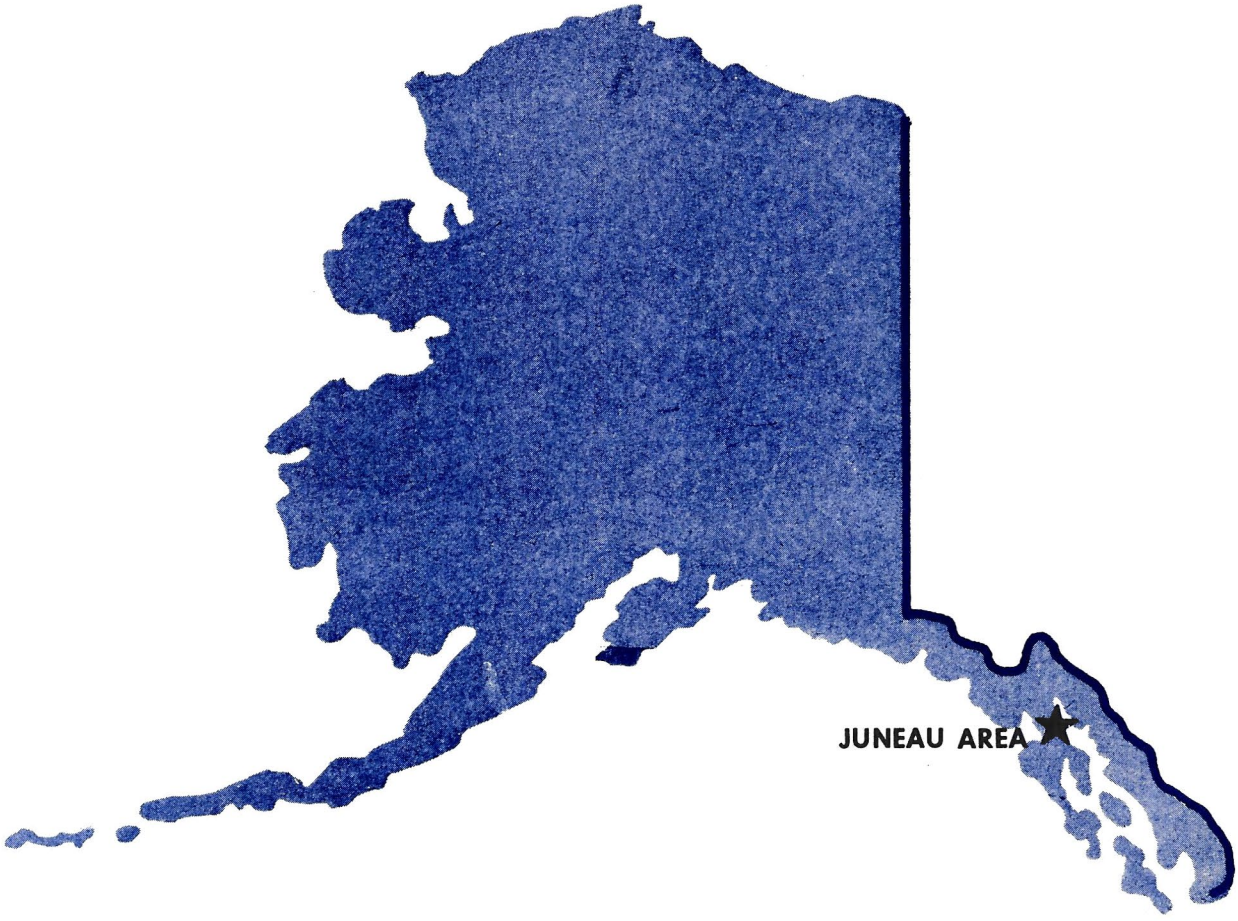
# SOILS
## *of the*
# JUNEAU AREA




SOIL CONSERVATION SERVICE

ALASKA 1974

# SOILS OF THE JUNEAU AREA, ALASKA 1/

by
Dale B. Schoephorster and Clarence E. Furbush
Soil Scientists
United States Department of Agriculture, Soil Conservation Service
Palmer, Alaska

JUNE 1974

## P R E F A C E

The rapid expansion of industrial and business activities in the Juneau Area has resulted in an urgent need for the construction of additional housing and other urban facilities. This soil survey was initiated at the request of the Greater Juneau Borough to provide soils information needed by planners, engineers, contractors, and others involved in the location, planning, and development of land for urban use.

The survey was conducted by the U.S. Soil Conservation Service, with assistance from the Borough and the U.S. Forest Service. It is a part of the technical assistance furnished by the Soil Conservation Service to the Alaska Soil Conservation District.

Persons interested in obtaining information about the soil on a particular tract of land should first locate that tract on the soil map and then with use of the map legend, identify the soils in it. They will find descriptions of the soils in the section headed "Soils." Information about properties of the soils pertinent to engineering, and about the suitability and limitations of the soils for various uses is presented in the section on "Engineering Applications."

* * * * * *

1/ This report is issued by the Soil Conservation Service as a special supplement to the report of the exploratory soil survey of Alaska, now in preparation.

TABLE OF CONTENTS


| | Page |
|---|---|
| General Description of the Area | 1 |
| How Soils are Mapped, Named, and Classified | 2 |
| Soils | 3 |
| Am Series | 3 |
| Au Series | 5 |
| Be Series | 6 |
| Co Series | 7 |
| Fu Series | 8 |
| Gravelly Beaches | 9 |
| Gravel Pits | 10 |
| He Series | 10 |
| Kaikli Series | 11 |
| Karheen Series | 12 |
| Karta Series | 13 |
| Kina Series | 14 |
| Kogish Series | 15 |
| Kupreanof Series | 16 |
| Le Series | 18 |
| Maybeso Series | 19 |
| Made Land | 20 |
| Mh Series | 20 |
| Riverwash | 21 |
| Salt Chuck Series | 21 |
| Tidal Flats | 22 |
| Tolstoi-McGilvery Complex | 23 |
| Wadleigh Series | 24 |
| Engineering Applications | 26 |
| Engineering Soil Classification Systems | 27 |
| Engineering Interpretations of Soil Properties | 29 |
| Sources of Topsoil | 29 |
| Sources of Sand and Gravel | 30 |
| Roads and Streets | 31 |
| Foundations for Low Buildings | 31 |
| Artificial Drainage | 33 |
| Septic Tank Filter Fields | 34 |
| Parks and Recreation | 35 |
| Corrosivity | 35 |
| Shallow Excavations | 37 |
| Sanitary Landfill | 37 |
| Daily Cover for Landfill | 38 |
| Glossary | 45 |
| Literature Cited | 48 |

## TABLES


| | | Page |
|---|---|---|
| Table 1. | Estimated Physical and Chemical Properties of the Soils | 39-40 |
| Table 2. | Engineering Interpretations of Soil Properties | 41-44 |
| | Soil Map Legend and Approximate Acreage in the Juneau Area | 49-50 |

## GENERAL DESCRIPTION OF THE AREA

The Juneau soil survey area contains 35,440 acres, and includes most of the likely sites for urban development in the Borough. It extends from a northern boundary near Berners Bay along Lynn Canal and Gastineau Channel to a point about 3 miles southeast of Thane, and covers a strip one-half to one mile wide on most of the circumference of Douglas Island. Elevations within the survey area range from sea level to about 1000 feet. Parts of the area lie within the boundaries of the Tongass National Forest, but are subject to selection by the State and Borough.

Broad areas of nearly level soils occur on the flood plains of major streams. Most of these soils are formed in waterlaid sandy and silty sediments underlain by coarse sandy and gravelly materials. The depth to gravel ranges from only a few inches to many feet. Many of the soils have high seasonal water tables and are subject to flooding. The depth and frequency of flooding varies with the elevation and location of the soils in the valleys (2)*.

On the uplands most of the soils are formed in glacial stony till that ranges from a few inches to many feet in thickness over bedrock. Generally, the steeper soils are very shallow and areas of these soils usually include rock outcrops. On benches and footslopes, where deposits of till are commonly thicker, many of the soils are poorly drained. The wet conditions are caused primarily by firm, compact, slowly permeable or impervious subsoil and substratum materials, which impede adequate percolation of water added to the soil by rains and by seepage from higher areas. On moraines and slopes that are not subject to seepage or runoff from higher

*Numbers in parentheses refer to Literature Cited.

areas, there are tracts of well drained soils.

Areas of very poorly drained peat soils occur both on the uplands and in the valleys. These soils have high water tables and are from about two feet to many feet thick over mineral materials. The peat materials, which are in various stages of decomposition, are derived from sedges, mosses, and woody vegetation.

## How Soils Are Mapped, Named, and Classified

Soils are made up of a series of nearly horizontal layers, or horizons. A soil profile is the sequence of these horizons from the surface down to the underlying material which has not been altered by weathering or plant roots. Soils that have profiles almost alike make up a soil series. All soils of one series have major horizons that are similar in important characteristics. These include (1) color; (2) texture, or relative proportions of gravel, sand, silt, and clay; (3) structure, or arrangement of soil particles into aggregates or clusters; (4) consistence, or degree of compaction and plasticity; (5) aeration and drainage conditions; (6) reaction, or degree of acidity or basicity; (7) thickness; and (8) arrangement in the profile. Each soil series is either named or identified by a two letter symbol. Those identified by symbols are not named because they have been observed in too limited an area to adequately define the series. They are described in this report as they occur in the Juneau Area, but are subject to review and possible correlation with soil series mapped elsewhere.

Soil series are further subdivided on the basis of external features that are important to use and management of the soil. The subdivisions

are called phases. Areas that have little plant cover, or that are frequently inundated by tides are called miscellaneous land types rather than soils.

Mapping units on the soil map of the Area are slope phases of soil series, miscellaneous land types, and, in one case, a complex of two soil series that occur in such close association that they could not be separated on the map. Because it is not possible, even on a detailed map, to show very small areas of soil, most mapping units contain patches of soil of some other kind that are too small to delineate separately.

## SOILS

Each of the soils and land types in the Area is described below. Their location and distribution are shown on the soil map attached to the report. The acreage of each soil and land type, and the map symbols used to identify them, are given in the map legend.

### Am Series

The Am series consists of somewhat poorly and poorly drained soils that occur on broad, nearly level valley bottoms and gently sloping alluvial fans. These soils are made up of gray silty and sandy waterlaid sediments 40 inches to many feet deep over gravel and coarse sand.

Two main types of vegetation occur on the Am soils. One type is dominated by tall willows and generally occurs on slightly lower portions of the flood plain where the water table is at times near the surface. The other type, on higher parts of the flood plain, is a forest of stunted western hemlock and Sitka spruce.

Representative profile of Am fine sandy loam, NW¼, NW¼, Sec. 36, T38S, R64E, Copper River Meridian:

| | | |
|---|---|---|
| O1 | 2½-0" | Black (10YR 2/1) mat of partially decomposed forest litter; many roots; abrupt smooth boundary. |
| A1 | 0-5" | Dark grayish brown (2.5Y 4/2) fine sandy loam; common, medium, distinct dark brown (10YR 4/3) mottles; weak fine subangular blocky structure; very friable; roots common; discontinuous reddish brown strongly cemented layer, 1/8 to 1/4 inch thick, at base of horizon; very strongly acid; abrupt smooth boundary. |
| B2g | 5-8½" | Olive (5Y 4/3) sand; many large faint olive gray (5Y 4/2) mottles, few medium prominent brown (7.5Y 4/4) mottles; single grain; loose; few roots; abrupt smooth boundary. |
| C1 | 8½-60" | Olive gray (5Y 4/2) stratified silt and fine sand; strata are 1/2 to 6 inches thick; massive; very friable; few roots; strongly acid. |

The texture of the mineral surface ranges from silt loam to sandy loam. In places, pebbles and cobblestones make up to 35 percent by volume of the mineral materials. Thin discontinuous layers of iron cemented materials and strata of very coarse sand as much as three inches thick may occur at any depth. The water table fluctuates from the surface to a depth of four feet but is generally less than two feet below the surface.

Mapping Units:

(AmA) - Am fine sandy loam, 0 to 3 percent slopes

This soil occupies areas on broad nearly level valley bottoms of major rivers. In places it is occasionally flooded for short periods of time.

