inches, dark-brown (10YR 3/3) silt loam; common, medium, distinct mottles of gray and dark reddish brown; massive; nonsticky; vesicular; medium acid; abrupt, wavy boundary.

D_g 27 to 40 inches +, mixed olive-gray (5Y 5/2) and brown (10YR 4/3) pebbly heavy silt loam; massive; moderately firm; coarse vesicles; medium acid; many feet thick.

Torpedo Lake soils, which also occur in depressions in the uplands, differ from the Coal Creek soils in having a darker colored surface layer, in containing many angular stones, and in being underlain by finer-textured material.

Profile of Torpedo Lake silt loam in the NW¼SE¼ sec. 13, T. 5 N., R. 8 W., Seward Meridian:

A_0 4 inches to 0, very dark brown (10YR 2/2) mat of roots and decomposing leaves of grasses and forbs; strongly acid; abrupt, smooth boundary; layer is 3 to 6 inches thick.

A_{11} 0 to 7 inches, dark reddish-brown (5YR 2/2) silt loam streaked with black (N 2/0); weak, medium, platy structure crushing to fine granules; nonsticky; abundant roots; strongly acid; clear, wavy boundary; layer is 5 to 10 inches thick.

A_{12} 7 to 15 inches, mixed very dark grayish-brown (2.5Y 3/2) and dark reddish-brown (5YR 2/2) stony silt loam; weak, coarse, subangular blocky structure breaking to weak, thick, platy; nonsticky; roots plentiful; stones are angular and make up about 20 percent of the horizon; strongly acid; clear, wavy boundary; layer is 5 to 10 inches thick.

C_g 15 to 26 inches, dark greenish-gray (5GY 4/1) silt loam; moderate, thin, platy structure; nonsticky; few roots; vesicular; strongly acid; abrupt, wavy boundary; layer is 8 to 15 inches thick.

D_g 26 to 36 inches +, greenish-gray (5GY 6/1) clay loam; common, medium, distinct mottles of pale olive; angular pebbles; massive breaking to coarse, angular blocks; firm; no roots; strongly acid; becomes firmer and stonier with depth; mottling changes to yellowish brown with depth; many feet thick.

Clam Gulch soils, which occur on alluvial plains and on the borders of muskegs, have a much finer texture in the substratum.

Profile of Clam Gulch silt loam in the SW¼NE¼ sec. 23, T. 4 N., R. 11 W., Seward Meridian:

A_{00} 6 to 3 inches, live moss.

A_0 3 inches to 0, dark-brown (7.5YR 3/2, moist) to light yellowish-brown (10YR 6/4, squeezed) moss peat mixed with roots and other parts of plants; very strongly acid to extremely acid; abrupt, smooth boundary; layer is 2 to 4 inches thick.

A_1 0 to 4 inches, dark reddish-brown (5YR 2/2) silt loam; white grains the size of sand; weak, fine, subangular blocky structure; nonsticky; abundant roots; very strongly acid to extremely acid; clear, wavy boundary; layer is 4 to 5 inches thick.

AC 4 to 12 inches, dark reddish-brown (5YR 3/2) silt loam; patches and streaks of brown (10YR 4/3) toward bottom of horizon; massive; nonsticky; few roots; few small pebbles; strongly acid; abrupt, smooth boundary; layer is 4 to 8 inches thick.

D_g 12 to 24 inches +, olive (5Y 5/3) silty clay loam; massive; firm; sticky; few roots; small pebbles common; many small, irregular vesicles with smooth, shiny sides; medium acid; many feet thick; becomes firmer and somewhat finer with depth.

Slikok soils, which also occur on alluvial plains, are very poorly drained and have a black, highly organic surface horizon.

Profile of Slikok mucky silt loam in the SE¼SE¼ sec. 33, T. 8 N., R. 11 W., Seward Meridian:

A_{00} 2 inches to 0, dark reddish-brown (5YR 2/2) mat of roots and leaves of grass.

A_{11} 0 to 4 inches, black (10YR 2/1) mucky silt loam; weak, fine, granular structure; nonsticky; abundant roots; strongly acid; clear, wavy boundary; layer is 3 to 6 inches thick.

A_{12} 4 to 9 inches, black (10YR 2/1) mucky silt loam; weak, fine, subangular blocky structure; nonsticky; roots plentiful; strongly acid; clear, wavy boundary; layer is 3 to 9 inches thick.

AC 9 to 24 inches, dark-brown (10YR 3/3) silt loam; pockets of sand and angular stones; massive breaking to coarse, angular blocks; nonsticky; few roots; medium acid; abrupt, wavy boundary; layer is 10 to 20 inches thick.

