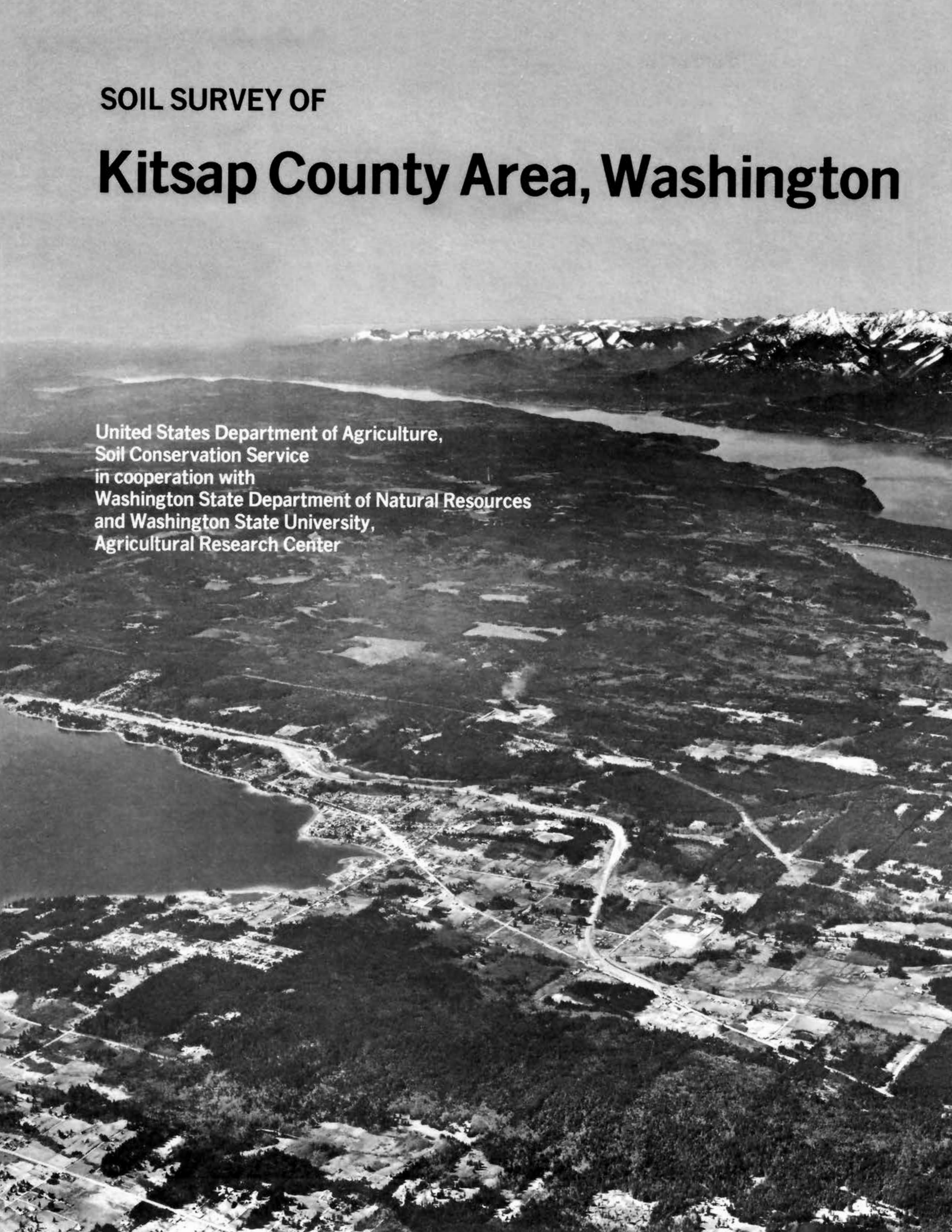
SOIL SURVEY OF

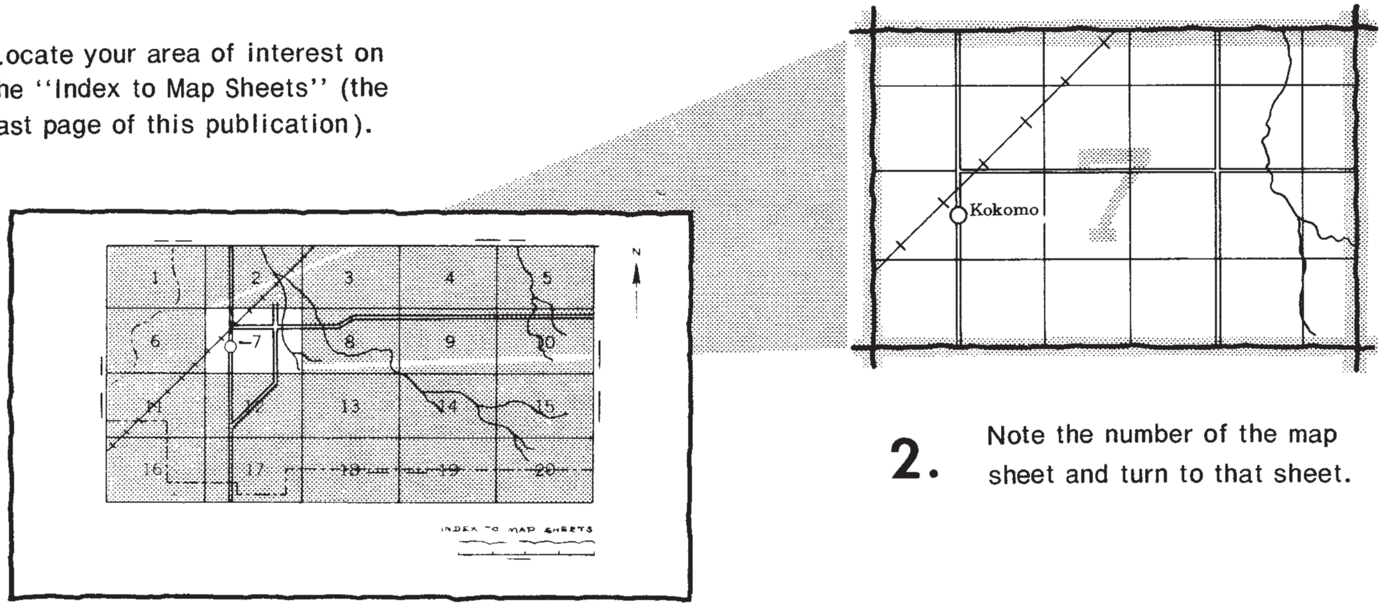
Kitsap County Area, Washington



United States Department of Agriculture,
Soil Conservation Service
in cooperation with
Washington State Department of Natural Resources
and Washington State University,
Agricultural Research Center

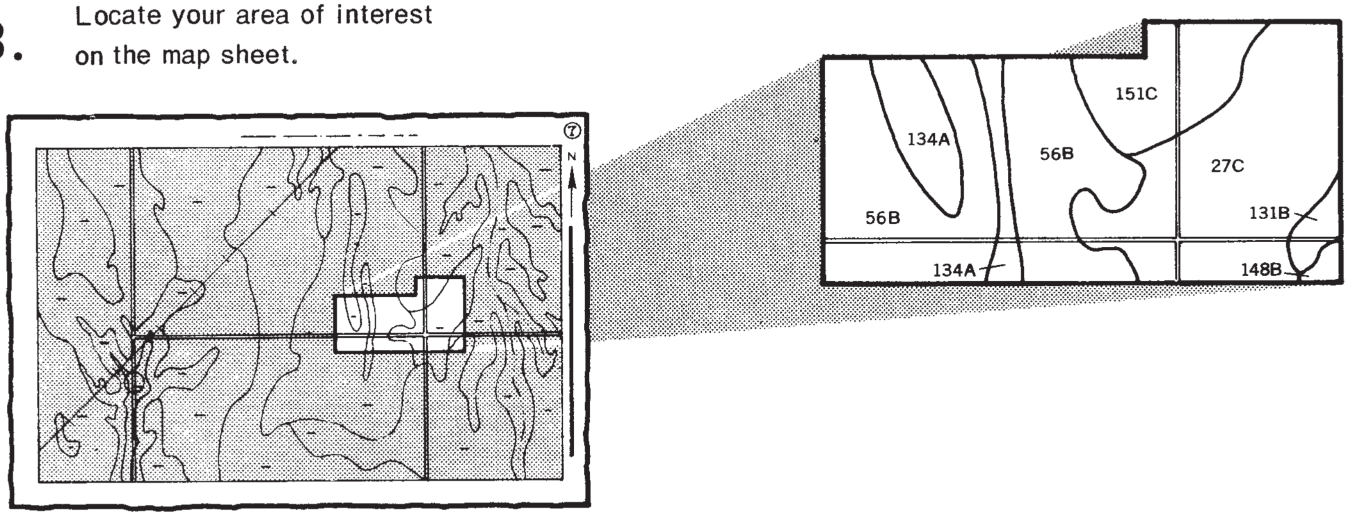
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