Included in the mapped areas are small streams, sloughs, wet sandy and gravelly spots, and patches of well drained He soils. In addition,

there are many small areas of poorly drained fine sandy loam soils that are shallow over gravel and coarse sand.

(AmB) - Am fine sandy loam, 3 to 7 percent slopes

This soil occupies a few gently sloping areas on alluvial fans. Many small streams, springs, seepage spots, and very gravelly soils are included in the mapped areas. Parts of these areas may be subject to overflow during periods of snow melt or heavy rainstorms.

Au Series

The Au series consists of excessively drained soils that occur on nearly level to gently sloping outwash plains. These soils are formed in very gravelly sandy materials. Beneath a mat of decomposing forest litter they have a thin grayish surface horizon, a series of thin dark reddish brown to brown horizons totaling about 5 to 10 inches in thickness, and a thick dark grayish brown underlying horizon. The vegetation is dominantly western hemlock and Sitka spruce.

Representative profile of Au very gravelly sandy loam; NW¼, SW¼, Sec. 31, T38S, R65E, Copper River Meridian:

| | | |
|---|---|---|
| O1 | 2-0" | Dark reddish brown (5YR 2/2) partially decomposed forest litter; many roots; abrupt smooth boundary. |
| A2 | 0-1" | Dark grayish brown (10YR 4/2) very gravelly sandy loam containing many white sand grains; weak, medium granular structure; very friable; roots common; extremely acid; abrupt wavy boundary. |
| B21 | 1-3" | Dark reddish brown (5YR 3/3) very gravelly sandy loam; very weak fine granular structure; very friable; roots common; extremely acid; clear wavy boundary. |
| B22 | 3-6" | Brown (7.5YR 4/4) very gravelly sandy loam; very weak fine granular structure; very friable; roots common; extremely acid; clear wavy boundary. |
| B3 | 6-9" | Brown (10YR 4/3) very gravelly loamy sand; massive; loose; few roots; extremely acid; clear wavy boundary. |

C1 9-60" Dark grayish brown (2.5Y 4/2) very gravelly sand; single grain; loose; very few roots; very strongly acid.

The texture of the A and B horizons ranges from loamy sand to sandy loam. The gravel content ranges from 30 to 50 percent by volume in the A and B horizons and from about 50 to 75 percent in the C horizon.

Mapping Units:

(AuA) - Au very gravelly sandy loam, 0 to 3 percent slopes

This soil occupies nearly level outwash plains in broad stream valleys. The mapped areas include patches of He, Am, and Be soils, a few abandoned stream channels, and low narrow moraines.

(AuB) - Au very gravelly sandy loam, 3 to 7 percent slopes

This soil occupies a few small gently sloping outwash plains and is less gravelly than the nearly level Au soils. The mapped areas include small spots of Wadleigh and Karta soils.

Be Series

The Be series consists of excessively drained very gravelly sandy soils that occur on nearly level alluvial plains and terraces, and on undulating to hilly moraines. They are olive gray in color. The vegetation consists of slow growing Sitka spruce, willows, patches of cottonwood, and scattered open patches of low shrubs, grasses, and herbs.

Representative profile of Be very gravelly sand; NE¼, SW¼, Sec. 31, T38S, R65E, Copper River Meridian:

O1 1-0" Very dark brown (10YR 2/2) partially decomposed forest litter.

C1 0-2" Olive (5Y 5/3) sand; single grain; loose; roots common; strongly acid.

C2 2-60" Olive gray (5Y 5/2) very gravelly sand; single grain; loose; strongly acid.

The texture of the upper 10 inches ranges from silt loam to very gravelly sand. Gravel and cobblestones generally make up 50 to 75 percent of the volume of the soil below 10 inches. In places there are many large stones and boulders. The water table is usually more than 4 feet below the surface but in some low-lying places it may occasionally fluctuate to levels near the surface.

Mapping Units:

(BeA) - Be very gravelly sand, 0 to 3 percent slopes

This soil occurs on nearly level alluvial plains and terraces. Spots of wet sandy soils, Mh soils, and a few steeper Be soils are included in the mapped areas. In most places flooding is rare, but a few low-lying areas near the coast and adjacent to streams may be inundated at times when tides or streams are exceptionally high.

(BeB) - Be very gravelly sand, 3 to 7 percent slopes

This soil occurs on undulating terraces and low stony moraines. Many small patches of Mh soils and a few small ponds and wet spots are included in the mapped area.

(BeC) & (BeD) - Be very gravelly sand, 7 to 20 percent slopes

This soil occurs on rolling and hilly moraines. The slopes are generally short and choppy. Included in the mapped areas are small spots of Mh soils, small ponds, and wet sandy spots. Stones and large boulders are common on the surface.

Co Series

The Co series consists of poorly drained soils on very low-lying, nearly level alluvial plains. The soils consist of deep gray silty waterlaid sediments that commonly contain thin strata of sandy materials

and seams of peat. The dominant vegetation consists of sedge and grasses, but in a few places the soils support stands of Sitka spruce and western hemlock.

Representative profile of Co silt loam; NE¼, NW¼, Sec. 24, T37S, R63E, Copper River Meridian.

| | | |
|---|---|---|
| 01 | 2-0" | Undecomposed straw. |
| A11 | 0-2" | Dark reddish brown (5YR 2/2) silt loam; weak fine granular structure; very friable; many roots. |
| A12 | 2-5" | Very dark grayish brown (10YR 3/2) silt loam; weak fine granular structure; very friable; many roots. |
| B2g | 5-60" | Dark gray (5Y 4/1) silt loam; common, medium prominent dark reddish brown (5YR 3/2) mottles; very thin platy structure; very friable; few thin seams of sedge peat; roots common; strongly acid. |

A few thin strata of fine sand and occasional seams or pockets of buried organic matter may occur at any depth. The water table is usually within two feet of the surface.

Mapping Unit:

(CoA) - Co silt loam, 0 to 3 percent slopes

This soil occupies nearly level very low-lying areas on alluvial plains near the coast. In most places it is susceptible to occasional overflow from freshwater streams, and in a few places it may be inundated by exceptionally high tides.

The mapped areas include spots of very poorly drained shallow peat soils, and small patches of Am and Le soils.

Fu Series

The Fu series consists of very poorly drained moderately deep peat soils that occur on nearly level valley bottoms near the coast. The peat

materials are derived chiefly from sphagnum moss and are underlain by silty tidal deposits or alluvial sediments.

The vegetation is mainly sphagnum moss and cottonsedge.

Representative profile of Fu peat, NE¼, SE¼, Sec. 2, T39S, R64E, Copper River Meridian.

| | | |
|---|---|---|
| Oi1 | 0-18" | Brown (10YR 5/3) peat, very pale brown (10YR 7/4) pressed; 90 percent fiber, 75 percent rubbed; about 80 percent sphagnum moss fibers and 20 percent sedge; gradual boundary. |
| Oi2 | 18-24" | Dark brown (10YR 4/3) peat, light yellowish brown (10YR 6/4) pressed; 80 percent fiber, 60 percent rubbed; about 75 percent sphagnum moss fibers and 25 percent sedge; clear smooth boundary. |
| IICl g | 24-60" | Dark greenish gray (5GY 4/1) silt; massive; slightly sticky, non-plastic; medium acid. |

The peat materials range from 20 to 50 inches in thickness. Depth to the water table is usually less than one foot.

Mapping Unit:

(FuA) - Fu peat, 0 to 3 percent slopes

This soil occupies nearly level areas in broad valleys near the coast. The mapped areas include spots of deep very poorly drained peat, small ponds, and small areas of Am soils.

Gravelly Beaches

This land type consists mainly of coarse gravel, sand, and cobblestones in narrow strips along the coast. These areas are inundated by higher than normal tides. They are usually nearly free of vegetation, but in places there are stands of grasses and other low growing plants.

Mapping Unit:

(Gb) - Gravelly Beaches

Gravel Pits

This land type consists of excavations in coarse textured materials. The areas delineated on the soil map are generally more than 3 acres in size. Smaller areas are not shown on the map.

Mapping Unit:

(GP) - Gravel Pits

He Series

The He series consists of well drained soils on nearly level alluvial plains in broad stream valleys. The soils are made up of olive gray silty and sandy waterlaid sediments more than 40 inches thick over gravel or coarse sand. They support a forest of Sitka spruce and western hemlock.

Representative profile of He fine sandy loam; SE¼, SE¼, Sec. 35, T38S, R64E, Copper River Meridian.

| | | |
|---|---|---|
| 01 | 2-0" | Dark reddish brown (5YR 2/2) mat of partially decomposed forest litter; many roots; abrupt smooth boundary. |
| C1 | 0-7" | Dark grayish brown (2.5Y 4/2) fine sandy loam; many streaks of olive brown (2.5Y 4/4) and grayish brown (2.5Y 4/2); very weak fine subangular blocky strucutre; very friable; roots common; very strongly acid; clear smooth boundary. |
| C2 | 7-40" | Olive gray (5Y 4/2) stratified silt and fine sand; streaks of dark grayish brown (2.5Y 4/2) and olive brown (2.5Y 4/4); thin discontinuous seams of black buried organic matter; very weak fine subangular blocky structure; very friable; roots common; strongly acid; clear smooth boundary. |
| C3 | 40-52" | Dark gray (5Y 4/1) stratified silt and fine sand; streaks of dark grayish brown (2.5Y 4/2); very weak fine subangular blocky structure; very friable; abrupt smooth boundary. |
| IIC4 | 52-60" | Coarse sand and gravel; single grain; loose. |

The stratified sediments range from 40 inches to 6 feet in thickness over coarse sand and gravel. They consist mainly of stratified silt, very fine sand, fine sand, and discontinuous seams of buried organic

matter, but in places there may be layers of coarse sand and pebbles up to 4 inches thick. The thickness and arrangement of strata varies from place to place and the mean texture ranges from silt loam to sandy loam. The water table is usually below 4 feet but may be higher for short periods of time.

Mapping Unit:

(HeA) - He fine sandy loam, 0 to 3 percent slopes

This soil occupies nearly level slightly elevated areas on alluvial plains in broad stream valleys. On rare occasions it may be flooded by exceptionally high water. Included in the mapped areas are patches of Am soils and low spots where flooding is more frequent and seasonally high water tables are near the surface. Other inclusions are small patches of sandy and gravelly soils, and a few narrow sloughs that carry overflow water when stream flow is higher than normal.

Kaikli Series

The Kaikli series consists of very poorly drained mucky peat soils that are shallow over bedrock. These soils occur on slopes that receive seepage from higher areas. They support a forest dominated by western hemlock.

Representative profile of Kaikli mucky peat; NE¼, NE¼, Sec. 35, T38S, R64E, Copper River Meridian.

| | | |
|---|---|---|
| Oe1 | 0-6" | Black (5YR 2/1) mucky peat; about 50 percent fibers, 20 percent after rubbing; nonsticky, nonplastic; fibers derived from woody and herbaceous materials; very strongly acid; gradual boundary. |
| Oa1 | 6-19" | Black (5YR 2/1) mucky peat; about 30 percent fiber, trace after rubbing; nonsticky, nonplastic, few woody fragments; very strongly acid; clear wavy boundary. |

IIClg 19-26" Very dark gray (5Y 3/1) very gravelly loam; massive; slightly sticky, slightly plastic; strongly acid; abrupt boundary.

R 26"+ Bedrock.

The mucky peat materials range from about 16 to 30 inches in thickness. Depth to bedrock ranges from 16 to 40 inches; in many places the loamy materials (IIClg horizon) are absent. The water table is commonly within a foot of the surface.

Mapping Units:

(KaB) & (KaC) - Kaikli mucky peat, 3 to 7 percent slopes
(KaD) - Kaikli mucky peat, 12 to 20 percent slopes
(KaE) - Kaikli mucky peat, 20 to 35 percent slopes

These soils are similar except in gradient. The mapped areas have many small inclusions of Tolstoi, Maybeso, and Wadleigh soils.

Karheen Series

The Karheen series consists of poorly drained very gravelly muck soils that occur on uplifted beaches in coastal areas. These soils support a forest of Sitka spruce and western hemlock.