D_g 24 to 36 inches +, dark greenish-gray (5BG 4/1) gravelly heavy silt loam; massive; slightly sticky; few roots; strongly acid; thin layer of sandy loam in uppermost part of horizon; many feet thick.

Coarse-textured Humic Gley soils are represented by two series—Moose River and Foreland. Soils in the Moose River series, which occur on flood plains bordering on many of the smaller streams, are generally sandy.

Profile of Moose River silt loam in the NE¼NE¼ sec. 1, T. 2 N., R. 12 W., Seward Meridian:

A_0 5 inches to 0, very dark brown (10YR 2/2) mat of roots, moss peat, and decomposing parts of plants; strongly acid to medium acid; abrupt, smooth boundary; layer is 3 to 6 inches thick.

A_1 0 to 5 inches, very dark grayish-brown (2.5Y 3/2) silt loam; very weak, thin, platy structure; nonsticky; roots plentiful; pockets and thin layers of olive sand; medium acid; abrupt, wavy boundary; layer is 4 to 8 inches thick.

D_{1g} 5 to 30 inches, dark greenish-gray (5GY 4/1) fine sand; thin lenses of silt loam and peat; structureless; loose; no roots; medium acid; layer is 15 to 40 inches thick.

D_{2g} 30 inches +, dark greenish-gray (5GY 4/1) gravelly sand; structureless; loose; no roots; many feet thick.

Soils in the Foreland series, which are much less extensive than Moose River soils, are gravelly except for a dark-colored silty layer at the surface.

Profile of Foreland silt loam in the SW¼SE¼ sec. 30, T. 3 N., R. 11 W., Seward Meridian:

A_{00} 6 inches to 0, brown (7.5YR 5/4, moist) to pink (7.5YR 8/4, squeezed dry) undecomposed moss peat; roots of trees and shrubs abundant; extremely acid; abrupt, smooth boundary; layer is 4 to 8 inches thick.

A_1 0 to 4 inches, mixed very dark brown (10YR 2/2), dark reddish-brown (5YR 2/2), and black (N 2/0) silt loam; massive; nonsticky; charcoal in upper part; admixture of stones in lower part; very strongly acid; clear, wavy boundary; layer is 3 to 6 inches thick.

D_g 4 to 18 inches +, gravelly sand; color varies with individual grains, but olive is overall color when soil material is moist; all gravel is rounded, but no pebbles are larger than 3 inches in diameter; structureless; loose in place; medium acid; many feet thick.

Soils in the Pincher series formed over stratified material in depressions and shallow drainageways on broad plains and low hills. They are not so poorly drained as the other Humic Gley soils, and they have a thinner dark-colored surface horizon.

Profile of Pincher silt loam in the NW¼NW¼ sec. 10, T. 5 N., R. 9 W., Seward Meridian:

A_0 2 inches to 0, very dark brown (10YR 2/2) organic material; black (N 2/0) near the surface where burned; strongly acid; abrupt, smooth boundary; layer is 2 to 4 inches thick.

A_1 0 to 5 inches, very dark brown (10YR 2/2) silt loam; common, medium, faint mottles of dark yellowish brown and patches of black; weak, fine, subangular blocky structure; friable; roots plentiful; strongly acid to medium acid; generally clear, wavy boundary, but where boundary coincides with old root channels it is irregular; layer is 3 to 6 inches thick.

B 5 to 14 inches, olive-brown (2.5Y 4/4) silt loam; very dark grayish-brown (2.5Y 3/2) irregular streaks toward bottom of horizon; weak, coarse, subangular blocky structure crushing to very fine granules; friable; roots plentiful; medium acid; clear, wavy boundary; layer is 6 to 10 inches thick.

C_g 14 to 19 inches, olive-gray (5Y 4/2) coarse silt loam; few, fine, faint mottles of olive brown; massive; friable; few roots; vesicular; slightly acid to medium acid; abrupt, smooth boundary.

D_{1g} 19 to 22 inches, olive-gray (5Y 4/2) loamy sand; structureless; loose in place; no roots; slightly acid; abrupt, smooth boundary.

D_{2g} 22 to 30 inches +, layered olive-gray (5Y 4/2) fine silt loam and olive-gray (5Y 4/2) sandy loam; common, medium, faint mottles of olive brown; silt loam is massive, firm, and vesicular; sandy loam is massive and friable; no roots; slightly acid to neutral.