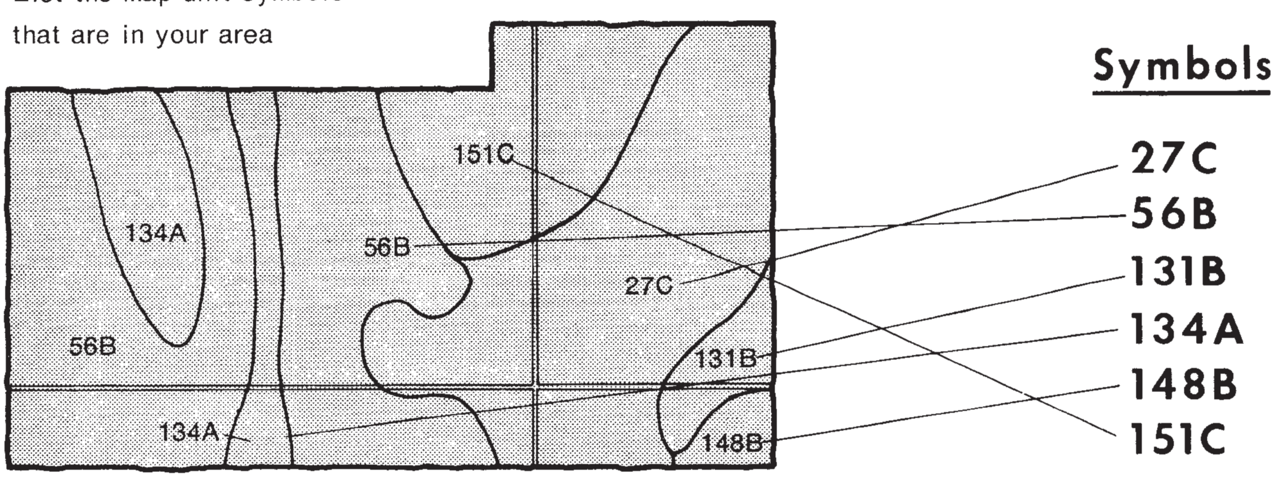


2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.

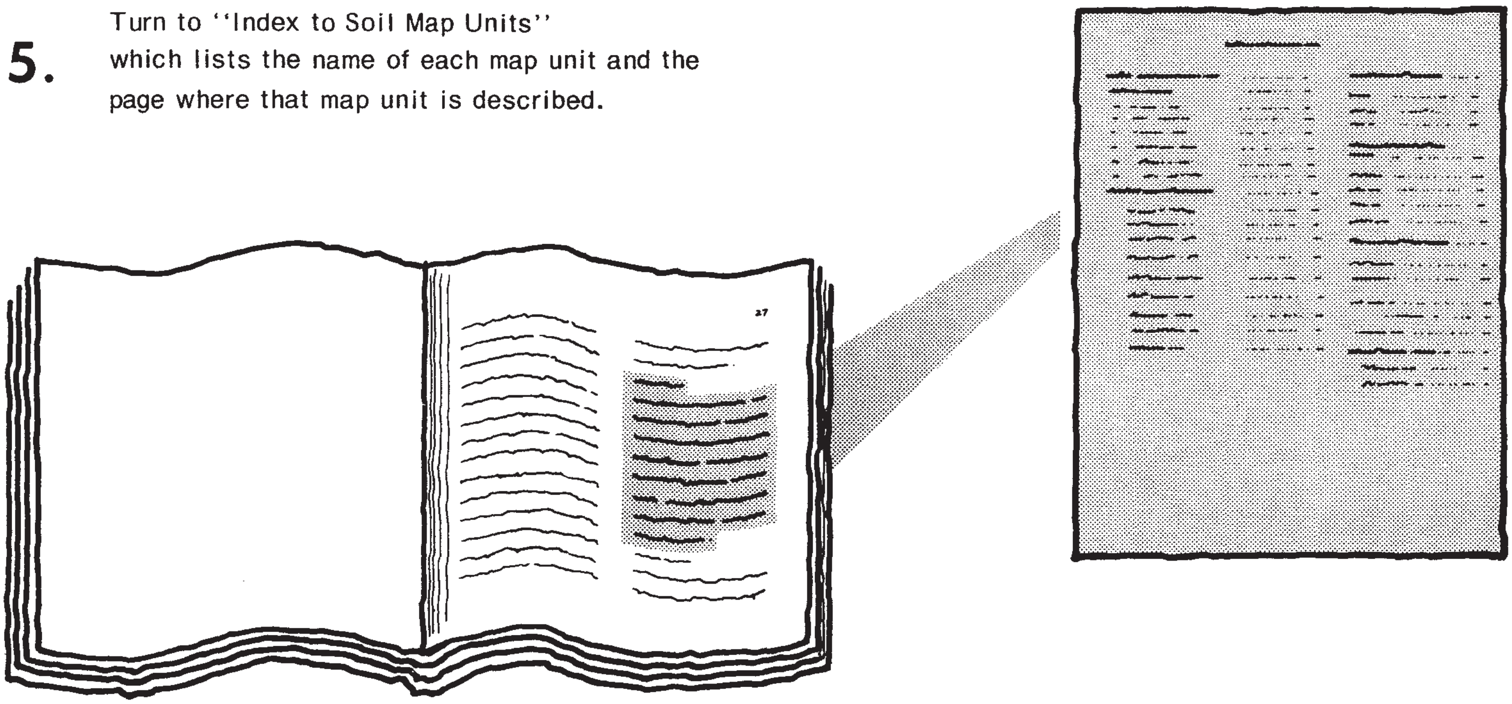


4. List the map unit symbols that are in your area

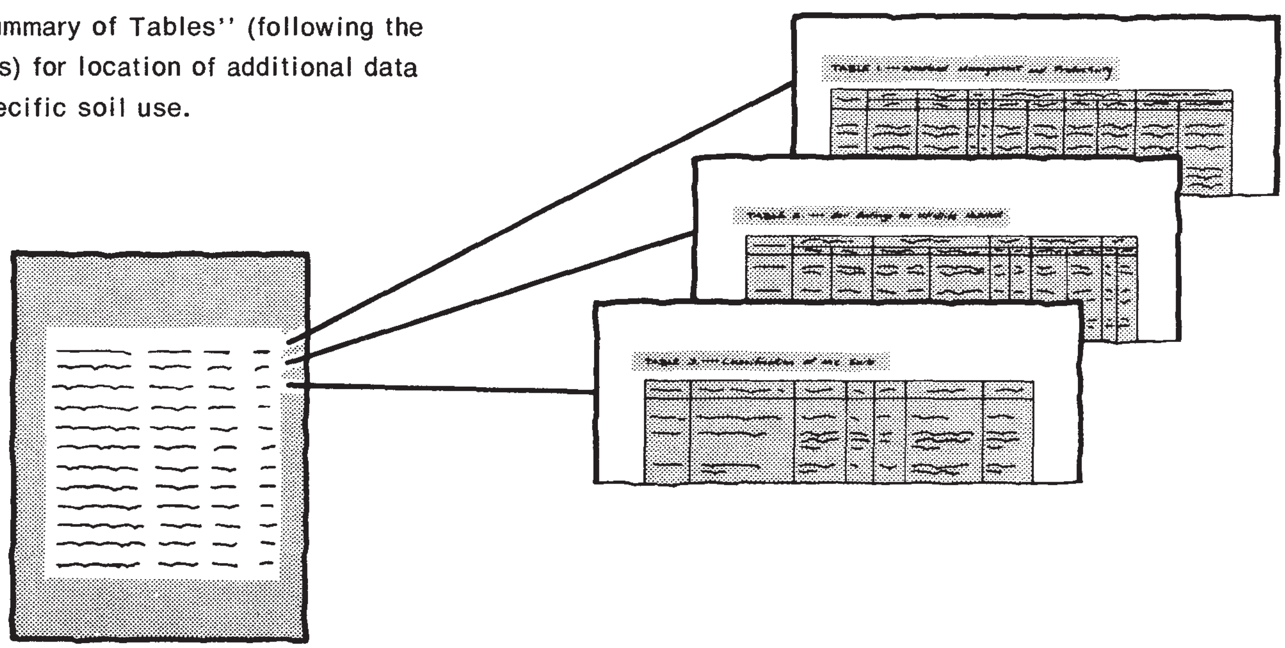


THIS SOIL SURVEY

5. Turn to ''Index to Soil Map Units'' which lists the name of each map unit and the page where that map unit is described.