Representative profile of Karheen very gravelly muck; NE¼, NE¼, Sec. 29, T40S, R65E, Copper River Meridian.

Oel 0-4" Black (5YR 2/1) partially decomposed forest litter; 60 percent fiber, 20 percent after rubbing; nonsticky, nonplastic; many roots; strongly acid; clear wavy boundary.

Oa2 4-32" Black (10YR 2/1) very gravelly muck; less than 10 percent fiber; nonsticky, nonplastic; gravel makes up about 75 percent of the soil volume; roots common; strongly acid. (This material extends to a depth of 5 feet or more.)

The depth to till or bedrock ranges from 60 inches to many feet. Pebbles and cobblestones make up 60 to 80 percent of the soil volume. The seasonally high water table is within two feet of the surface.

Mapping Units:

(KhA) & (KhC) - Karheen very gravelly muck, 0 to 12 percent slopes

This soil occurs on nearly level to moderately sloping uplifted beaches. Included in the mapped areas are patches of very gravelly Salt Chuck soils and a few small spots of wet mucky soils that are underlain by very gravelly materials.

Karta Series

The Karta series consists of well drained soils that occur on rolling to steep uplands. These soils are formed in very gravelly till. Under a mat of forest litter they have a thin gray silty layer, layers of dark reddish brown to yellowish brown gravelly materials, and a firm, brittle substratum. They support a forest of Sitka spruce and western hemlock.

Representative profile of Karta silt loam; NE¼, SW¼, Sec. 31, T37S, R64E, Copper River Meridian.

| | | |
|---|---|---|
| O11 | 6-2" | Dark reddish brown (5YR 2/2) partially decomposed moss and forest litter; many roots; clear smooth boundary. |
| O12 | 2-0" | Black (5YR 2/1) partially decomposed organic materials; many roots; abrupt smooth boundary. |
| A2 | 0-3" | Gray (5YR 5/1) silt loam; weak fine subangular blocky structure; very friable; many roots; extremely acid; abrupt wavy boundary. |
| B21 | 3-4½" | Dark reddish brown (5YR 3/4) gravelly silt loam; moderate fine granular structure; very friable; smeary when rubbed; few weakly cemented fragments; few fine dark concretions; roots common; extremely acid; clear wavy boundary. |
| B22 | 4½-11" | Dark brown (7.5YR 4/4) gravelly silt loam; streaks of dark yellowish brown (10YR 3/4) and dark brown (7.5YR 3/2); weak fine granular structure; very friable; smeary when rubbed; roots common; very strongly acid; clear wavy boundary. |
| B3 | 11-19" | Streaks and patches of yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/4) very gravelly sandy loam; weak fine granular structure; friable; slightly smeary; roots common; very strongly acid; clear smooth boundary. |

C1x 19-34" Dark grayish brown (2.5Y 4/2) very gravelly sandy loam; patches of light olive brown (2.5Y 5/4) and few fine distinct brown (10YR 4/4) mottles; massive; firm; few roots; strongly acid.

C2 34-60" Very gravelly sandy loam; massive; friable.

The texture of the mineral surface ranges from silt loam to very gravelly sandy loam. Below a depth of 10 inches the texture ranges from very gravelly sandy loam to very gravelly loam. Coarse fragments make up 40 to 60 percent of the soil volume. Depth to the firm substratum ranges from 15 to 24 inches. Stones and boulders are common.

Mapping Units:

(KtC) - Karta silt loam, 7 to 12 percent slopes
(KtE) - Karta silt loam, 20 to 35 percent slopes
(KtF) - Karta silt loam, 35 to 75 percent slopes

The Karta soils in these mapping units are similar except for gradient. Small areas of gently sloping and moderately sloping soils that occur on narrow benches and rounded ridgetops are included in the mapped areas. In addition, there are small inclusions of Maybeso, Wadleigh, and Kupreanof soils. In a few places there are large boulders on the surface.

Kina Series

The Kina series consists of very poorly drained deep peat soils that occur on benches and footslopes. The peat materials are derived chiefly from sedges. The vegetation consists of scattered lodgepole pine and a ground cover of sedges and mosses.

Representative profile of Kina peat; NE¼, SE¼, Sec. 25, T37S, R63E, Copper River Meridian.

Oi1 0-5" Dark reddish brown (5YR 2/2) peat; 85 percent fiber, 70 percent after rubbing; about 60 percent sedge fibers and 35 percent moss; many roots; very strongly acid; clear smooth boundary.

Oe1 5-40" Dark brown (7.5YR 3/2) peat; 70 percent fibers, 20 percent after rubbing; about 70 percent sedge fibers; roots common; very strongly acid; clear smooth boundary.

Oe2 40-60" Very dark grayish brown (10YR 3/2) peat; 40 percent fibers, 10 percent after rubbing; very strongly acid.

The peat materials are commonly between 4½ and 6 feet in depth over mineral materials, but in places they are deeper. The underlying material may be rock or glacial till. The water table is usually near the surface.

Mapping Units:

(KiA) - Kina peat, 0 to 3 percent slopes
(KiB) - Kina peat, 3 to 7 percent slopes
(KiC) & (KiD) Kina peat, 7 to 12 percent slopes

The Kina soils in these mapping units differ from each other mainly in gradient. The mapped areas include small patches of Maybeso and Wadleigh soils. A few of the areas include spots of Kogish peat and small ponds.

Kogish Series

The Kogish series consists of very poorly drained nearly level to strongly sloping peat soils that occur in valleys and on broad benches. The peat materials are derived chiefly from sphagnum moss, which is the dominant vegetation.

Representative profile of Kogish peat; SE¼, SW¼, Sec. 24, T40S, R65E, Copper River Meridian.

Oi1 0-18" Brown (10YR 4/3) peat, yellowish brown (10YR 5/4) pressed; about 70 percent fiber, 40 percent after rubbing; largely sphagnum moss fibers; roots common; very strongly acid; clear smooth boundary.

Oi2 18-60" Yellowish brown (10YR 5/6) peat, yellow (10YR 7/6) pressed; about 80 percent fiber, 50 percent after rubbing; largely sphagnum moss fibers; extremely acid.

The peat materials are more than 5 feet thick. They may be underlain by till, bedrock, or alluvial sediments. The water table is usually near the surface.

Mapping Units:

(KoA) - Kogish peat, 0 to 3 percent slopes
(KoB) - Kogish peat, 3 to 7 percent slopes
(KoC) - Kogish peat, 7 to 12 percent slopes
(KoD) - Kogish peat, 12 to 20 percent slopes

The Kogish soils in these mapping units are similar except for gradient. In places, small ponds and patches of Kina and Fu soils are included in the mapped areas.

Kupreanof Series

The Kupreanof series consists of well drained soils on moraines. These soils are formed in very gravelly loamy till. Beneath a layer of forest litter, they have a thin light brownish gray layer, fairly thick layers with dark reddish brown to dark grayish brown colors, and an olive gray substratum. They support a forest dominated by Sitka spruce and western hemlock.

Representative profile of Kupreanof gravelly silt loam; NW¼, NW¼, Sec. 11, T39S, R64E, Copper River Meridian.

O1 7-2" Black (10YR 2/1) partially decomposed forest litter; many roots; abrupt smooth boundary.

O2 2-0" Black (5YR 2/1) muck; many roots; extremely acid; abrupt smooth boundary.

A2 0-1½" Light brownish gray (10YR 6/2) gravelly silt loam; massive; very friable; smeary; many fine roots; extremely acid; abrupt irregular boundary.

B21 1½-4" Dark reddish brown (5YR 2/2) gravelly silt loam; weak fine granular structure; very friable; smeary; few roots; extremely acid; abrupt wavy boundary.

B22 4-9" Dark reddish brown (5YR 3/4) gravelly silt loam; weak fine subangular blocky structure; very friable; smeary; extremely acid; gradual boundary.

B23 9-18" Dark brown (7.5YR 4/4) gravelly silt loam; weak fine subangular blocky structure; very friable; smeary; few roots; very strongly acid; clear wavy boundary.

B3 18-24" Dark grayish brown (2.5Y 4/2) very gravelly sandy loam; few patches of dark brown (7.5YR 3/3); massive; friable; strongly acid; clear wavy boundary.

C1 24-60" Olive gray (5Y 4/2) very gravelly sandy loam; massive; friable; strongly acid.

The texture of the mineral surface layer ranges from gravelly silt loam to very gravelly sandy loam. The substratum ranges in texture from very gravelly loam to very gravelly sandy loam. Coarse fragments make up 40 to 60 percent of its volume. Large stones and boulders are common.

Mapping Units:

(KuA) - Kupreanof gravelly silt loam, 0 to 3 percent slopes
(KuB) - Kupreanof gravelly silt loam, 3 to 7 percent slopes
(KuC) - Kupreanof gravelly silt loam, 7 to 12 percent slopes
(KuD) - Kupreanof gravelly silt loam, 12 to 20 percent slopes

The Kupreanof soils in each of these mapping units are similar except for gradient. The mapped areas include small spots of Wadleigh, Maybeso, and Karta soils. There are also a few patches of Tolstoi soils.

(KuE) - Kupreanof gravelly silt loam, 20 to 35 percent slopes
(KuF) - Kupreanof gravelly silt loam, 35 to 75 percent slopes

These soils occur on moderately steep and steep uplands. In addition to small spots of Tolstoi and Karta soils, the mapped areas include a few nearly level to moderately sloping Kupreanof soils on narrow benches and rounded ridgetops.

Le Series

The Le series consists of very poorly drained soils that occur on nearly level flood plains. These soils are formed in dark gray silty sediments and have a thick mat of partially decomposed organic material on the surface. The dominant vegetation consists of sedges, grasses, and patches of willow and alder brush.

Representative profile of Le silt loam; SW¼, SE¼, Sec. 13, T40S, R65E, Copper River Meridian.

| | | |
|---|---|---|
| 01 | 13-0" | Very dark brown (10YR 2/2) mat of coarse partially decomposed organic materials; fibers derived chiefly from sedges and grasses; strongly acid; abrupt smooth boundary. |
| B2g | 0-19" | Dark gray (5Y 4/1) silt; common, large faint dark grayish brown (2.5Y 4/2) mottles and few fine prominent dark yellowish brown (10YR 4/4) mottles; weak thin platy structure; nonsticky, nonplastic; few black streaks of buried organic matter; roots common in upper 6 inches, few below; strongly acid; gradual boundary. |
| C1 | 19-60" | Dark gray (5Y 4/1) silt loam; massive; nonsticky, nonplastic; few thin strata of fine sand; strongly acid. |

The mat of organic materials on the surface ranges from about 5 to 15 inches in thickness. The sediments are dominantly silty but may contain thin strata of fine sand. They range from 40 inches to many feet in thickness over a gravelly substratum. Depth to the water table is usually less than one foot.

Mapping Unit:

(LeA) - Le silt loam, 0 to 3 percent slopes

This nearly level soil occurs on slight depressions in broad stream valleys. It is susceptible to occasional flooding.

The mapped areas include small streams, and patches of Fu and Am soils.

Maybeso Series

The Maybeso series consists of very poorly drained soils of nearly level to strongly sloping seepage areas, drainageways, and benches. These soils are made up of mucky peat 16 to 50 inches thick over glacial till. They support a forest of western hemlock and scattered Sitka spruce.

Representative profile of Maybeso mucky peat; SW¼ SE¼, Sec. 25, T37S, R63E, Copper River Meridian.

Oe1 0-12" Dark reddish brown (5YR 2/2) peat; about 60 percent fiber, 15 percent after rubbing; nonsticky; mixed woody, herbaceous, and moss fibers; many roots; very strongly acid; gradual boundary.

Oa1 12-27" Black (5Y 2/1) mucky peat; about 20 percent fibers, trace after rubbing; nonsticky; roots common; many buried woody fragments; very strongly acid; clear smooth boundary.

IIC1 27-60" Dark greenish gray (5GY 4/1) very gravelly loam; massive; slightly sticky, slightly plastic; very strongly acid.

The mineral substratum is loamy compact till with slow to moderately slow permeability. Coarse fragments make up 40 tp 60 percent by volume of the till. In places, the mineral materials are weakly cemented. The water table is usually less than two feet below the surface. Stones and boulders are common.