Only two small areas of Corea soils were mapped in the Area. These soils formed from silty colluvium and consist mostly of alternate layers of silty and mucky material. They have a high content of organic matter. These soils have properties that are intermediate between those of Humic Gley soils and those of Bog soils.

Bog soils

Organic soils are widely distributed in the Kenai-Kasilof Area. Most of the existing lakes are bordered by these soils. In other depressions, the basins are almost completely filled by organic material, and there are only scattered pools of open water and channels of sluggish streams.

Salamatof soils are the most extensive of the Bog soils. They consist chiefly of undecomposed sphagnum moss peat, and in most places there are also layers of sedge peat. The surface layer is always composed of sphagnum moss. The soils are always saturated. The vegetation consists principally of low shrubs, sedges, and black spruce in addition to the moss.

Profile of Salamatof peat in the NE¼NE¼ sec. 3, T. 6 N., R. 12 W., Seward Meridian:

0 to 6 inches, dark reddish-brown (5YR 3/4, wet) to pink (7.5YR 7/4, squeezed dry) moss; many roots of woody shrubs; very strongly acid; layer is 3 to 8 inches thick.
6 to 9 inches, dark reddish-brown (5YR 2/2, wet; 5YR 3/2, squeezed dry), dense mat of roots and moss peat; very strongly acid to extremely acid; layer is 0 to 4 inches thick.
9 to 48 inches +, dark reddish-brown (5YR 3/3, wet) to brown (7.5YR 5/4, squeezed dry) moss peat mixed with fibrous peat; few roots below 18 inches; medium acid; 30 inches to many feet thick.

In the Salamatof soils, the peat is usually more than 4 feet thick over the mineral substratum. Moss peat less than 30 inches thick is separated as the Doroshin series if it occurs in undrained depressions, or as the Clunie series if it overlies bluish, fine-grained tidal deposits similar to those mapped as Tidal marsh.

In the Starichkof soils, the peat is more finely divided than the peat in the Salamatof soils. There are some layers of coarse peat in Starichkof soils, however, either on the surface or deeper in the profile. It is likely that the level of the water table has fluctuated from time to time and that, during the drier periods, the peat has been slightly decomposed. At the present time, the ground water is always near or at the surface in most areas of Starichkof soils.

Profile of Starichkof peat in the NE¼NW¼ sec. 28, T. 2 N., R. 12 W., Seward Meridian:

2 inches to 0, dark reddish-brown (5YR 2/2, moist; 5YR 3/3, squeezed dry) living moss; few roots of sedges and shrubs.
0 to 3 inches, black (N 2/0, moist and squeezed dry), coarse moss peat; extremely acid; layer is 2 to 5 inches thick.
3 to 8 inches, dark reddish-brown (5YR 2/2, moist; 5YR 3/4, squeezed dry), coarse moss peat; very strongly acid to strongly acid; layer is 4 to 8 inches thick.
8 to 36 inches +, dark reddish-brown (5YR 3/2), finely divided peat; no color change when squeezed; few thin lenses of dark-brown (10YR 3/3) silt loam; very strongly acid to strongly acid; very thin layer of white sand grains at top of horizon; 24 inches to many feet thick.

The Nikolai soils, which occur in a narrow strip along the coast, differ from the other peat soils in the Kenai-Kasilof Area in several respects. The water table is low. The peat is from plants other than mosses, is well decomposed, is arranged in thin layers, and contains thin lenses of silt. These soils support a dense stand of grass. It is likely that they developed in slightly higher and better drained areas near the edges of large muskegs.

Profile of Nikolai silty peat in the SW¼SE¼ sec. 12, T. 4 N., R. 12 W., Seward Meridian:

6 to 3 inches, mat of mostly undecomposed leaves and stems of grasses.
3 inches to 0, dark reddish-brown (5YR 2/2) and black (N 2/0) mat of roots and decomposing stems and leaves of grasses; contains charcoal; very strongly acid; abrupt, smooth boundary; layer is 2 to 5 inches thick.
0 to 7 inches, dark reddish-brown (5YR 2/2) silty peat; peat is finely divided; moderate, very fine, granular structure; weakly laminated; very friable and slick; abundant roots; very strongly acid to strongly acid; clear, wavy boundary; layer is 5 to 10 inches thick.
7 to 24 inches +, mixed dark reddish-brown (5YR 2/2, 5YR 3/3) and black (N 2/0) peat; very finely laminated in place; in places thin layers of silt between laminations; crumbles easily to very friable, slick consistence; roots plentiful; very strongly acid; patches of brown (10YR 5/3) silt loam and very thin layers of white sand grains; 1½ to more than 4 feet thick; overlies loose sand or sand and gravel.