6. See ''Summary of Tables'' (following the Contents) for location of additional data on a specific soil use.



7. Consult ''Contents'' for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1976-77. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1977. This survey was made cooperatively by the Soil Conservation Service; the Washington State Department of Natural Resources; and Washington State University, Agricultural Research Center. It is part of the technical assistance furnished to the Kitsap County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: A view looking southwest toward the Olympic Mountains and Hood Canal of Puget Sound. The Olympic Mountains greatly influence the climate of the Kitsap County Area. Silverdale is in the middle foreground.

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soil series

Issued September 1980

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foreword

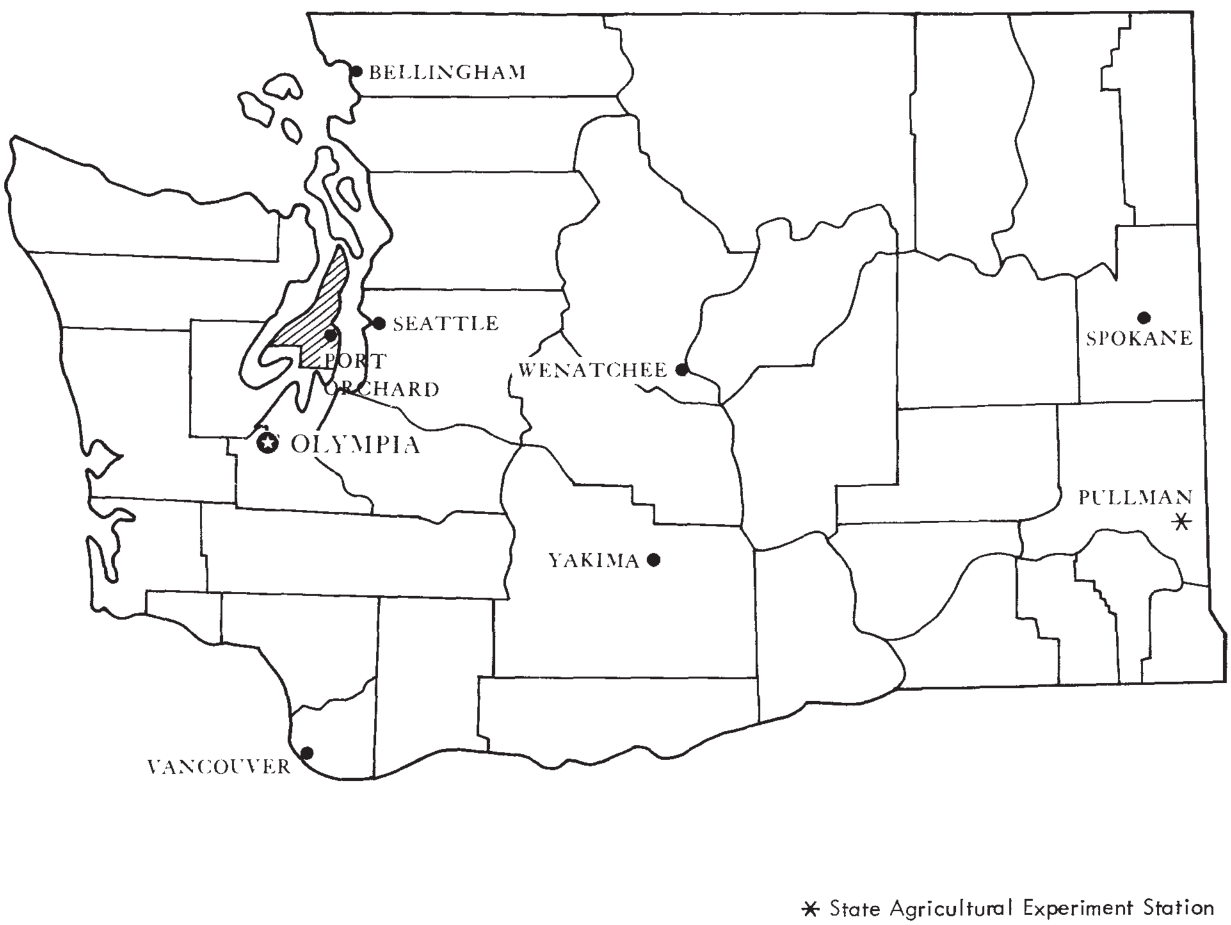
This soil survey contains information that can be used in land-planning programs in Kitsap County Area, Washington. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Lynn A. Brown
State Conservationist
Soil Conservation Service



Location of Kitsap County Area in Washington.

soil survey of
Kitsap County Area, Washington

By Carl J. McMurphy, Washington State Department of Natural Resources

Surveyed by Carl J. McMurphy, Dr. Chien-Lu Ping, and Gerry Coleman,
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Forestry fieldwork by Richard Johnson, Soil Conservation Service;
and Andy Card, Washington State Department of Natural Resources

United States Department of Agriculture, Soil Conservation Service
in cooperation with Washington State Department of Natural Resources
and Washington State University, Agricultural Research Center

KITSAP COUNTY AREA is in the center of Puget Sound Basin. Kitsap County is about 393 square miles, or 251,520 acres, of which 241,730 acres, excluding the United States military reservations, is included in the survey area. Port Orchard, the county seat, is about 14 miles southwest of Seattle.

This survey replaces an earlier soil survey of Kitsap County published in 1939 (*17*). It updates the earlier survey by providing more detailed information and current interpretations for land use planning. This survey of Kitsap County Area joins published soil surveys for nearby county areas, including King County Area (*11*), Jefferson County Area (*7*), and Pierce County Area (*19*). These three county areas have many of the soil series that are in the Kitsap County Area.

Kitsap County is a long, narrow, irregular-shaped part of the Kitsap Peninsula. It has a very long, irregular coastline formed by the indentation of many bays or inlets. All of the county except the southern part is bounded by waters of Puget Sound. Kitsap County is joined at its southern boundary by Mason and Pierce Counties. The waters of Puget Sound form the county's eastern and northern boundaries; Hood Canal, a long arm of Puget Sound, forms the western boundary.

In addition to the mainland, the county includes Bainbridge and Blake Islands. Bainbridge Island is about 28 square miles. It is east of the Kitsap Peninsula and is separated from the peninsula by Agate Passage and Rich Passage. Blake Island, about 1 square mile, is 2 miles east of Colby.

The relief of the county is moderately subdued. The central part of the county averages about 250 feet above sea level and consists mainly of long, narrow terraces, oriented north to south, separated by many narrow troughs and a few wide valleys. An exception is a conspicuous, rough, mountainous area a few miles west of Bremerton. Gold Mountain is the highest peak and has an elevation of 1,761 feet.

Forest products are important in the economy of the Kitsap County Area. A total of 16,711,000 board feet was harvested in 1966. By 1975, the total harvest had grown to 435,141,000 board feet. Large timber companies harvest trees for saw logs, while smaller land owners cut trees for pulp. Christmas tree culture is the main operation in the southwestern part of the county.

Farmland is being converted from specialty crops to pasture for livestock or to Christmas trees. At one time, most of the cleared land on Bainbridge Island was used for strawberries. Now, only a few strawberry and caneberry patches are commercially harvested.

In 1960 the population of Kitsap County was 84,176. It increased to 116,090 in 1976. Urban development in central Kitsap County has increased tremendously. The Bangor Naval Submarine Depot building program has changed the central part of the county from forest and farmland to a large rural area of many homes in large wooded lots. The Bremerton, Port Orchard, Poulsbo, and Silverdale rural areas have spread into the countryside at a rapid pace.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

The climate of Kitsap County is greatly tempered by winds from the Pacific Ocean. Summers are fairly warm, but hot days are rare. Winters are cool, but snow and freezing temperatures are not common except at higher elevations. During summer, rainfall is extremely light, so crops growing actively during this period need irrigation. Often, several weeks pass without precipitation. During the rest of the year, rains are frequent, especially late in fall and in winter.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Bremerton, Washington in the period 1952 to 1976. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 40 degrees F, and the average daily minimum temperature is 35 degrees. The lowest temperature on record, which occurred at Bremerton on December 16, 1964, is 8 degrees. In summer the average temperature is 62 degrees, and the average daily maximum temperature is 73 degrees. The highest recorded temperature, which occurred on August 10, 1960, is 99 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 50 inches. Of this, 10 inches, or 20 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 8 inches. The heaviest 1-day rainfall during the period of record was 4.17 inches at Bremerton on November 3, 1955. Thunderstorms occur on about 7 days each year, and most occur in summer.