Mapping Units:

(MaA) - Maybeso mucky peat, 0 to 3 percent slopes
(MaB) - Maybeso mucky peat, 3 to 7 percent slopes
(MaC) - Maybeso mucky peat, 7 to 12 percent slopes
(MaD) & (MaE) - Maybeso mucky peat, 12 to 20 percent slopes

Soils in these mapping units are similar, except for gradient. The mapped areas include many small patches of Wadleigh soils, and a few spots of Kina and Kaikli soils.

Made Land

This land type consists of areas filled with very gravelly materials hauled from mines and borrow pits. Parts of these areas have been smoothed and used for construction sites but the major portion is rough and hummocky.

Mapping Units:

(MD) & (ML) - Made land

Mh Series

The Mh series consists of well drained soils on low undulating to hilly moraines near the front of large glaciers. The soils are made up of dark gray loamy materials that contain variable quantities of gravel, stones, and boulders. The vegetation in most areas is a Sitka spruce western hemlock forest.

Representative profile of Mh gravelly sandy loam, SE¼, SE¼, Sec. 31, T38S, R65E, Copper River Meridian.

| | | |
|---|---|---|
| O1 | 1½-0" | Dark reddish brown (5YR 2/2) partially decomposed forest litter. |
| A1 | 0-3" | Dark reddish brown (5YR 3/2) gravelly sandy loam; massive; friable; many roots; strongly acid; clear smooth boundary. |
| C1 | 3-60" | Dark gray (5Y 4/1) gravelly sandy loam; massive; friable; few roots; strongly acid. |

The texture ranges from gravelly sandy loam to gravelly silt loam. Pebbles and cobblestones make up 30 to 50 percent by volume of the soil. In places, many large boulders are near the surface.

Mapping Units:

(MhB) - Mh gravelly sandy loam, 0 to 3 percent slopes
(MhC) - Mh gravelly sandy loam, 3 to 7 percent slopes
(MhD) - Mh gravelly sandy loam, 7 to 12 percent slopes

The Mh soils in these mapping units are similar, except for gradient. The slopes are short and irregular. Included in the mapped areas are many small ponded depressions and patches of Be soils. In places, short very steep slopes and patches of very bouldery soils are included.

Riverwash

This land type consists of recent waterlaid sediments in gravel and sand bars bordering major rivers and streams. These sediments are usually very gravelly or stony. Many areas have no vegetation, but in places there are clumps of willow brush or a sparse cover of grasses and herbs. The mapped areas are frequently flooded.

Mapping Unit:

(Rw) - Riverwash

Salt Chuck Series

The Salt Chuck series consists of well drained very gravelly soils on alluvial fans and uplifted beaches. The soils are generally black or dark brown near the surface, and dark gray below. They support a forest dominated by Sitka spruce and western hemlock.

Representative profile of Salt Chuck very gravelly silt loam; NW¼ NE¼, Sec. 23, T40S, R65E, Copper River Meridian.

| | | |
|---|---|---|
| 01 | 5-0" | Dark reddish brown (5YR 2/2) partially decomposed forest litter. |
| A2 | 0-½" | Gray (N 5/) silt loam; massive; very friable; roots common; abrupt wavy boundary. |
| B21 | ½-4" | Black (5YR 2/1) very gravelly silt loam; massive; very friable; roots common; very strongly acid; abrupt wavy boundary. |
| B22 | 4-7" | Dark brown (7.5YR 3/2) very gravelly silt loam; massive; very friable; roots common very strongly acid; clear wavy boundary. |

B3 7-19" Very dark grayish brown (2.5Y 3/2) very gravelly sandy loam; massive; very friable; roots common; very strongly acid; clear wavy boundary.

C1 19-48" Dark gray (5Y 4/1) very gravelly loamy sand; massive; very friable; few roots; very strongly acid.

The texture ranges from very gravelly sand to very gravelly silt loam. The coarse fragments are commonly flat or subangular and make up 40 to 75 percent of the soil volume.

Mapping Units:

(SaA) - Salt Chuck very gravelly silt loam, 0 to 3 percent slopes

This nearly level soil occurs on alluvial fans and uplifted beaches. The water table is generally below a depth of four feet but in places it occasionally rises to within two feet of the surface. The mapped areas include a few small wet spots, a few small streams, and abandoned stream channels.

(SaB) - Salt Chuck very gravelly silt loam, 3 to 7 percent slopes
(SaC) - Salt Chuck very gravelly silt loam, 7 to 12 percent slopes

These soils occupy gently and moderately sloping alluvial fans formed by small streams from narrow mountain valleys. Although the water table is normally below four feet, some of the soils are susceptible to overflow during periods of melting snow or heavy rainstorms in the mountains.

Included in the mapped areas are small stream channels and patches of Am soils.

Tidal Flats

This land type consists of nearly level areas bordering the coast. These areas are frequently inundated by tides that are higher than normal.

They commonly consist of medium textured sediments, but in places they may be gravelly. Most areas support sedges, rushes, grasses, and other plants of coastal meadows, but a few areas are nearly bare.

Mapping Unit:

(Tf) - Tidal flats

Tolstoi-McGilvery Complex

The Tolstoi-McGilvery complex includes two major components--the Tolstoi series and the McGilvery series. The soils are so closely intermixed that they cannot be separated on the soil map. The Tolstoi series consists of well drained soils that are very shallow over bedrock. Beneath a mat of forest litter, these soils have a thin gray layer and dark reddish brown and brown layers over bedrock. The McGilvery soils consist of forest litter that rests directly on bedrock. They occur on hilly to steep ridges and mountainsides. Stones and large boulders are common on or near the surface. Both soils support a forest dominated by Sitka spruce and western hemlock.

Representative profile of Tolstoi very stony silt loam; NW¼ SE¼, Sec. 25, T37S, R63E, Copper River Meridian.

| | | |
|---|---|---|
| 01 | 4-0" | Dark reddish brown (5YR 2/2) partially decomposed forest litter and moss; abrupt wavy boundary. |
| A2 | 0-2" | Reddish gray (5Y 5/2) very stony silt loam; weak fine granular structure; friable; roots common; extremely acid; abrupt wavy boundary. |
| B21 | 2-6" | Dark reddish brown (5YR 2/2) very stony silt loam; strong fine granular structure; friable; slightly smeary; roots common; extremely acid; clear wavy boundary. |
| B22 | 6-9" | Patchy brown and dark brown (7.5YR 4/4 and 3/2) very stony very gravelly sandy loam; massive; friable; slightly smeary; roots common; extremely acid, abrupt smooth boundary. |
| R | 9"+ | Slightly weathered bedrock. |

In the Tolstoi soils, depth to bedrock ranges from 5 to 20 inches. The texture of the soil materials ranges from stony silt loam to very stony sandy loam.

In the McGilvery soils, the forest litter ranges from 6 to 20 inches in thickness. In places, 1 to 4 inches of loamy material occurs between the litter and the underlying bedrock.

Mapping Units:

(ToC) & (ToD) - Tolstoi-McGilvery complex, 12 to 20 percent slopes
(ToE) - Tolstoi-McGilvery complex, 20 to 35 percent slopes
(ToF) - Tolstoi-McGilvery complex, 35 to 75 percent slopes

The soils in these mapping units are similar except for gradient. They commonly have very rough irregular slopes. The mapped areas include many sheer rocky cliffs and other rock outcrops, and wet spots with Wadleigh, Maybeso, and Kaikli soils.

Wadleigh Series

The Wadleigh series consists of somewhat poorly drained soils that occur on lower slopes of hills and mountains. These soils are formed in very gravelly loamy materials underlain by firm glacial till that impedes internal drainage. They have a mat of forest litter, a thin grayish brown layer, and dark reddish brown to dark yellowish brown layers above the firm substratum. The vegetation is a forest of western hemlock and scattered Sitka spruce.

Representative profile of Wadleigh gravelly silt loam; NE¼ NW¼, Sec. 25, T37S, R63E, Copper River Meridian.

01 8-3" Dark reddish brown (5YR 2/2) partially decomposed forest litter; many roots; clear smooth boundary.

02 3-0" Black (5YR 2/1) finely divided organic matter; many roots; abrupt smooth boundary.

| | | |
|---|---|---|
| A2 | 0-3" | Grayish brown (10YR 5/2) gravelly silt loam; few fine prominent (7.5YR 4/4) mottles; very weak medium subangular blocky structure; friable; roots common; abrupt wavy boundary. |
| B21 | 3-5" | Dark reddish brown (5YR 2/2) very gravelly silt loam; moderate fine granular structure; very friable; few soft fine concretions; few weakly cemented fragments; smeary when rubbed; roots common; very strongly acid; clear irregular boundary. |
| B22 | 5-10" | Dark brown (7.5YR 3/2) very gravelly sandy loam; weak fine subangular blocky structure; friable; slightly smeary; roots common; very strongly acid; clear wavy boundary. |
| B23 | 10-16" | Dark yellowish brown (10YR 3/4) very gravelly sandy loam; very weak medium subangular blocky structure; friable; roots common; very strongly acid; clear smooth boundary. |
| B3x | 16-23" | Olive brown (2.5Y 4/4) very gravelly sandy loam; few fine prominent strong brown (7.5YR 5/6) mottles, and many streaks of dark brown (10YR 4/3); weak medium platy structure; weakly cemented; slightly brittle; clear smooth boundary. |
| C1x | 23-30" | Patchy olive gray (5Y 4/2) and dark grayish brown (2.5Y 4/2) very gravelly sandy loam; few medium distinct olive brown (2.5Y 4/4) mottles; very weak medium platy structure; weakly cemented; slightly brittle; clear smooth boundary. |
| C2 | 30-60" | Olive gray (5Y 4/2) very gravelly loam; few medium faint dark gray (5Y 4/1) mottles; massive; slightly sticky, slightly plactic; very strongly acid. |

The surface texture ranges from silt loam to very gravelly sandy loam. Below 10 inches coarse fragments, including cobblestones, make up 35 to 65 percent of the soil volume. Depth to the firm substratum ranges from 15 to 25 inches. Seepage water from adjacent higher areas is commonly perched above the very slowly permeable compact substratum.

Mapping Units:

(WaA) & (WaB) - Wadleigh gravelly silt loam, 3 to 7 percent slopes
(WaC) & (FoC) - Wadleigh gravelly silt loam, 7 to 12 percent slopes
(WaD) - Wadleigh gravelly silt loam, 12 to 20 percent slopes
(WaE) & (WaF) - Wadleigh gravelly silt loam, 20 to 50 percent slopes

Except for gradient, the soils in these mapping units are similar. Included in the mapped areas are many small patches of Maybeso and Karta soils. In addition, there are a few small scattered spots of Tolstoi and Kina soils.

## ENGINEERING APPLICATIONS

The information in this section is intended to be useful to those who need information about soils of significance in engineering and construction. It can be helpful to planners, land developers, engineers, contractors, and others who:

1. Select potential residential, industrial, commercial, and recreational sites.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay
4. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
5. Develop preliminary estimates pertinent to construction in a particular area.

Among properties of soils that are highly important in engineering and construction are permeability, soil drainage condition, shrink-swell potential, grain size distribution, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and soil slope. These properties, in various degrees and combinations, affect construc-

tion and maintenance of roads, airports, buried pipes, foundations for small buildings, and systems for disposal of sewage and refuse.

Most of this information is presented in the soil descriptions and in Tables 1 and 2, which show, respectively, estimated soil properties significant to engineering and interpretations for various soil uses. This information, along with the soil map, can be used to make interpretations in addition to those given in Table 2, and to make other useful maps.

It is important to recognize that the information presented here does not eliminate the need for detailed investigations at the site of proposed construction. This is especially true for engineering works that involve heavy loading or that require excavation to depths of greater than those shown in the tables, generally 5 feet. Inspection of sites is also needed because many delineated areas of soil mapping units contain small areas of other kinds of soil that may have different suitabilities or limitations for soil engineering.

Some of the terms used in this report have a special meaning to soil scientists that is not familiar to all engineers. These terms are defined in the Glossary.

## Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system used by the Soil Conservation Service, Department of Defense, and other agencies, and the AASHO system (1) adopted by the American Association of State Highway Officials.

The Unified system is used to classify soils according to those properties that affect use as a construction material for purposes other

than highway construction and maintenance and as a foundation material.

In the Unified system, soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content and are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils close to the borderline between two classes are designated by symbols for both classes; for example, CL-ML.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Organic soils are placed in group A-8. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A-7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Both the Unified and AASHO classifications are given in table 1 for all soils mapped in the survey area. More detailed explanations of both classification systems are given in the PCA Soil Primer (4) and in standard textbooks on soil mechanics.

USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary.

## Engineering Interpretations of Soil Properties

Table 2 contains estimates of suitability of the soils as a source of construction materials, and lists by degree and kind some limiting factors that affect the use of soils for specified purposes. It is assumed that frost is not a limiting factor since deep penetration of frost is rare in this area. Some of the major engineering problems and practices are discussed below.

Sources of topsoil - Topsoil, as used here, refers to soil materials spread over roadbanks, lawns, or gardens to provide a seedbed for plants. Ideally, topsoil should be of loamy texture, free of gravel and stones, and moderately high in organic matter. Soils used as a source of topsoil should be deep over bedrock or gravel and should have fairly deep water tables for ease of excavation. Natural fertility is not an important factor, as nutrient deficiencies can be overcome easily by fertilization and other management practices.

The only soils that are suitable as a source of topsoil in the Juneau area are those formed in deep medium textured alluvial materials in the valley floors. Most extensive and best are the He soils, which meet all requirements for topsoil except for adequate organic matter content. The Am and Co soils have high water tables and are occasionally flooded, features that would make excavation difficult. The Fu and Le soils are even wetter, and for that reason are poor sources of topsoil.

Sources of road fill (highway subgrade material). Roadfill is soil material removed from its original location and used as borrow for highway subgrades. In general, the most desirable material is gravel, or gravel mixed with a moderate amount of sand. Loamy soils are less desirable, but may be used. Fine-grained and organic soils are usually unsatis-

factory. Soils with a high water table and a high natural moisture content usually are difficult to excavate and handle.

Soils in coarse till and well drained glaciofluvial and alluvial sand and gravel are the best sources of roadfill. These are the Au, Be, Mh, and Salt Chuck soils. Riverwash and Gravelly beach material is also usable, but pebbles and stones are usually too rounded for good compaction. Soils derived from glacial till that contains a fairly high proportion of silt and clay, such as the Karta and Kupreanof soils, have only fair compaction and stability characteristics. The Wadleigh and Maybeso soils are also formed in till, but have high water tables. The upper part of the Maybeso soils consists of organic matter, which must be removed before excavation for roadfill.

Sources of sand and gravel. For use in concrete or as a road subbase, sand and gravel should be nearly free of fine-grained materials and organic matter. The best sources of sand and gravel in the Juneau area are soils in coarse glacial moraines and alluvial deposits. Soils with high water tables are undesirable because of the difficulty of excavation.

The Au and Be soils are the best sources of sand and gravel in the Juneau area. Somewhat less suitable are the Mh and Salt Chuck soils, which contain appreciable proportions of silt. The Karta and Kupreanof soils are sources of gravel, but they contain much silt and clay and many boulders. Sand and gravel may also be obtained from Riverwash and Gravelly beaches, but high water tables may hinder excavation. In all suitable soils in the Juneau area, sand and gravel are intermixed; there are essentially no natural sources of gravel free sand.

Roads and streets. It is assumed in evaluating soils for use in place as a foundation for roads that the subsoil is undisturbed, but that the surface soil with its higher content of organic matter will be removed in construction. The best soils for this use are well drained, have high bearing strength, have no steep slopes, and are not subject to flooding.

Most soils in the Juneau area have at least some limitations as road sites. Only the Au soils, the gently sloping phases of the Be and Mh soils, and the nearly level and gently sloping phases of the Kupreanof soils have no serious limitations. Most soils on the valley floors have high water tables and are subject to flooding, though some, including the He soils and the nearly level Be soils, have moderately deep water tables and flood infrequently. In the uplands, road cuts in the moderately sloping to steep Karta and Kupreanof soils of moraines would be subject to severe erosion and, in some cases, landslides. Roads through areas of Tolstoi and McGilvery soils would require much blasting of bedrock. On lower slopes in the uplands, the dominant Wadleigh and Maybeso soils have high water tables. The peat in the upper 15 to 50 inches of the Maybeso soils would need to be removed before construction. Roads on these soils require adequate provision for diversion of seepage water.

Foundations for low buildings. The suitability of soils as foundations for buildings depends largely on their bearing strength. Potential slippage on steep slopes, damage to basements by a high water table, and possible damage by floods are also important considerations.

Two major factors influencing the bearing strength of soils are natural soil drainage and the compaction and density of the soil material. Generally, the load supporting capacity of soils decreases with higher

moisture content and lower density. Other factors affecting bearing strength are soil permeability and shrink-swell potential. Only general statements concerning bearing strength can be made here. This property must be determined at the site of actual construction.

Serious damage to building foundations constructed on poorly drained soils affected by seepage water, such as the Wadleigh and Maybeso series, usually can be avoided only by artificial drainage. Placing tile lines near the foundation footings and backfilling the excavations with porous materials is one method that may be used to remove excess water. This is usually in addition to the practice of grading the building site to obtain good surface runoff. Open ditches or carefully placed tile lines also can be used to intercept and divert seepage water away from the building.

Special flood protection measures are desirable on most soils of the flood plains, even on the Be and He soils which flood only rarely. These measures, including construction of gravel pads to raise the building level, are essential on the Am, Co, and Le soils, which flood more frequently. It is likely that basements are not feasible in any buildings on the flood plains.

The organic Fu, Kina, and Kogish soils would have low bearing strength even after drainage. If these soils must be used as building sites, it will be necessary to resort to pilings or other special site preparation.

Most of the well drained soils of the area with level to moderate slopes have few limitations as building sites. These include the Au, Be (on gentle or moderate slopes), Kupreanof, Mh, and Salt Chuck soils. The well drained Karta soils of uplands have slowly permeable substrata

which will reduce percolation after heavy rains. Landslides are a potential hazard after clearing. Some form of artificial drainage is required to protect buildings on these soils.

Artificial drainage. Artificial drainage refers to the removal of surface water and the lowering of the natural water table by means of ditches, drainage tile, storm pipe, and other structures. Drainage can be accomplished most easily in permeable soils and soils on gentle or moderate slopes. It is most difficult in soils that flood regularly and that are only slightly higher than ditch or pipe outlets.

Soils with impeded drainage and high water tables occupy about 40 percent of the mapped area. Included are mineral and organic soils of the lower slopes of hills and mountains, and soils of flood plains. The wet conditions result from ponding, seepage on slopes, and low elevations with respect to river levels.

The most extensive soils of footslopes, the Wadleigh and Maybeso soils, have slowly permeable substrata. As a result, water from adjacent higher areas and from rainfall seep laterally through the upper layers of the soil. The seepage can be intercepted by ditches aligned across the slopes, and diverted to outlet ditches or natural drainageways. This can be done for individual building sites or for fairly large areas. In areas with extensive development, ditches constructed for streets and highways can be designed as part of the overall drainage system. On moderately sloping land (7 to 12 percent slopes), it may be difficult to avoid excess gradients and erosion of ditches unless erosion control structures are built. On strongly sloping land (12 to 20 percent slopes), more extensive erosion control measures may be required. Construction of

ditches in these soils may be difficult because of the extreme stoniness of the subsoil.

Drainage of the Am, Co, and Le soils of flood plains would require, in many cases, an elaborate system of levees, ditches, and flood gates. Drainage of individual building sites generally would not be feasible. In years with exceptionally high stream levels, drainage systems may not be effective.

It may be possible to drain the organic Kina and Kogish soils, but even after drainage these soils would be unsatisfactory sites for most structures, including roads.

Septic tank filter fields. A septic tank filter field is a system of subsurface tile drains laid out in such a way that effluent draining from an individual septic tank is uniformly distributed and absorbed by the soil. A concentration of individual septic tank filter fields, such as may occur in residential areas where there is no community sewer system, is undesirable because of the risk of contamination of the ground water.

The soil features that adversely affect the functioning of septic tank filter fields are low permeability, seasonally high water tables, susceptibility to flooding or to inundation by high tides, shallow bedrock, and steep slopes. Most soils in the Juneau area have one or more of these limitations. All soils of the flood plains may be expected to be inundated occasionally. Many of these soils also have high water tables throughout the year. The Maybeso and Wadleigh soils are usually wet and have slowly permeable substrata. Even after artificial drainage, it is likely that septic tanks will not function satisfactorily in these soils. The peaty

Karheen, Kina, and Kogish soils are entirely unsuited for filter fields. The Kupreanof and Mh soils have substrata that will impede water movement, but well designed filter systems would operate in these soils. Only the Au and Salt Chuck soils, and the sloping Be soils, have few limitations for septic tanks.

Even more than in other engineering practices, the design of septic tank filter fields must be based on on-site investigations.

Parks and recreation. Play areas, picnic areas, riding and hiking trails, and other areas subject to heavy foot traffic should be firm, well drained, and reasonably free of surface stones. For certain purposes, such as athletic fields, the soils should be level or nearly so; for other uses, such as hiking trails, slope is less important, but most developed recreation areas should be no more than moderately sloping. Occasional floods do not detract seriously from play areas, but areas with frequent floods would not be acceptable. It is assumed that any area selected for parks and recreation will remain largely in its natural condition, and that no extensive construction or earth moving will take place.

The most desirable soils for recreation areas are the Be and He soils on flood plains, and the Au, Be, Karta, Kupreanof, Mh, and Salt Chuck soils on low hills. The steeper Karta and Kupreanof soils are less suitable. Organic soils, such as Kina and Kogish, and soils kept wet by seepage, such as Maybeso and Wadleigh, are not well adapted to this use.

Corrosivity. Structural materials, such as iron or concrete pipe, may corrode when buried in soil. The corrosivity potential is different for different soils and different materials. Protective coatings in the case of steel and special cements and manufacturing methods in the case

of concrete may be used to reduce the rate of corrosion.

Corrosion of steel in soils is a physical-biochemical process that converts iron into soluble forms. Some soil properties that accelerate this process are high moisture content, low resistivity of the soil solution, and strong acidity. Soils with low corrosivity generally are well drained (except that sandy or gravelly soils may be somewhat poorly drained), are moderately to rapidly permeable, have pH values higher than 6.0, and have an electrical resistivity when saturated of more than 5000 ohms/cm. Soils with high corrosivity generally are either fine textured or are somewhat poorly or poorly drained, have pH values of 5.0 or less, and resistivity of less than 1500 ohms/cm. Soils with textural stratification, like many of the soils of flood plains, usually have higher corrosion potential than soils with uniform textures throughout the profile. Organic (peat) soils with fluctuating water tables generally have high corrosivity, but some with water tables at the surface throughout the year may have only a moderate corrosion potential.

The rate of deterioration of concrete pipe in soil depends on soil texture, soil acidity, and the amount of soluble sulfates in the soil. Soils affected by sea water, which is high in sulfates, are considered to have high corrosion potential for concrete pipe. Soils with a low potential generally are those with pH values of 6.0 or higher and less than 1000 parts per million of soluble sulfates. Those with high potential generally have pH values of 5.0 or less or more than 2000 parts per million of sulfates.

Construction of buildings, paving, fill and compaction,aand surface additions that alter soil permeability can increase the corrosion probab-

ility. Similarly, any mechanical agitation or excavation that results in aeration and nonuniform mixing of soil layers of different textures may increase corrosivity.

Because of frequent saturation and strong acidity, it is likely that even the excessively drained soils in the Juneau area have a moderate corrosivity potential for both steel and concrete pipe. Soils with seasonally high water tables are considered to have a high corrosivity potential for steel pipe and a moderate potential for concrete pipe. Soils subject to inundation by sea water and the very strongly acid organic soils have a high corrosion potential for concrete.