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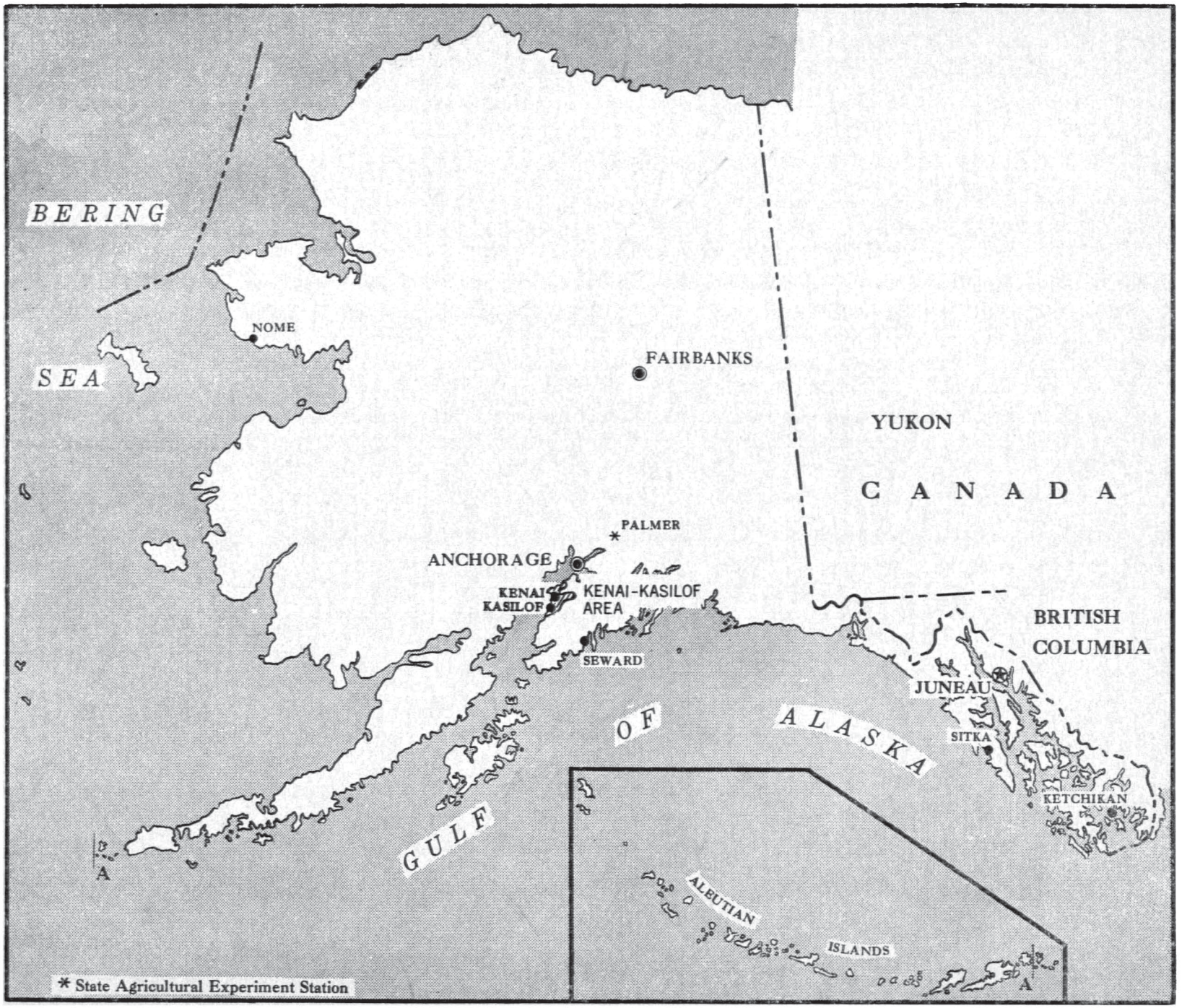
[See table 3, page 8, for approximate acreage and proportionate extent of the soils. See tables 4, 5, and 6, pages 30, 32, and 38, for information on the engineering properties of the soils]