Average seasonal snowfall is 9 inches. The greatest snow depth at any one time during the period of record was 14 inches. On an average of 1 day, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 60 percent of the time possible in summer and 30 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 10 miles per hour, in January.

In most winters, one or two storms over the whole area bring strong and sometimes damaging winds. In some years, the accompanying heavy rains cause serious flooding. Every few years, either in winter or summer, a large invasion of a continental air mass from the east causes abnormal temperatures. In winter, several consecutive days are well below freezing; in summer, a week or longer is sweltering.

physiography, relief, and drainage

Kurt L. Othberg, geologist, Division of Geology and Earth Resources, Department of Natural Resources, Olympia, Washington, helped prepare this section.

The Kitsap County Area lies in a structural downfold between two mountain ranges, a feature common to much of the Pacific Border physiographic province. This downfold is the Puget Trough, commonly known as the Puget Sound Lowland.

Kitsap County is a long, narrow, irregular-shaped part of the Kitsap Peninsula and is indented by many bays or inlets that form a very long, irregular-shaped coastline. All of the county except the southern part is bounded by waters of the Puget Sound. In addition to the mainland, the county includes Bainbridge and Blake islands.

The relief of the area is moderately subdued. Most of the area's soils are north-south elongated and are undulating to rolling on uplands. Elevation ranges mainly from 100 to 400 feet. An exception is Green and Gold Mountains, a conspicuous mountainous area a few miles west of Bremerton. This area consists of several high, narrow, elongated, gently rounded ridges that have steep dissected slopes. Elevation ranges mainly from 1,000 to 1,700 feet. Bordering the coastline are steep and often irregular sea cliffs and former sea cliffs alternating with strips of land that gently slope to the shoreline.

The soils of Kitsap County formed mainly in glacial drift deposited by the most recent of several continent-sized glacial ice sheets (*4*). This 3,000-foot thick glacier, emanating from Canada, formed most of the topography and waterways of the area between 13,000 and 15,000 years ago.

The predominant deposit, and therefore soil parent material, is glacial till. It generally consists of compact basal till covered by a thin, discontinuous layer of ablation till. The Alderwood, Harstine, Kapowsin, Poulsbo, Shelton, and Sinclair soils formed in this till material. As the glacier approached and receded from the area, melt water streams deposited outwash sand and gravelly sand. The Indianola, Ragnar, Neilton, and Grove soils formed in the outwash material. Glaciolacustrine silt and clay were also deposited in some places during glaciation. The Kitsap and Kapowsin Variant soils formed in this material.

Underlying these youngest glacial deposits is sediment deposited during previous glacial or interglacial periods. This sediment, generally exposed only on sea cliffs, consists primarily of stratified clay, silt, sand, and gravel. Where this deposit has glaciolacustrine properties, Kitsap soils formed. On many of the steep colluvial slopes, such as sea cliff areas, this survey classifies soils only to the subgroup, Dystric Xerorthents. Secondarily, there are sand and gravelly sand glacial outwash, and silt and clay glaciolacustrine deposits. Underlying these deposits, and generally exposed only on sea cliffs and in stream valleys, are older glacial and interglacial deposits that consist mainly of stratified silt, sand, and gravel.

The greater relief of the Green and Gold Mountain area is due to the occurrence of 40- to 50-million-year-old basalt bedrock. Locally, thin deposits of till occur on these basalt bedrock mountains where glacier ice overrode them. The Kilchis soils formed in the basalt, and the Shelton soils formed in local till deposits. The Schneider soils formed in basalt colluvium which mantles many steep slopes.

Sedimentary bedrock is in Bremerton and Waterman and on the southern part of Bainbridge Island, but it is not an extensive soil parent material. The Cathcart soils formed in this parent material.

Many small valleys, closed depressions, swales, and flats are in the area. These commonly contain post-glacial to recent alluvium, or bog deposits and organic-rich sediment, such as peat (*10*). The Norma, Bellingham, McKenna, and Belfast soils formed in mineral deposits, while the Mukilteo, Semiahmoo, and Shalcar soils formed in organic deposits.

There are relatively few perennial streams in the county area. Because of the glaciation, the existing surface drainage system is not well developed. There are numerous small depressions. The few perennial streams have very few tributaries. These probably are mostly spring-fed.

Most of the surface drainage is controlled by either the glacially-formed topography or by large channels that were the sites of glacial melt water streams. A small percentage of the area, in small valleys or depressions, is poorly drained. Most of the area is moderately well drained because of the widespread presence of soils that formed in ablation till and compact basal till. This, and the cool, wet winters, result in relatively low surface runoff and saturation of the lower part of the soil profile. This condition creates high potential for ground water recharge, but generates problems for urbanization. Poor drainage affects onsite sewage disposal and causes basement flooding. The same condition also creates problems for forest management, such as shallow rooting depth and windthrow hazard.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

1. Poulsbo-Ragnar

Nearly level to moderately steep, moderately deep and deep, moderately well drained and well drained soils; on broad uplands, rolling uplands, and terraces

This map unit is in the northern part of the Kitsap Peninsula.

These soils formed in glacial till and glacial outwash. These soils break abruptly into drainageways, into Puget Sound, or into Hood Canal. Creeks draining the area have little or no flood plain.

Elevation ranges from 0 to 500 feet. The average annual precipitation is about 30 to 65 inches. The mean annual air temperature is about 50 degrees F.

This map unit makes up about 22 percent of the survey area. It is about 35 percent Poulsbo soils and 30 percent Ragnar soils. Indianola, Kapowsin, Sinclair, Kitsap, Norma, and McKenna soils make up the remaining 35 percent.

Poulsbo soils are nearly level to moderately steep, moderately deep, moderately well drained soils on broad uplands. They formed in glacial till. Typically, the surface of Poulsbo soils is covered by a mat of undecomposed needles, leaves, and wood fragments. The subsurface layer and subsoil are gravelly sandy loam. The substratum is a weakly-silica-cemented hardpan about 4 inches thick over very compact gravelly sandy loam glacial till. Depth to the hardpan ranges from 20 to 40 inches.

Ragnar soils are nearly level to moderately steep, deep, well drained soils on terraces and uplands. They formed in glacial outwash. Typically, Ragnar soils have a surface layer and subsoil of fine sandy loam. The substratum is loamy sand to a depth of 60 inches or more.

The soils of this map unit are used mainly for forest. This map unit contains the most productive soils for Douglas-fir in the county area. Large areas are in commercial forest of second and third growth Douglas-fir. Brush picking for floral arrangements is an important minor industry.

Some areas are used for farming. Cultivated crops consist mainly of hay and pasture. Potential yields are fair to good.

There is some residential development. Homesites are scattered in the interior and concentrated along the shoreline. Residential development on the Poulsbo soils is limited by wetness, depth to the pan, and, in the steeper areas, by slope. The sandy Ragnar soils are suited to moderate and high density residential development if onsite sewage disposal systems are built. Slope is the main limitation for use of the Ragnar soils for homesites.

2. Shelton

Nearly level to steep, moderately deep, moderately well drained soils; on glacial moraines and till plains

This map unit is along Hood Canal in the southwestern part of the county.

These soils formed in glacial till. Very steep side slopes are along Hood Canal and major drainageways. Many small lakes and wet areas are in this map unit. Wildcat Lake, about 110 acres, is the largest.

Elevation ranges from 100 to 800 feet. The average annual precipitation is about 50 to 70 inches. The mean annual air temperature is about 49 degrees F.

This map unit makes up about 16 percent of the survey area. It is about 60 percent Shelton soils. Dystric Xerorthents make up about 15 percent. Grove, McKenna, Indianola, and other soils make up the remaining 25 percent.

Typically, the surface of Shelton soils is covered by a mat of undecomposed needles and wood fragments. The surface layer and subsoil are very gravelly sandy loam. The substratum is compact silica-cemented glacial till to a depth of 60 inches or more. Depth to the silica-cemented hardpan ranges from 20 to 35 inches.

The soils of this map unit are used mainly for forest and Christmas trees. They have fair suitability for Douglas-fir. Brush picking for floral arrangements is an important minor industry.

Droughtiness caused by excessive gravel and low fertility limit the use of these soils for farming.

There is some residential development around the larger lakes and along Hood Canal. Residential development of this soil is limited by wetness, depth to the hardpan, and, in the steeper areas, by slope. Community sewage systems should be considered in areas of moderate and high population density.

3. Kilchis

Moderately steep to very steep, shallow, well drained soils; on ridge crests and side slopes

This map unit is on Green and Gold Mountains.

These soils formed in material weathered from basalt.