Shallow excavations. Shallow excavations are those that require digging or trenching to a depth of less than 6 feet as, for example, in excavations for water or sewer lines, telephone and power transmission lines, basements, and cemeteries. Desirable soil properties are good workability, resistance to sloughing, gentle slopes, absence of rock outcrops or large stones, freedom from flooding, and a deep water table.

No soils in the Juneau Area combine all of those properties. The He soils, which flood only rarely, and the Mh soils, which are only moderately stony, have the fewest limitations. The Kaikli, Tolstoi, and McGilvery soils, which are shallow over bedrock, and the Fu, Kina, Kogish, and Lena soils, which have consistently high water tables, have the greatest limitations for this practice.

Sanitary landfill. Soil requirements for areas to be used as sites for sanitary landfills are those that affect ease of excavation, trafficability for heavy vehicles, and the potential pollution of ground water. The most suitable soils are those with water tables deeper than 5 feet,

and not subject to flooding, and that are at least moderately well drained but not so permeable that ground water is easily polluted, and no more than gently sloping.

The most suitable soils in the Juneau area for use as sanitary landfills are the gently sloping Kupreanof, Mh, and Be soils (except for nearly level areas that may be flooded at times). Soils with only moderate limitations are the He soils and the moderately sloping Be, Karta, Kupreanof, and Mh soils. Very poorly drained soils and soils that are shallow over bedrock are not suitable for this purpose.

Daily cover for landfill. Refuse in area-type landfills must be covered at least once every day, normally with soil obtained from another site. A final cover of soil material at least 2 feet thick is placed over the fill when it is completed. The suitability of a soil for use as cover in the landfill depends on its workability--ease of digging, moving, and spreading over the refuse during both wet and dry periods--and on its slope, wetness, and thickness. The area from which the soil is borrowed must be capable of being reclaimed through revegetation and erosion control measures.

The most desirable soils for use as sources of cover material should be friable or loose, of loamy texture with few pebbles or stones, more than 40 inches thick, no more than gently sloping, and better than poorly drained. In the Juneau area only the He soils meet all of these specifications. The Mh soils are satisfactory except for stoniness and, in most cases, excessive slope. Organic soils, other soils with high water tables, and soils that are shallow over bedrock have the greatest limitations.

Table 1. Estimated Physical and Chemical Properties of the Soils.

| Soil series or land type | Map Symbol | Depth to seasonally high water table (feet) | Depth to bedrock (feet) | Depth from surface typical profile (inches) | Classification | | | Permeability 2/ (inches/hour) | Reaction pH | Shrink-swell potential | Corrosivity potential | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | USDA Texture 1/ | Unified | AASHO | | | | Untreated steel pipe | Concrete pipe |
| Am | AmA AmB | <2 | >5 | 0-60 | fsl | SM or ML | A-2 or A-4 | 0.6 -2.0 | 5.1-5.5 | low | high | moderate |
| Au | AuA | >5 | >5 | 0-9 | vgsl | GM | A-1 or A-2 | 2.0 -6.0 | 4.0-5.0 | low | moderate | moderate |
| | AuB | | | 9-60 | vgs | GP or GW | A-1 | >6.0 | 4.0-5.0 | low | | |
| Be | BeA BeB BeC BeD | 4 to 5 | >5 | 0-60 | vgs | GP or GW | A-1 | >6.0 | 5.1-5.5 | low | moderate | moderate |
| Co | CoA | <2 | >5 | 0-60 | sil | ML | A-4 | 0.6 -2.0 | 5.1-5.5 | low | high | moderate |
| Fu | FuA | <1 | >5 | 0-24 | pt | Pt | A-8 | - | 5.1-5.5 | high shrink, low swell | high | high |
| | | | | 24-60 | si | ML | A-4 | 0.6 -2.0 | 5.5-6.0 | low | | |
| Gravelly beach | Gb | 0 | >5 | 0-60 | vgs or vgsl | GW or GM | A-1 | >6.0 | - | low | high | high |
| Gravel pit | Gp | Variable material | | | | | | | | | | |
| He | HeA | 4 to 5 | >5 | 0-52 | fsl | SM or ML | A-2 or A-4 | 0.6 -2.0 | 5.1-5.5 | low | high | moderate |
| | | | | 52-60 | vgs | GP or GW | A-1 | >6.0 | 5.1-5.5 | low | | |
| Kaikli | KaB KaC KaD | <1 | 1 to 3 | 0-19 | pt | Pt | A-8 | - | 4.5-5.5 | high shrink, low swell | high | moderate |
| | KaE | | | 19-26 | vgl | GM | A-1 or A-2 | 0.2 -0.6 | 4.5-5.5 | low | | |
| | | | | 26+ | bedrock | - | - | - | - | - | - | - |
| Karheen | KhA KhC | <2 | >5 | 0-60 | very gravelly muck | GM | A-1 | 0.6 -2.0 | 5.1-5.5 | low | high | high |
| Karta | KtC KtE KtF | >5 | >5 | 0-11 | gsil | ML | A-4 | 0.6 -2.0 | 4.5-5.0 | low | high | moderate |
| | | | | 11-34 | vgsl | GM | A-1 | <0.06 | 4.5-5.0 | low | | |
| | | | | 34-60 | vgsl | GM | A-1 | 0.2 -0.6 | 4.5-5.5 | low | | |
| Kina | KiA KiB KiC KiD | <1 | >5 | 0-60 | pt | Pt | A-8 | - | 4.5-5.0 | high shrink, low swell | high | high |
| Kogish | KoA KoB KoC KoD | <1 | >5 | 0-60 | pt | Pt | A-8 | - | <4.5 | high shrink, low swell | high | high |
| Kupreanof | KuA,KuB, KuC,KuD, KuE,KuF | >5 | >5 | 0-18 | gsil | ML | A-4 | 0.6 -2.0 | 4.5-5.0 | low | high | moderate |
| | | | | 18-60 | vgsl | GM | A-1 | 0.6 -2.0 | 5.1-5.5 | low | | |

Table 1. Estimated Physical and Chemical Properties of the Soils. (Continued)

| Soil series or land type | Map Symbol | Depth to seasonally high water table (feet) | Depth to bedrock (feet) | Depth from surface typical profile (inches) | Classification | | | Permeability 2/ (inches/hour) | Reaction pH | Shrink-swell potential | Corrosivity potential | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | USDA Texture 1/ | Unified | AASHO | | | | Untreated steel pipe | Concrete pipe |
| Le | LeA | <1 | >5 | 0-60 | sil | ML | A-4 | 0.6 -2.0 | 5.1-5.5 | low | high | moderate |
| Maybeso | MaA,MaB, MaC,MaD | <2 | >5 | 0-27 | pt | Pt | A- 8 | - | 4.5-5.5 | high shrink, low swell | high | moderate |
| | MaE | | | 27-60 | vgl | GM | A-1 or A-2 | 0.06-0.2 | 5.1-5.5 | low | | |
| McGilvery-in complex with Tolstoi | | - | ½-1½ | 0-14 | pt | Pt | A-8 | - | 4.5 | high shrink, low swell | high | moderate |
| | | | | 14+ | bedrock | - | - | - | - | | - | - |
| Mh | MhB,MhC, MhD | >5 | >5 | 0-60 | gsl | GM | A-1 | 0.6 -2.0 | 5.1-5.5 | low | high | moderate |
| Riverwash | Rw | 0 | >5 | 0-60 | vgs | GP or GW | A-1 | >6.0 | - | low | high | moderate |
| Salt Chuck | SaA | 4 to 5 | >5 | 0-17 | vgsil or vgsl | GM | A-1 or A-2 | 0.6-2.0 | 4.5-5.5 | low | high | moderate |
| | SaB | | | 17-60 | vgls | GP-GM | A-1 | 2.0-6.0 | 4.5-5.5 | low | | |
| | SaC | | | | | | | | | | | |
| Tidal Flats | Tf | 0 | >5 | 0-60 | variable material | | | - | - | - | - | - |
| Tolstoi | ToC | - | ½ to 2 | 0-9 | vstsil | ML | A-4 | 0.6 -2.0 | 4.5-5.0 | low | - | - |
| | ToD | | | 9+ | bedrock | - | - | - | - | - | | |
| | ToE | | | | | | | | | | | |
| | ToF | | | | | | | | | | | |
| Wadleigh | WaA,WaB | <1 | >5 | 0-16 | vgsil or vgsl | GM | A-1 or A-2 | 0.6 -2.0 | 4.5-5.0 | low | high | moderate |
| | WaC,FoC, | | | 16-30 | vgsl | GM or SM | A-1 | <0.06 | 4.5-5.5 | low | | |
| | WaD,WaE, | | | 30-60 | vgl | GM | A-1 or A-2 | 0.2 -0.6 | 4.5-5.5 | low | | |
| | WaF | | | | | | | | | | | |

1/ Symbols have the following meanings (see glossary):

fsl - fine sandy loam
gsil - gravelly silt loam
pt - peat
si - silt
gsl - gravelly sandy loam
vgs - very gravelly sand
sil - silt loam
vgsil - very gravelly silt loam
vgsl - very gravelly sandy loam
vstsil - very stony silt loam

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

Table 2. Engineering Interpretations

| Soil series or land type | Map Symbol | Suitability as source of | | | Soil limitation ratings [2] and major limiting factors affecting | | |
|---|---|---|---|---|---|---|---|
| | | Topsoil | Road fill | Sand and gravel | Roads and streets | Foundations for low buildings | Artificial drainage |
| Am | AmA | Fair 2 [3] | Poor 2 | Poor 2,5 | Severe 2,3 | Severe 2,3 | Severe 3,11 |
| | AmB | Fair 2 | Poor 2 | Poor 2,5 | Severe 2,3 | Severe 2,3 | Severe 3,11 |
| Au | AuA | Unsuited 6 | Good | Good | Slight | Slight | Not needed |
| | AuB | Unsuited 6 | Good | Good | Slight | Slight | Not needed |
| Be | BeA | Unsuited 6 | Good | Good | Moderate 3 | Severe 3 | Severe 3 |
| | BeB | Unsuited 6 | Good | Good | Slight | Slight | Not needed |
| | BeC, BeD | Unsuited 6 | Good | Good | Moderate 8 | Slight | Not needed |
| Co | CoA | Fair 2 | Unsuited 2,5 | Unsuited 2,5 | Severe 2,3 | Severe 2,3 | Severe 3,11 |
| Fu | FuA | Poor 2 | Unsuited 2,5 | Unsuited 2,5 | Very severe 2,7 | Very severe 2,3 | Very severe 3,11 |
| Gravelly beach | Gb | Unsuited 6 | Fair 3 | Fair to good 5 | Very severe 3 | Very severe 3 | Not needed |
| He | HeA | Good | Fair 5 | Poor to fair 5 | Moderate 3 | Severe 3 | Severe 3 |
| Kaikli | KaB, KaC | Unsuited 7 | Unsuited 7 | Unsuited 7 | Very severe 4,7 | Very severe 2,7 | Very severe 4 |
| | KaD | Unsuited 7 | Unsuited 7 | Unsuited 7 | Very severe 4,7 | Very severe 2,7 | Very severe 4 |
| | KaE | Unsuited 7 | Unsuited 7 | Unsuited 7 | Very severe 4,8 | Very severe 4,8 | Very severe 4 |
| Karheen | KhA, KhC | Unsuited 6 | Poor 2,7 | Poor 2,7 | Moderate 2,7 | Severe 2 | Slight 2 |
| Karta | KtC | Unsuited 6 | Fair 5 | Poor 5 | Moderate 8 | Slight | Not needed |
| | KtE | Unsuited 6 | Fair 5 | Poor 5 | Severe 8,10 | Severe 8,10 | Not needed |
| | KtF | Unsuited 6 | Fair 5 | Poor 5 | Very severe 8,10 | Very severe 8,10 | Not needed |
| Kina | KiA | Unsuited 7 | Unsuited 7 | Unsuited 7 | Very severe 2,7 | Very severe 2,7 | Very severe 7,11 |
| | KiB | Unsuited 7 | Unsuited 7 | Unsuited 7 | Very severe 2,7 | Very severe 2,7 | Very severe 7,11 |
| | KiC, KiD | Unsuited 7 | Unsuited 7 | Unsuited 7 | Very severe 2,7 | Very severe 2,7 | Very severe 7,11 |
| Kogish | KoA | Unsuited 7 | Unsuited 7 | Unsuited 7 | Very severe 2,7 | Very severe 2,7 | Very severe 7,11 |
| | KoB | Unsuited 7 | Unsuited 7 | Unsuited 7 | Very severe 2,7 | Very severe 2,7 | Very severe 7,11 |
| | KoC | Unsuited 7 | Unsuited 7 | Unsuited 7 | Very severe 2,7 | Very severe 2,7 | Very severe 7,8 |
| | KoD | Unsuited 7 | Unsuited 7 | Unsuited 7 | Very severe 2,7 | Very severe 2,7 | Very severe 7,8 |
| Kuprea-nof | KuA | Poor 6 | Good | Poor 5 | Slight | Slight | Not needed |
| | KuB | Poor 6 | Good | Poor 5 | Slight | Slight | Not needed |
| | KuC | Poor 6 | Good | Poor 5 | Moderate 8 | Slight | Not needed |
| | KuD | Poor 6 | Good | Poor 5 | Severe 8 | Moderate 8 | Not needed |
| | KuE | Poor 6 | Poor 10 | Poor 5 | Severe 8,10 | Severe 8 | Not needed |
| | KuF | Poor 6 | Poor 10 | Poor 5 | Very severe 8,10 | Very severe 8 | Not needed |