Map symbol	Mapping unit	Page	Management Group	Management Page
AnA	Anchorage very fine sandy loam, nearly level	9	14	27
AnC	Anchorage very fine sandy loam, rolling	9	21	28
BeE	Bernice sandy loam, strongly sloping to steep	9	21	28
BoB	Boulder Point very fine sandy loam, gently sloping	10	1	25
BoC	Boulder Point very fine sandy loam, rolling	10	7	26
BoE	Boulder Point very fine sandy loam, hilly to steep	10	15	27
Ca	Clam Gulch silt loam	10	10	26
Ce	Clunie peat	10	19	27
CkA	Coal Creek silt loam, nearly level	11	10	26
CkB	Coal Creek silt loam, gently sloping	11	10	26
CoA	Cohoe silt loam, nearly level	11	2	25
CoB	Cohoe silt loam, gently sloping	11	1	25
CoC	Cohoe silt loam, moderately sloping	11	3	25
CoD	Cohoe silt loam, strongly sloping	11	8	26
CpC	Cohoe-Kenai association, rolling	11	7	26
CpD	Cohoe-Kenai association, hilly	11	15	27
CpE	Cohoe-Kenai association, moderately steep	11	15	27
CpF	Cohoe-Kenai association, steep	12	17	27
Cr	Corea silt loam	12	11	26
Do	Doroshin peat	12	19	27
Fo	Foreland silt loam	12	18	27
Gb	Gravelly beach (land type)	12	23	28
IaA	Island silt loam, nearly level	13	2	25
IaB	Island silt loam, gently sloping	13	1	25
KaA	Kalifonsky silt loam, nearly level	13	9	26
KaB	Kalifonsky silt loam, gently sloping	13	9	26
Kc	Karluk silt loam	14	11	26
KfA	Kasilof silt loam, nearly level	14	16	27
KfB	Kasilof silt loam, gently sloping	14	16	27
KnA	Kenai silt loam, nearly level	14	5	25
KnB	Kenai silt loam, gently sloping	14	5	25
KnC	Kenai silt loam, moderately sloping	15	12	27
KnCC	Kenai silt loam, rolling	15	7	26
KnD	Kenai silt loam, strongly sloping	15	8	26
KnDD	Kenai silt loam, hilly	15	15	27
KnE	Kenai silt loam, moderately steep	15	15	27
KnF	Kenai silt loam, steep	15	17	27
Kg	Killey sandy loam	15	9	26
LoA	Longmare silt loam, nearly level	15	4	25
LoB	Longmare silt loam, gently sloping	16	4	25
Mo	Moose River silt loam	16	10	26
Ms	Moose River silt loam, shallow	16	18	27
NaA	Naptowne silt loam, nearly level	16	2	25
NaB	Naptowne silt loam, gently sloping	16	1	25
NaC	Naptowne silt loam, moderately sloping	16	3	25
NaCC	Naptowne silt loam, rolling	16	7	26
NaD	Naptowne silt loam, strongly sloping	16	8	26
NaDD	Naptowne silt loam, hilly	17	15	27
NaE	Naptowne silt loam, moderately steep	17	15	27
NaF	Naptowne silt loam, steep	17	17	27
NkA	Nikishka silt loam, nearly level	17	6	26
NkB	Nikishka silt loam, gently sloping	17	6	26
NkC	Nikishka silt loam, moderately sloping	17	13	27
NkD	Nikishka silt loam, strongly sloping	17	13	27
NkE	Nikishka silt loam, moderately steep	17	15	27
NkF	Nikishka silt loam, steep	17	17	27
Np	Nikolai silty peat	18	11	26
Pe	Pincher silt loam	18	4	25
Sa	Salamatof peat	18	19	27
Sb	Salamatof peat, forested	18	22	28
Sc	Sea cliff (land type)	18	23	28
Sk	Slikok mucky silt loam	19	10	26
SlA	Soldatna silt loam, nearly level	20	2	25
SlB	Soldatna silt loam, gently sloping	20	1	25
SlC	Soldatna silt loam, moderately sloping	20	3	25
SnC	Soldatna-Nikishka association, rolling	20	7	26
SnD	Soldatna-Nikishka association, hilly	20	15	27
SnE	Soldatna-Nikishka association, moderately steep	20	15	27
SnF	Soldatna-Nikishka association, steep	20	17	27
Sr	Starichkof peat	20	19	27
St	Starichkof peat, forested	21	22	28
Ta	Tidal flats	21	23	28
Tm	Tidal marsh	21	20	28
To	Torpedo Lake silt loam	21	10	26
TuA	Tustumena silt loam, nearly level	22	2	25
TuB	Tustumena silt loam, gently sloping	22	1	25
TuC	Tustumena silt loam, moderately sloping	22	3	25



Location of Kenai-Kasilof Area in Alaska.

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