Elevation ranges from 300 to 1,700 feet. The average annual precipitation is about 65 to 80 inches. The mean annual air temperature is about 47 degrees F.

This map unit makes up about 5 percent of the survey area. It is about 70 percent Kilchis soils. Schneider, Shelton, and other soils make up the remaining 30 percent.

Typically, Kilchis soils have a surface layer of very gravelly sandy loam. The subsoil is extremely gravelly loam over basalt. Depth to the basalt ranges from 16 to 20 inches.

The soils of this map unit are used mainly for forest and watersheds. The production of Douglas-fir is fair. Near Gorst, basalt is quarried and used for ballast and for other construction purposes.

4. Alderwood-Harstine

Nearly level to steep, moderately deep, moderately well drained soils; on uplands

This map unit is on Bainbridge Island and in the area between Silverdale and the Pierce County line. The city of Bremerton is in this map unit.

These soils formed in material weathered from glacial till. The soils are mainly nearly level to rolling. Steep and very steep soils break abruptly from the uplands into drainageways or directly into Puget Sound. Numerous small streams drain the uplands.

Elevation ranges from 0 to 800 feet. The average annual precipitation is about 35 to 55 inches. The mean annual air temperature is about 50 degrees F.

This map unit makes up about 57 percent of the survey area. It is about 30 percent Alderwood soils and 25 percent Harstine soils. Dystric Xerochrepts and Kapowsin, Indianola, Kitsap, Norma, McKenna, and Neilton soils make up the remaining 45 percent.

Typically, the surface of Alderwood soils is covered by a thin mat of undecomposed needles and wood fragments. The subsurface layer is very gravelly sandy loam. The subsoil is very gravelly loam. The substratum is gravelly sandy loam glacial till that is weakly-silica-cemented in the upper part. Depth to this hardpan ranges from 20 to 40 inches.

Typically, the surface of Harstine soils is covered by a thin mat of undecomposed needles and wood fragments. The surface layer and subsoil are gravelly sandy loam. The substratum is weakly-silica-cemented gravelly loamy sand over weakly-cemented compact glacial till. Depth to the hardpan ranges from 25 to 40 inches.

The soils of this map unit are used mainly for woodland and urban development.

Christmas trees are produced in the southwestern part of this map unit. Brush picking for floral arrangements is an important minor industry.

Cultivated acreage is not extensive. Specialty crops, especially on Bainbridge Island, consist of strawberries, caneberries, and blueberries. Hay and pasture are also grown, and potential yields are fair to good.

Urban development on these soils is limited by wetness, depth to the cemented pan, and, in the steeper areas, by slope. Community sewage systems should be considered in areas of moderate and high population density.

broad land use considerations

Population growth in the Kitsap County Area places extreme pressure on natural resources. Forest land and pastureland surrounding urban centers have been converted to urban uses. About 29 square miles, or more than 7 percent of the county, is urban land (*9*).

The general soil map is helpful in understanding the potential of the soil resources and for planning broad land use patterns. It cannot be used to select specific sites for specific uses. In general, the soils in the survey area have good potential for urban development. The data about specific soils in the section "Detailed soil map units" and in the tables are helpful for planning detailed land use patterns.

Most of the Kilchis unit of the general soil map contains soils with dominantly steep slopes and basalt at shallow depths. Potential land uses are reduced if these limitations cannot be overcome. Large parts of the other map units have gently sloping or strongly sloping soils and a hardpan at a moderate depth. The soils of other map units have higher potential for urban uses than the soils of the Kilchis map unit because most of the soil limitations can be overcome through sound conservation practices. However, the very slow permeability of the hardpan limits the choice of waste disposal systems for high density residential development to sanitary sewers. Conventional urban construction methods may not be adequate for the unstable soils in the Alderwood-Harstine map unit.

The wet soils of low lying areas in the Alderwood-Harstine map unit and the Shelton map unit have good potential for wetland wildlife habitat.

In most of the survey area, the soils are generally of low quality for farming. There are small areas of prime farmland in the Alderwood-Harstine map unit. Wetness is a limitation to the nonfarm use of these soils.

In some parts of the Alderwood-Harstine map unit, there are soils of low fertility and low available water capacity which have good potential for forest specialty crops. In general, soils in the Poulsbo-Ragnar map unit have fair to good potential for high forest yields. When considering broad land uses, the potential of these soils to supply forest products to local industries should not be overlooked.

Wildlife and wildlife habitat make up a valuable natural resource. Maintenance of wildlife habitat is an important consideration when land use plans are being made.

The soils of the Kitsap County Area are used mainly for forest. The use of certain forest production practices can maintain or improve fish and wildlife habitat. Small-scale clear cutting helps to create a variety of successional stages which provide a wide range of habitat types. Strips of riparian vegetation left along streambanks and shorelines not only provide valuable habitat, but also act as a filter zone to help minimize water pollution and aquatic habitat destruction. Leaving snag trees and scattered hardwoods provides nesting sites for cavity-nesting birds as well as food for many kinds of animals.

Because of the extreme steepness of most soils in the Kilchis map unit, care is needed in the construction of logging roads to avoid erosion and reduce sediment buildup in area streams.

Most of the farming in the survey area is on the soils of the Alderwood-Harstine map unit. Such farming practices as preservation of vegetative strips along streambanks and shorelines, close regulation of livestock in stream corridors and wetland areas, and prevention of surface water pollution through runoff from animal holding areas can maintain wildlife habitat. Careful use of herbicides and pesticides can prevent harm to nontarget plants and animals.

Careful use of herbicides and pesticides in farming and in forest and Christmas tree production can ensure that nontarget plants and animals are not adversely affected, and that the chemicals will not pollute surface waters and degrade the aquatic environment.

Soils in the Shelton map unit are well suited to the development of ponds and wetlands. The construction of dikes, water control structures, and islands can create or improve wetland habitat. Pond construction provides wetland wildlife habitat and areas for recreational fishing.

The soils of the Alderwood-Harstine map unit are expected to support most of the future urban development in Kitsap County. With proper planning in the selection of location and methods of construction, however, wildlife habitat on these soils can be preserved. Onsite retention of sediment generated by construction, and proper disposal methods for sewage, storm runoff, and other possible contaminants will minimize environmental pollution and maintain the quality of wildlife habitat. Landscaping should include plants that provide food and cover for wildlife.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Much of the Kitsap County Area is used as woodland, and Douglas-fir is the dominant species. Most map unit descriptions include a 50-year site index and MAI (mean annual increment) (*5, 3*) and a 100-year site index and CMAI (culmination of mean annual increment) (*6*) for Douglas-fir. Some map units list a 50-year site index for red alder (*18*).

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Kitsap silt loam, 2 to 8 percent slopes, is one of several phases in the Kitsap series.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Ragnar-Poulsbo complex, 15 to 30 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Beaches is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

1—Alderwood very gravelly sandy loam, 0 to 6 percent slopes. This moderately deep, moderately well drained soil is on uplands. It formed in glacial till. Individual areas of this map unit are long and narrow and oriented north to south. Areas average about 100 acres. Native vegetation is mainly conifers and hardwoods.

The elevation ranges from 50 to 550 feet. The average annual precipitation is 40 to 55 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments. The subsurface layer is brown very gravelly sandy loam 1/2 inch thick. The subsoil is brown very gravelly loam about 21 inches thick. The substratum to a depth of 60 inches or more is grayish brown gravelly sandy loam that is weakly-silica-cemented in the upper part. Depth to the silica-cemented hardpan ranges from 20 to 40 inches.

Included with this soil in mapping, and making up about 10 percent of the map unit, are McKenna soils in depressions, Norma and Shalcar soils in drainageways and troughs, and Harstine and Kapowsin soils in concave pockets. Also included are small areas of soils that have a stony and bouldery surface layer.

Permeability of this Alderwood soil is moderately rapid above the hardpan and very slow in the pan. The available water capacity is low. The effective rooting depth ranges from 20 to 40 inches. Matting of roots directly above the hardpan is common. Runoff is slow, and the hazard of water erosion is slight. This Alderwood soil has a perched water table at a depth of 2.5 to 3 feet for short periods during the rainy season in winter and spring.

This Alderwood soil is used mainly for woodland. Much of the area is used for Christmas trees. Some areas are used for crops.

This soil is suited to crops if practices that maintain soil tilth and fertility are used. The weakly cemented hardpan limits the use of this soil for deep-rooted crops. Proper grazing practices, weed control, and supplemental irrigation increase forage yields.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is a pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 year or strawberries for 3 years. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

This soil is suited to Douglas-fir, western hemlock, western redcedar, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 135 with CMAI of 138 cubic feet per acre. The site index based on a 50-year site curve is 104 with MAI of 125 cubic feet per acre at 50 years.