of Soil Properties [1]

| Soil limitation ratings [2] and major limiting factors affecting (Cont'd) | | | | | |
|---|---|---|---|---|---|
| Septic tank filter fields | Parks and Recreation | Shallow Excavations | Sanitary landfill | Daily cover for landfill | Remarks |
| Severe 2,3 | Severe 2,3 | Severe 2,3 | Severe 2 | Severe 2,3 | High water table, Floods occasionally |
| Severe 2,3 | Severe 2,3 | Severe 2,3 | Severe 2 | Severe 2,3 | High water table, Floods occasionally |
| Slight 9 | Slight | Severe 6 | Severe 9 | Severe 6 | |
| Slight 9 | Slight | Severe 6 | Severe 9 | Severe 6 | |
| Severe 3,9 | Slight | Severe 6 | Slight [4] | Severe 6 | Floods occasionally |
| Slight 9 | Slight | Severe 6 | Slight | Severe 6 | |
| Moderate 8 | Slight | Severe 6 | Moderate 8 | Severe 6 | |
| Severe 2,3 | Severe 2,3 | Severe 2,3 | Severe 2,3 | Severe 2,3 | High water table, Floods occasionally |
| Very severe 2,3 | Very severe 2 | Very severe 2,3 | Very severe 2,3 | Very severe 2 | High water table, Floods occasionally |
| Severe 2,3 | Severe 3 | Very severe 3,6 | Very severe 2,3 | Very severe 3,6 | Frequently inundated |
| Severe 3,9 | Slight | Moderate 3 | Moderate 3 | Slight | Floods occasionally |
| Very severe 4,7 | Very severe 2,7 | Very severe 2,4 | Very severe 2,4 | Very severe 2,4 | High water table, shallow bedrock |
| Very severe 4,7 | Very severe 2,7 | Very severe 4,8 | Very severe 4,8 | Very severe 2,4 | High water table, shallow bedrock |
| Very severe 4,8 | Very severe 2,8 | Very severe 4,8 | Very severe 4,8 | Very severe 4,8 | High water table, shallow bedrock |
| Very severe 2 | Moderate 2,7 | Very severe 2,6 | Very severe 2,7 | Very severe 2,6 | High water table |
| Severe 1 | Slight | Severe 6 | Moderate 8 | Severe 6 | Compact subsoil |
| Very severe 8 | Severe 8 | Very severe 6,8 | Very severe 8 | Very severe 6,8 | Land slide hazard |
| Very severe 8 | Severe 8 | Very severe 6,8 | Very severe 8 | Very severe 6,8 | Land slide hazard |
| Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | High water table, low bearing strength |
| Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | High water table, low bearing strength |
| Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | High water table, low bearing strength |
| Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | High water table, low bearing strength |
| Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | High water table, low bearing strength |
| Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | Very severe 2,7 | High water table, low bearing strength |
| Moderate 1 | Moderate 6 | Severe 6 | Slight | Severe 6 | |
| Moderate 1 | Moderate 6 | Severe 6 | Slight | Severe 6 | |
| Moderate 1,8 | Moderate 6 | Severe 6 | Moderate 8 | Severe 6 | |
| Severe 1,8 | Severe 6,8 | Severe 6,8 | Severe 8 | Severe 6,8 | Steep slopes |
| Very severe 8 | Very severe 6,8 | Very severe 6,8 | Very severe 8 | Very severe 6,8 | Steep slopes |
| Very severe 8 | Very severe 6,8 | Very severe 6,8 | Very severe 8 | Very severe 6,8 | Steep slopes |

Table 2. Engineering Interpretations

| Soil series or land type | Map Symbol | Suitability as source of | | | Soil limitation ratings 2/ major limiting factors affecting | | |
|---|---|---|---|---|---|---|---|
| | | Topsoil | Road fill | Sand and gravel | Roads and streets | Foundations for low buildings | Artificial drainage |
| Le | LeA | Poor 2 | Unsuited 2,5 | Unsuited 2,5 | Severe | Very severe 2 | Very severe 11 |
| Maybeso | MaA | Unsuited 7 | Poor 2,7 | Poor 7 | Severe 2,7 | Severe 2,7 | Moderate 6 |
| | MaB | Unsuited 7 | Poor 2,7 | Poor 7 | Severe 2,7 | Severe 2,7 | Moderate 6 |
| | MaC | Unsuited 7 | Poor 2,7 | Poor 7 | Severe 2,7 | Severe 2,7 | Severe 6,8 |
| | MaD, MaE | Unsuited 7 | Poor 2,7 | Poor 7 | Severe 7,8 | Severe 2,7 | Severe 6,8 |
| Mh | MhB | Unsuited 6 | Good | Fair 5 | Slight | Slight | Not needed |
| | MhC | Unsuited 6 | Good | Fair 5 | Moderate 8 | Slight | Not needed |
| | MhD | Unsuited 6 | Good | Fair 5 | Severe 8 | Moderate 8 | Not needed |
| River-wash | Rw | Unsuited 3,6 | Fair to good 3 | Fair to good 3 | Very severe 3 | Very severe 2,3 | Very severe 3 |
| Salt Chuck | SaA | Unsuited 6 | Good | Fair 5 | Slight | Slight | Not needed |
| | SaB | Unsuited 6 | Good | Fair 5 | Slight | Slight | Not needed |
| | SaC | Unsuited 6 | Good | Fair 5 | Moderate 8 | Slight | Not needed |
| Tidal flats | Tf | Poor 3 | Unsuited 3,5 | Unsuited 3,5 | Very severe 3 | Very severe 2,3 | Very severe 3 |
| Tolstoi | ToC, ToD | Unsuited 4 | Unsuited 4 | Unsuited 4 | Very severe 4,8 | Moderate 4,8 | Not needed |
| | ToE | Unsuited 4 | Unsuited 4 | Unsuited 4 | Very severe 4,8 | Severe 4,8 | Not needed |
| | ToF | Unsuited 4 | Unsuited 4 | Unsuited 4 | Very severe 4,8 | Very severe 4,8 | Not needed |
| Wadleigh | WaA, WaB | Unsuited 6 | Poor 2 | Poor 2,5 | Moderate 2 | Severe 2 | Moderate 6 |
| | WaC, FoC | Unsuited 6 | Poor 2 | Poor 2,5 | Moderate 2,8 | Severe 2 | Severe 6,8 |
| | WaD | Unsuited 6 | Poor 2 | Poor 2,5 | Severe 2,8 | Severe 2,8 | Severe 6,8 |
| | WaE, WaF | Unsuited 6,8 | Poor 2,8 | Poor 2,8 | Very severe 8 | Very severe 8 | Severe 6,8 |

1/ Refers to soil properties to a depth of 5 feet unless other wise stated in the text.

2/ Soil limitation ratings:

Slight - The soil limitations, if any, are easy to overcome.

Moderate- Soil limitations need to be recognized, but can be overcome by good planning, careful design, and proper construction.

Severe - Soil limitations are difficult to overcome; very careful engineering design and construction will be necessary if the soil is used for the specified purpose. In some cases the limitations may not be economically feasible to correct.

Very severe - Soil limitations are ordinarily not economically feasible to overcome.

of Soil Properties 1/ (Continued)

| Soil limitation ratings 2/ and major limiting factors affecting (Cont'd) | | | | | |
|---|---|---|---|---|---|
| Septic tank filter fields | Parks and Recreation | Shallow Excavations | Sanitary Landfill | Daily cover for landfill | Remarks |
| Very severe 2,3 | Very severe 2 | Very severe 2,3 | Very severe 2,3 | Very severe 2,3 | High water table |
| Very severe 1,2 | Very severe 2 | Severe 2,6 | Severe 2 | Severe 2,6 | High water table |
| Very severe 1,2 | Very severe 2 | Severe 2,6 | Severe 2 | Severe 2,6 | High water table |
| Very severe 1,2 | Very severe 2 | Severe 2,6 | Severe 2 | Severe 2,6 | High water table |
| Very severe 2,8 | Very severe 2,8 | Very severe 2,8 | Very severe 2,8 | Very severe 2,8 | High water table |
| Slight 9 | Slight | Moderate 6 | Slight | Moderate 6 | |
| Moderate 8 | Slight | Moderate 6,8 | Moderate 8 | Moderate 6,8 | |
| Severe 8 | Moderate 8 | Severe 8 | Severe 8 | Severe 8 | Irregular slopes |
| Very severe 3 | Very severe 3 | Very severe 3,6 | Very severe 3 | Very severe 3,6 | Floods frequently |
| Slight 9 | Slight | Severe 6 | Severe 9 | Severe 6 | |
| Slight 9 | Slight | Severe 6 | Severe 9 | Severe 6 | |
| Moderate 8 | Slight | Severe 6 | Severe 9 | Severe 6 | |
| Very severe 3 | Very severe 3 | Very severe 3 | Very severe 3 | Very severe 3 | Floods frequently |
| Very severe 4 | Very severe 4 | Very severe 4,8 | Very severe 4,8 | Very severe 4,8 | Shallow bedrock |
| Very severe 4,8 | Very severe 4,8 | Very severe 4,8 | Very severe 4,8 | Very severe 4,8 | Shallow bedrock, steep slopes |
| Very severe 4,8 | Very severe 4,8 | Very severe 4,8 | Very severe 4,8 | Very severe 4,8 | Shallow bedrock, steep slopes |
| Very severe 1,2 | Very severe 2 | Severe 2,6 | Severe 2 | Severe 2,6 | High water table |
| Very severe 1,2 | Very severe 2 | Severe 2,6 | Severe 2 | Severe 2,6 | High water table |
| Very severe 1,2 | Very severe 2 | Severe 2,8 | Severe 2,8 | Severe 2,8 | High water table |
| Very severe 1,8 | Very severe 8 | Very severe 2,8 | Very severe 2,8 | Very severe 2,8 | High water table |

3/ Numbers following ratings refer to soil properties or limitations as follows:

1. Low soil permeability
2. High water table or seepage
3. Susceptibility to flooding or to inundation
4. Shallow bedrock
5. Silty material
6. Presence of coarse fragments (coarse gravel, cobbles, boulders).
7. Organic material (peat)
8. Steep slopes or rough topography
9. Possible contamination of ground water
10. Erosion or landslide hazard
11. Few outlets for drainage ditches

4/ Rating is moderate in areas that may be subject to inundation.

## GLOSSARY

Acidity: See Reaction (pH)

Clay: As a soil separate, the mineral soil particles less than .002 mm in diameter. As a soil textural class, soil material with 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Corrosivity: The potential of a soil to create conditions that will result in wearing away or perforation of buried metal or concrete.

Drainage, soil: The relative rapidity and extent of removal of water, under natural conditions, from the surface and within the soil. Terms commonly used to describe soil drainage are:

Very poorly drained - Water is removed so slowly that the soil remains wet most of the time, and water ponds on the surface frequently. The water table is at the surface most of the time.