During periods of heavy rainfall, a perched water table is at a shallow depth for a short time. Trees are subject to windthrow when winds are strong and the soil is saturated. Rooting depth is limited by the weakly cemented pan and very compact substratum.

This soil is suited to urban development if community sewage systems are built. The main limitations are depth to the cemented hardpan and the seasonal perched water table. In areas of moderate or high population density, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall because of these limitations. Excavation involves ripping the weakly cemented hardpan. Topsoil needs to be stockpiled and subsequently used to cover the excavated material. This soil has adequate strength to support a heavy load.

This Alderwood soil is in capability subclass IVw.

2—Alderwood very gravelly sandy loam, 6 to 15 percent slopes. This moderately deep, moderately well drained soil is on broad uplands. It formed in glacial till. Individual areas of this map unit are long and narrow and oriented north to south. Areas average about 125 acres. The vegetation is conifers and hardwoods.

The elevation ranges from 50 to 550 feet. The average annual precipitation is 40 to 55 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface of this soil is covered by a mat of undecomposed needles and wood fragments. The subsurface layer is brown very gravelly sandy loam 1/2 inch thick. The subsoil is brown very gravelly loam about 21 inches thick. The substratum to a depth of 60 inches or more is grayish brown gravelly sandy loam that is weakly-silica-cemented in the upper part. Depth to the silica-cemented hardpan ranges from 20 to 40 inches.

Included with this soil in mapping, and making up about 8 percent of the map unit, are Indianola and Neilton soils on side slopes. Also included, and making up about 6 percent of the map unit, are Kapowsin and Harstine soils, and areas of Alderwood very gravelly sandy loam that have slopes of less than 6 percent.

Permeability of this Alderwood soil is moderately rapid above the hardpan and very slow in the pan. The available water capacity is low. The effective rooting depth ranges from 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. This soil has a perched water table at a depth of 2.5 to 3 feet during the rainy season in winter and spring. Water flows laterally along the top of the cemented layer and seeps at the bottom of slopes.

This Alderwood soil is used mainly for woodland (fig. 1). Much of the area is used for Christmas trees. Some areas are in crops.

This soil is suited to crops if practices that reduce erosion and maintain tilth and fertility are used. The weakly cemented hardpan limits use of this soil for deep-rooted crops. Proper grazing practices, weed control, and supplemental irrigation increase forage yields.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is 5 or 6 years of orchardgrass and white clover for hay or pasture followed by 1 year of oats or 3 years of strawberries. Most crops respond to nitrogen, phosphorus, and potassium.

This soil is suited to Douglas-fir, western hemlock, western redcedar, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 135 with CMAI of 138 cubic feet per acre. The site index based on a 50-year site curve is 104 with MAI of 125 cubic feet per acre at 50 years.

Rooting depth is limited by the weakly cemented pan and compact substratum. Trees are subject to windthrow when winds are strong and the soil is saturated.

This soil is suited to urban development if community sewage systems are built. The main limitations are slope, depth to the cemented hardpan, and the seasonal perched water table. In areas of moderate or high population density, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall because of these limitations. Excavation involves ripping the weakly cemented hardpan. Topsoil needs to be stockpiled and subsequently used to cover excavated material. This soil has adequate strength to support a heavy load.

This Alderwood soil is in capability subclass IVe.

Figure 1.—Alderwood very gravelly sandy loam, 6 to 15 percent slopes. Douglas-fir is the dominant tree and salal is the main understory plant.

3—Alderwood very gravelly sandy loam, 15 to 30 percent slopes. This moderately deep, moderately well drained soil is on broad uplands. It formed in glacial till. Mapped areas average about 150 acres. They are long and narrow and oriented north to south (fig. 2). The vegetation is conifers and hardwoods.

The elevation ranges from 200 to 800 feet. The average annual precipitation is 40 to 55 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface of this soil is covered by a mat of undecomposed needles and wood fragments. The subsurface layer is brown very gravelly sandy loam 1/2 inch thick. The subsoil is brown very gravelly loam about 21 inches thick. The substratum to a depth of 60 inches or more is grayish brown gravelly sandy loam that is weakly-silica-cemented in the upper part. Depth to the silica-cemented hardpan ranges from 20 to 40 inches.

Included with this soil in mapping, and making up about 10 percent of the map unit, are Neilton, Ragnar, and Indianola soils. In places, cobbles and stones are on the surface. Also included are areas of advanced glacial outwash that have a 2 foot capping of strongly compacted material in the substratum.

Permeability of the Alderwood soil is moderately rapid above the hardpan and very slow in the pan. The available water capacity is low. The effective rooting depth ranges from 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. This soil has a perched water table at a depth of 2.5 to 3 feet for short periods during the rainy season in winter and spring. Water flows along the top of the cemented layer and seeps at the bottom of slopes.

This Alderwood soil is used mainly for woodland. Much of the area is used for Christmas trees. Some areas are in pasture.

Figure 2.—Alderwood very gravelly sandy loam, 15 to 30 percent slopes. This soil is oriented north-south on narrow hills.

This soil is suited to Douglas-fir, western hemlock, western redcedar, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 135 with CMAI of 138 cubic feet per acre. The site index based on a 50-year site curve is 104 with MAI of 125 cubic feet per acre at 50 years.

Trees are subject to windthrow when winds are strong and the soil is saturated.

Proper grazing practices and weed control help to maximize the forage yields for pasture. Grasses respond to nitrogen, and legumes respond to phosphate fertilizer. Supplemental irrigation also helps to increase yields.

This soil is poorly suited to homesites or urban development because of the steep slopes. Excavation involves ripping the weakly cemented hardpan. Topsoil needs to be stockpiled and subsequently used to cover excavated material. A site preparation system that controls runoff and maintains the esthetic value of the site is needed. During the rainy season in winter and spring, septic effluent from onsite sewage disposal systems may seep at points further down the slope.

This Alderwood soil is in capability subclass IVe.

4—Beaches. Coastal beaches are long, narrow strips of sloping, sandy and gravelly beaches. These beaches are above mean tide, but are swept by storm waves. Most areas have no vegetation, although some areas have a sparse cover of beach grasses.

Small areas of Tacoma soil are included in this map unit.

Coastal beaches are used as recreation areas. Some of the beaches are used for urban development.

Beaches is in capability subclass VIIIw.

5—Belfast loam. This deep, moderately well drained soil is on flood plains. It formed in stratified alluvium. Most areas are long and narrow. Slopes are 0 to 2 percent. Native vegetation is mainly a mixture of hardwoods, conifers, and shrubs.

The elevation ranges from 20 to 600 feet. The average annual precipitation is 50 to 70 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is very dark brown loam about 5 inches thick. The upper part of the underlying layer is olive gray fine sandy loam about 17 inches thick. The lower part of the underlying layer is stratified dark brown and dark yellowish brown fine sandy loam and silt loam to a depth of 60 inches or more. In some pedons, the lower part of the underlying layer is sandy loam or gravelly loamy sand. Iron stains are common in root channels.

Included with this soil in mapping is about 10 percent Norma soils. Also included in some mapped areas is about 2 percent Indianola soils.

Permeability of this Belfast soil is moderate. The available water capacity is high. Runoff is very slow, and water erosion is not a hazard or is a slight hazard. Depth to the seasonal high water table is 3.5 to 6 feet. The soil is occasionally flooded for very brief periods.

This Belfast soil is used mainly for woodland, pasture, and homesites.

This soil is suited to Douglas-fir, red alder, and western redcedar. Based on a 100-year site curve, the average site index for Douglas-fir is 160 with CMAI of 170 cubic feet per acre. The site index based on a 50-year site curve is 120 with MAI of 156 cubic feet per acre at 50 years. Logging operations should be limited to the drier periods in summer and fall.

Proper grazing and weed control help to maximize the forage yields for pasture. Grasses respond to nitrogen, and legumes respond to phosphate fertilizer. Supplemental irrigation also helps to increase yields.

This soil is poorly suited to homesites or urban development because of flooding and wetness. Septic tank absorption fields do not function properly during the wet season because of the high water table.

This Belfast soil is in capability subclass IIIw.

6—Bellingham silty clay loam. This deep, poorly drained soil is on flood plains. It formed in alluvium. Mapped areas are 5 to 20 acres. Most areas are long and narrow, and a few are nearly round. Slopes are 0 to 3 percent. Vegetation is primarily grass and sedge with some conifers and hardwoods.

The elevation ranges from 20 to 600 feet. The average annual precipitation is 35 to 60 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is mottled, very dark brown silty clay loam about 8 inches thick. The subsoil to a depth of 60 inches is mottled grayish brown silty clay.