Poorly drained - Water is removed so slowly that the soil remains wet much of the time. The water table is at or near the surface during a considerable part of the year.

Somewhat poorly drained - Water is removed so slowly that the soil is wet for significant periods, but not all the time.

Moderately well drained - Water is removed somewhat slowly, and the soil is wet for a small but significant part of the time.

Well drained - Water is removed readily but not rapidly.

Excessively drained - Water is removed very rapidly.

Fine sandy loam: A textural class that consists of sandy loam soil material (see Texture, soil) in which the dominant part of the sand fraction is between .1 and .25 mm in size.

Gravelly sandy loam: Soil material with 15 to 35 percent, by volume, of particles coarser than 2 mm (No. 10 sieve), and with sandy loam textural class (see Texture) in the fraction finer than 2 mm.

Gravelly silt loam: Soil material with 15 to 35 percent, by volume, of particles coarser than 2 mm (No. 10 sieve), and with silt loam textural class (see Texture, soil) in the fraction finer than 2 mm.

Horizon, soil: A layer of soil, approximately parallel to the soil surface, with characteristics produced by soil - farming processes.

Peat: Material composed principally of organic materials.

Percent slope: The number of unit lengths (commonly feet) change in elevation in a horizontal distance of 100 unit lengths.

Permeability: The rate at which water penetrates or passes through saturated soil; expressed here in inches per hour.

Reaction (pH): The degree of acidity or alkalinity of a soil expressed in pH values. A soil at pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. Degrees of acidity and alkalinity are expressed as follows:

| | |
|---|---|
| Extremely acid | Below pH 4.5 |
| Very strongly acid | pH 4.5 to 5.0 |
| Strongly acid | pH 5.1 to 5.5 |
| Medium acid | pH 5.6 to 6.0 |
| Slightly acid | pH 6.1 to 6.5 |
| Neutral | pH 6.6 to 7.3 |
| Mildly alkaline | pH 7.4 to 7.8 |
| Moderately alkaline | pH 7.9 to 8.4 |
| Strongly alkaline | pH 8.5 to 9.0 |
| Very strongly alkaline | Above pH 9.0 |

Sand: As a soil separate, individual rock or mineral fragments ranging from 0.05 mm to 2 mm. As a textural class, soil material with 85 percent or more sand and in which the percentage of silt plus 1½ times the percentage of clay does not exceed 15.

Sandy loam: A textural class that includes soil material with either (1) more than 52 percent sand and less than 20 percent clay, provided that the percentage of silt plus twice the percentage of clay exceeds 30; or (2) between 43 and 52 percent sand, with less than 7 percent clay and less than 50 percent silt.

Shrink-swell potential: An indication of the volume change to be expected in a soil with changes in the moisture content.

Silt: As a soil separate, individual mineral particles that range in diameter from .002 mm to .05 mm. As a textural class, soil material with more than 80 percent silt and less than 12 percent clay.

Silt loam: A textural class that includes soil material with more than 50 percent silt and less than 27 percent clay, but that excludes material with more than 80 percent silt and less than 12 percent clay.

Silty clay loam: A textural class that includes soil material with 27 to 40 percent clay and less than 20 percent sand.

Texture, soil: The relative proportions by weight of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportions of fine particles, are sand, loamy sand,

sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided into coarse, fine, and very fine depending on the dominant size range of the sand fraction. Textural classes are based on the particles finer than 2 mm. The word "gravelly" added to any textural class name indicates that 15 to 50 percent of the whole soil consists of particles or rock fragments coarser than 2 mm. "Very gravelly" indicates that coarse fragments make up 50 to 90 percent of the soil.

Very gravelly sand: Soil material with more than 35 percent by volume of particles coarser than 2 mm (No. 10 sieve), and with sand textural class (See Texture) in the fraction finer than 2 mm.

Very gravelly sandy loam: Soil material with more than 35 percent, by volume, of particles coarser than 2 mm (No. 10 sieve), and with sandy loam textural class (See Texture, soil) in the fraction finer than 2 mm.

Very gravelly silt loam: Soil material with more than 35 percent, by volume, of particles coarser than 2 mm (No. 10 sieve), and with silt loam textural class (See Texture, soil) in the fraction finer than 2 mm.

Very stony silt loam: Soil in which 50 percent or more of the volume consists of large stones and boulders, and the remaining portion of silt loam.

## LITERATURE CITED


(1) American Association of State Highway Officials. 1961. Specifications for Highway Materials and Methods of Sampling and Testing. Ed. 8, 2 parts, illus.

(2) Army Corps of Engineers, Alaska District, Flood Plain Management Services. 1970. Flood Plain Information, Mendenhall River, Juneau, Alaska. 23 pp., illus.

(3) Army Corps of Engineers, Alaska District, Flood Plain Management Services. 1968. Flood Proofing to Prevent Damage. 8 pp., illus.

(4) Portland Cement Association. 1956. PCA Soil Primer. 88 pp., illus.

(5) Waterways Experiment Station, Corps of Engineers. 1953. The Unified Soil Classification System, Corps of Engineers, U.S. Army Tech. Memo. No. 3-357, V. 1, 33 pp. and charts. Vicksburg, Miss.

Soil Map Legend and Approximate Acreage in the Juneau Area

| Map Symbol 1/ | Soil or Land Type | Approximate Area (acres) | Proportionate Extent (%) |
|---|---|---|---|
| AmA | Am fine sandy loam, 0 to 3 percent slopes | 1,217 | 3.43 |
| AmB | Am fine sandy loam, 3 to 7 percent slopes | 25 | .07 |
| AuA | Au very gravelly sandy loam, 0 to 3 percent slopes | 73 | .20 |
| AuB | Au very gravelly sandy loam, 3 to 7 percent slopes | 21 | .06 |
| BeA | Be very gravelly sand, 0 to 3 percent slopes | 1,022 | 2.88 |
| BeB | Be very gravelly sand, 3 to 7 percent slopes | 31 | .09 |
| BeC, BeD | Be very gravelly sand, 7 to 20 percent slopes | 21 | .06 |
| CoA | Co silt loam, 0 to 3 percent slopes | 914 | 2.58 |
| FoC | (See Wadleigh silt loam, 7 to 12 percent slopes) | | |
| FuA | Fu peat, 0 to 3 percent slopes | 237 | .67 |
| Gb | Gravelly beach | 104 | .29 |
| Gp | Gravel pit | 101 | .29 |
| HeA | He fine sandy loam | 1,685 | 4.75 |
| KaB, KaC | Ka mucky peat, 3 to 12 percent slopes | 3 | .01 |
| KaD | Ka mucky peat, 12 to 20 percent slopes | 150 | .42 |
| KaE | Ka mucky peat, 20 to 30 percent slopes | 46 | .13 |
| KhA, KhC | Karheen very gravelly muck, 0 to 12 percent slopes | 30 | .08 |
| KtC | Karta silt loam, 7 to 12 percent slopes | 13 | .04 |
| KtE | Karta silt loam, 20 to 35 percent slopes | 141 | .40 |
| KtF | Karta silt loam, 35 to 75 percent slopes | 174 | .49 |
| KiA | Kina peat, 0 to 3 percent slopes | 828 | 2.34 |
| KiB | Kina peat, 3 to 7 percent slopes | 828 | 2.34 |
| KiC, KiD | Kina peat, 7 to 20 percent slopes | 414 | 1.17 |
| KoA | Kogish peat, 0 to 3 percent slopes | 128 | .36 |
| KoB | Kogish peat, 3 to 7 percent slopes | 587 | 1.66 |
| KoC | Kogish peat, 7 to 12 percent slopes | 64 | .18 |
| KoD | Kogish peat, 12 to 20 percent slopes | 35 | .10 |
| KuA | Kupreanof gravelly silt loam, 0 to 3 percent slopes | 38 | .11 |
| KuB | Kupreanof gravelly silt loam, 3 to 7 percent slopes | 471 | 1.33 |
| KuC | Kupreanof gravelly silt loam, 7 to 12 percent slopes | 791 | 2.23 |
| KuD | Kupreanof gravelly silt loam, 12 to 20 percent slopes | 930 | 2.62 |
| KuE | Kupreanof gravelly silt loam, 20 to 35 percent slopes | 1,487 | 4.20 |
| KuF | Kupreanof gravelly silt loam, 35 to 75 percent slopes | 1,401 | 3.95 |
| LeA | Le silt loam, 0 to 3 percent slopes | 695 | 1.96 |
| MaA | Maybeso mucky peat, 0 to 3 percent slopes | 504 | 1.42 |
| MaB | Maybeso mucky peat, 3 to 7 percent slopes | 1,460 | 4.12 |
| MaC | Maybeso mucky peat, 7 to 12 percent slopes | 1,717 | 4.85 |
| MaD, MaE | Maybeso mucky peat, 12 to 20 percent slopes | 794 | 2.24 |
| MD, ML | Made land | 112 | .31 |

Soil Map Legend and Approximate Acreage of Soils in the Juneau Area (Cont'd)

| Map Symbol 1/ | Soil or Land Type | Approximate Area (acres) | Proportionate Extent (%) |
|---|---|---|---|
| MhB | Mh gravelly sandy loam, 3 to 7 percent slopes | 47 | .13 |
| MhC | Mh gravelly sandy loam, 7 to 12 percent slopes | 121 | .34 |
| MhD | Mh gravelly sandy loam, 12 to 20 percent slopes | 539 | 1.52 |
| Rw | Riverwash | 147 | .42 |
| SaA | Salt Chuck very gravelly silt loam, 0 to 3 percent slopes | 57 | .16 |
| SaB | Salt Chuck very gravelly silt loam, 3 to 7 percent slopes | 213 | .60 |
| SaC | Salt Chuck very gravelly silt loam, 7 to 12 percent slopes | 61 | .17 |
| Tf | Tidal Flats | 322 | .91 |
| ToB | Tolstoi-McGilvery complex, 12 to 20 percent slopes | 13 | .04 |
| ToC, ToD | Tolstoi-McGilvery complex | 235 | .66 |
| ToE | Tolstoi-McGilvery complex, 20 to 35 percent slopes | 865 | 2.44 |
| ToF | Tolstoi-McGilvery complex, 35 to 75 percent slopes | 8,710 | 24.58 |
| WaA, WaB | Wadleigh gravelly silt loam, 3 to 7 percent slopes | 547 | 1.54 |
| WaC, FoC | Wadleigh gravelly silt loam, 7 to 12 percent slopes | 1,398 | 3.95 |
| WaD | Wadleigh gravelly silt loam, 12 to 20 percent slopes | 1,754 | 4.95 |
| WaE, WaF | Wadleigh gravelly silt loam, 20 to 75 percent slopes | 285 | .81 |
| Airport | | 372 | 1.05 |
| Urban | | 462 | 1.30 |
| | Total land area | 35,440 | 100.00 |
| Water (lakes and larger streams) | | 515 | |
| | Total map area | 35,955 | |

1/ The map symbol consists of 2 parts. The first, a capital letter and lower case letter, is an abbreviation of the soil name. The second, a capital letter, refers to slope group as follows:

A - 0 to 3 percent slopes
B - 3 to 7 percent slopes
C - 3 to 12 percent slopes
D - 12 to 20 percent slopes
E - 20 to 35 percent slopes
F - 35 to 75 percent slopes



1879-81

# Accessibility Statement

This document is not accessible by screen-reader software. The U.S. Department of Agriculture is committed to making its electronic and information technologies accessible to individuals with disabilities by meeting or exceeding the requirements of Section 508 of the Rehabilitation Act (29 U.S.C. 794d), as amended in 1998. Section 508 is a federal law that requires agencies to provide individuals with disabilities equal access to electronic information and data comparable to those who do not have disabilities, unless an undue burden would be imposed on the agency. The Section 508 standards are the technical requirements and criteria that are used to measure conformance within this law. More information on Section 508 and the technical standards can be found at www.section508.gov.

If you require assistance or wish to report an issue related to the accessibility of any content on this website, please email Section508@oc.usda.gov. If applicable, please include the web address or URL and the specific problems you have encountered. You may also contact a representative from the USDA Section 508 Coordination Team.

**Nondiscrimination Statement**

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

(1) mail: U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.