Included with this soil in mapping, and making up about 10 percent of the map unit, is Norma soils. North of Manchester the Bellingham soil has layers of volcanic ash and diatomaceous earth in the subsoil and substratum. In some areas, the surface layer is black muck.

Permeability of this Bellingham soil is slow. The available water capacity is high. The effective rooting depth is limited by the high water table. This soil is ponded during winter. Runoff is ponded, and water erosion is not a hazard or is a slight hazard.

This Bellingham soil is used mainly for hay, pasture, woodland, and wildlife habitat. Most of the area is artificially drained.

This soil requires careful management. Conservation practices are difficult to apply and maintain if this soil is cultivated. Artificial drainage by tiling or open ditching reduces wetness. Proper grazing and weed control help to maximize forage yields.

The organic matter content of the soil can be maintained by growing green manure crops and using a suitable cropping system. Green manure crops add organic matter, improve soil structure, and make the soil easier to work. A suitable cropping system is pasture of meadow foxtail, timothy, white clover, and big trefoil for 5 or 6 years followed by oats for 1 or 2 years. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from application of agricultural lime.

When ponded, this soil serves as a resting area for ducks, herons, and other waterfowl. Plantings of smartweed, wild millet, and bulrush increase waterfowl populations.

This soil is suited to red alder and western redcedar. The site index for red alder, based on a 50-year site curve, is 80 with CMAI of 84 cubic feet per acre.

A high water table is above or at the surface throughout the rainy season. Unless logging roads constructed on this soil have extra ballast and sufficient drainage, the movement of equipment is restricted to the dry season.

This soil is poorly suited to urban development because of depth to the seasonal high water table, seasonal ponding, and the shrink-swell potential of the subsoil. Septic tank drainage fields do not function properly during the wet season because of the seasonal high water table and restricted permeability.

The Bellingham soil is in capability subclass IIIw.

7—Cathcart silt loam, 2 to 8 percent slopes. This deep, moderately well drained soil is on glaciated uplands. It formed in glacial drift over weathered siltstone. Mapped areas range from 10 to more than 100 acres and are generally elongated. Native vegetation is conifers and hardwoods.

The elevation ranges from 50 to 300 feet. The average annual precipitation is 40 to 50 inches, the mean annual air temperature is about 49 degrees F, and the average frost-free season is about 200 days.

Typically, the surface layer is dark brown silt loam about 9 inches thick. The subsoil is dark yellowish brown and yellowish brown loam about 29 inches thick. Weathered, soft, fine siltstone fragments average less than 10 percent in the upper part of the subsoil and 65 percent in the lower part. The substratum is pale yellow clay loam that has about 65 percent soft, weathered, shattered siltstone fragments to a depth of 60 inches or more.

Included with this soil in mapping are as much as 5 percent Kapowsin soils, and 4 percent Cathcart soils that have slopes of more than 8 percent. In some areas, from 2 to 72 inches of strongly compacted glacial till overlies the weathered siltstone bedrock.

Permeability of this Cathcart soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This Cathcart soil is used mainly for woodland, cropland, and urban land.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 160 with CMAI of 170 cubic feet per acre. The site index based on a 50-year site curve is 120 with MAI of 156 cubic feet per acre at 50 years.

Crop yields are moderate if the soil is properly managed. The soil surface is easily puddled during the wet season. Proper grazing practices, weed control, and supplemental irrigation increase forage yields.

The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is a pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 year. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

This soil is well suited to urban development if community sewage systems are built. In areas of moderate or high population density, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall because of restricted permeability.

This Cathcart soil is in capability subclass IIIe.

8—Cathcart silt loam, 8 to 15 percent slopes. This deep, moderately well drained soil is on glaciated uplands. It formed in glacial drift over weathered siltstone. Mapped areas range from 20 to over 100 acres. Native vegetation is mainly conifers and hardwoods.

The elevation ranges from 50 to 300 feet. The average annual precipitation is 40 to 50 inches, the mean annual air temperature is about 49 degrees F, and the average frost-free season is about 200 days.

Typically, the surface layer is dark brown silt loam about 9 inches thick. The subsoil is dark yellowish brown and yellowish brown loam about 29 inches thick. Weathered, fine siltstone fragments average less than 10 percent in the upper part of the subsoil and 65 percent in the lower part. The substratum is pale yellow clay loam that has about 65 percent soft, weathered, shattered siltstone fragments to a depth of 60 inches or more.

Included with this soil in mapping are as much as 5 percent Cathcart soils that have slopes of less than 8 percent, 5 percent Cathcart soils that have slopes of more than 15 percent, and about 3 percent Kapowsin soils. In some areas, from 2 to 72 inches of strongly compacted glacial till overlies the weathered siltstone bedrock.

Permeability of this Cathcart soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This Cathcart soil is used mainly for woodland, cropland, and urban land.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 160 with CMAI of 170 cubic feet per acre. The site index based on a 50-year site curve is 120 with MAI of 156 cubic feet per acre at 50 years.

Crop yields are moderate if the soil is properly managed. The soil surface is easily puddled during the wet season. Proper grazing practices, weed control, and supplemental irrigation increase forage yields. The organic matter content of the soil can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is a pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 year. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

This soil is suited to urban development if community sewage systems are built. The main limitation is slope. In areas of moderate or high population density, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall because of restricted permeability.

This Cathcart soil is in capability subclass IIIe.

9—Cathcart silt loam, 15 to 30 percent slopes. This deep, moderately well drained soil is on glaciated uplands. It formed in glacial drift over weathered siltstone. Mapped areas range from 10 and 45 acres, and one area is 155 acres. Native vegetation is mainly conifers and hardwoods.

The elevation ranges from 50 to 300 feet. The average annual precipitation is 40 to 50 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 200 days.

Typically, the surface layer is dark brown silt loam about 9 inches thick. The subsoil is dark yellowish brown and yellowish brown loam about 29 inches thick. Weathered, fine siltstone fragments average less than 10 percent in the upper part of the subsoil and 65 percent in the lower part. The substratum is pale yellow clay loam that has about 65 percent weathered, shattered siltstone fragments to a depth of 60 inches or more.

Included with this soil in mapping is as much as 8 percent Cathcart soils that have slopes of less than 15 percent. Also included is a small area of wet, clayey soils that is south of the intersection of Country Club Road and Fort Ward Road in the southern part of Bainbridge Island. In some areas, 2 to 72 inches of strongly compacted glacial till overlies the weathered siltstone bedrock.

Permeability of this Cathcart soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This Cathcart soil is used mainly for woodland and for wildlife habitat.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 160 with CMAI of 170 cubic feet per acre. The site index based on a 50-year site curve is 120 with MAI of 156 cubic feet per acre at 50 years.

This soil is poorly suited to urban development because of slope. In areas of moderate or high population density, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall because of restricted permeability.

This Cathcart soil is in capability subclass IVe.

10—Dystric Xerorthents, 45 to 70 percent slopes. These deep, moderately well drained to somewhat excessively drained soils are on sidewalls of river valleys and sidewalls of entrenched streams. These soils formed mainly in glacial till, but some formed in sandy and gravelly outwash. Areas are long and narrow on the contour. Most slopes are about 65 percent. The vegetation is conifers and hardwoods.

The elevation ranges from near 0 to 1,200 feet. The average annual precipitation is 35 to 70 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 200 days.

Included with these soils in mapping are small areas of Indianola and Kitsap soils, and beaches and escarpments that are devoid of vegetation. Also included are small areas of Kapowsin, Harstine, and Poulsbo soils that have slumped.

Typically, this soil has a mat of undecomposed needles and wood fragments over a surface layer of dark yellowish brown very gravelly sandy loam about 10 inches thick. The upper part of the underlying material is dark brown, brown, and dark yellowish brown very gravelly sandy loam about 40 inches thick. The lower part of the underlying material to a depth of 60 inches is dark grayish brown and grayish brown very gravelly sandy loam and very gravelly loamy sand.

The permeability of these soils is moderate to rapid. Runoff is medium to very rapid. These soils are mainly in tree-covered slump areas.

These soils are used for watershed, wildlife habitat, and forest.

These soils are suited to Douglas-fir, western hemlock, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 145 with CMAI of 152 cubic feet per acre. The site index based on a 50-year site curve is 110 with MAI of 135 cubic feet per acre at 50 years.

The hazard of erosion is high, and the use of equipment is severely limited on this soil. Plant competition and seedling mortality are moderate. The windthrow hazard is slight to moderate.

These soils are in capability subclass VIIe.

11—Grove very gravelly sandy loam, 0 to 3 percent slopes. This deep, somewhat excessively drained soil is on glacial terraces and plains. It formed in glacial outwash. Individual areas of this map unit are long and narrow and oriented north to south. Native vegetation is mostly of conifers and shrubs.

The elevation ranges from 200 to 500 feet. The average annual precipitation is 55 to 70 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments. The surface layer is dark grayish brown very gravelly sandy loam 2 inches thick. The upper part of the subsoil is brown and light brown very gravelly sandy loam 15 inches thick. The lower part of the subsoil is brown extremely gravelly loamy sand 13 inches thick. The substratum is olive gray very gravelly sand to a depth of 60 inches or more.

Included with this Grove soil in mapping are as much as 10 percent Shelton soils, 3 percent Indianola soils, and about 3 percent Grove soils that have slopes of more than 3 percent. The surface layer is lacking in some places. In some locations the substratum is strongly compacted. In some areas the surface layer is very gravelly loamy sand.

Permeability of this Grove soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is not a hazard or is a slight hazard.

This Grove soil is used mainly for woodland. It is well suited to Christmas trees.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 140 with CMAI of 145 cubic feet per acre. The site index based on a 50-year site curve is 106 with MAI of 128 cubic feet per acre at 50 years.

Trees can be harvested during the rainy season without major difficulty. This soil can produce moderate amounts of floral greenery, such as salal, evergreen huckleberry, and western swordfern. Douglas-fir responds to applications of nitrogen fertilizer. Christmas trees tend to be pale unless nitrogen fertilizer is added.

The soil is well suited to urban development. Community sewage systems should be considered in areas of moderate or high population density. Cutbanks may cave in excavations.

This Grove soil is in capability subclass VIs.

12—Grove very gravelly sandy loam, 3 to 15 percent slopes. This deep, somewhat excessively drained soil is on glacial terraces and plains. It formed in glacial outwash. Individual areas of this map unit are long and narrow and oriented north to south. Native vegetation is mostly conifers and shrubs.

The elevation ranges from 200 to 500 feet. The average annual precipitation is 55 to 70 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments. The surface layer is dark grayish brown very gravelly sandy loam 2 inches thick. The upper part of the subsoil is brown and light brown very gravelly sandy loam 15 inches thick. The lower part of the subsoil is brown extremely gravelly loamy sand 13 inches thick. The substratum is olive gray very gravelly sand to a depth of 60 inches or more.

Included with this soil in mapping are as much as 8 percent Shelton soils, and 5 percent Grove soils that have slopes of less than 3 percent or more than 15 percent. The surface layer is lacking in places. In places the substratum is strongly compacted. In some areas the surface layer is very gravelly loamy sand.

Permeability of this Grove soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This Grove soil is used for woodland. It is well suited to Christmas trees.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 140 with CMAI of 145 cubic feet per acre. The site index based on a 50-year site curve is 106 with MAI of 128 cubic feet per acre at 50 years.

Trees can be harvested during the rainy season without major difficulty. This soil can produce moderate amounts of floral greenery, such as salal, evergreen huckleberry, and western swordfern. Douglas-fir responds to applications of nitrogen fertilizer. Christmas trees tend to be pale unless nitrogen fertilizer is added.

The main limitation for use of this soil for urban development is the slope. Community sewage systems should be considered in areas of moderate or high population density. Cutbanks may cave in excavations.

This Grove soil is in capability subclass VIe.

13—Grove very gravelly sandy loam, 15 to 30 percent slopes. This deep, somewhat excessively drained soil is on glacial terraces and plains. It formed in glacial outwash. Individual areas of this map unit are long and narrow and oriented north to south. Native vegetation consists mostly of conifers and shrubs.

The elevation ranges from 200 to 500 feet. The average annual precipitation is 55 to 70 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments. The surface layer is dark grayish brown very gravelly sandy loam 2 inches thick. The upper part of the subsoil is brown and light brown very gravelly sandy loam 15 inches thick. The lower part of the subsoil is brown extremely gravelly loamy sand 13 inches thick. The substratum is olive gray very gravelly sand to a depth of 60 inches or more.

Included with this soil in mapping are as much as 10 percent Shelton soils, 5 percent Indianola soils, and about 3 percent Grove soils that have slopes of less than 15 percent. The surface layer is lacking in places. In some locations the substratum is strongly compacted In places the surface layer is very gravelly loamy sand.

Permeability of this Grove soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate.

This Grove soil is used for woodland. It is well suited to Christmas trees.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 140 with CMAI of 145 cubic feet per acre. The site index based on a 50-year site curve is 106 with MAI of 128 cubic feet per acre at 50 years.

Trees can be harvested during the rainy season without major difficulty. This soil can produce moderate amounts of floral greenery, such as salal, evergreen huckleberry, and western swordfern. Douglas-fir responds to applications of nitrogen fertilizer. Christmas trees tend to be pale unless nitrogen fertilizer is added.

The main limitation of this soil for urban development is the slope. Community sewage systems should be considered in areas of moderate or high population density. Cutbanks may cave in excavations.

This Grove soil is in capability subclass VIe.

14—Harstine gravelly sandy loam, 0 to 6 percent slopes. This moderately deep, moderately well drained soil is on broad uplands. It formed in sandy glacial till. Mapped areas average about 50 acres. The vegetation is conifers.

The elevation ranges from 0 to 400 feet. The average annual precipitation is 35 to 55 inches, the mean annual air temperature is about 51 degrees F, and the average frost-free season is about 180 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments about 2 inches thick. The surface layer is very dark grayish brown gravelly sandy loam about 1/2 inch thick. The subsoil is brown and dark yellowish brown gravelly sandy loam about 32 inches thick. The substratum is grayish brown, strongly-silica-cemented gravelly loamy sand about 5 inches thick over compact, weakly-silica-cemented glacial till. Depth to the hardpan ranges from 25 to 40 inches.

Included with this soil in mapping are about 5 percent Alderwood soils, 5 percent Indianola soils, and 5 percent McKenna and Norma soils. Also included in some areas are as much as 5 percent Harstine soils that have slopes of more than 6 percent.

Permeability of this Harstine soil is moderate to the hardpan and very slow through the pan. The available water capacity is low. The effective rooting depth ranges from 25 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. A perched water table develops for short periods during the rainy season in winter and spring.

This Harstine soil is used mainly for woodland, cropland, and urban development. Hay and pasture are the main crops. The weakly cemented pan limits the suitability of this soil for deep-rooted crops.

Brush picking for floral arrangements is an important minor industry.

This soil is fairly productive if practices that maintain soil tilth and fertility are used. Prevention of overgrazing, weed control, and supplemental irrigation help to maximize forage yields.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is a pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 year or strawberries for 3 years. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 139 with CMAI of 144 cubic feet per acre. The site index based on a 50-year site curve is 105 with MAI of 127 cubic feet per acre at 50 years.

During periods of heavy rainfall, a perched water table develops. However, it is generally of short duration and has little or no effect on root growth. Some windthrow can be expected when winds are strong and the soil is saturated.

Wetness and depth to the cemented pan are the main limitations for use of this soil for urban development. In areas of moderate or high population density, onsite sewage disposal systems fail or do not function properly during periods of high rainfall because of the depth to the cemented pan and the seasonal perched water table.

This soil has adequate strength to support a heavy load.

This Harstine soil is in capability subclass IVw.

15—Harstine gravelly sandy loam, 6 to 15 percent slopes. This moderately deep, moderately well drained soil is on broad uplands (fig. 3). It formed in sandy glacial till. Mapped areas average about 100 acres. Most slopes are about 8 percent. The vegetation is conifers.

Figure 3.—Harstine gravelly sandy loam, 6 to 15 percent slopes, is on ridgetops of the north-south linear hill in background. Harstine gravelly sandy loam, 15 to 30 percent slopes, is on side slopes. The poorly drained Norma soils are between the ridges in the foreground.

The elevation ranges from 0 to 400 feet. The average annual precipitation is 35 to 55 inches, the mean annual air temperature is about 51 degrees F, and the average frost-free season is about 180 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments about 2 inches thick. The surface layer is very dark grayish brown gravelly sandy loam about 1/2 inch thick. The subsoil is brown and dark yellowish brown gravelly sandy loam about 32 inches thick. The substratum is grayish brown, weakly-silica-cemented gravelly loamy sand about 5 inches thick over compact, weakly-silica-cemented glacial till. Depth to the hardpan ranges from 25 to 40 inches.

Included with this soil in mapping are 5 percent Indianola and Neilton soils on side slopes and 2 percent

Figure 4.—Harstine gravelly sandy loam, 6 to 15 percent slopes, is important in the Kitsap County Area for Douglas-fir production.

Norma and McKenna soils in troughs. Also included are some areas of Harstine soils that have slopes of less than 6 percent or more than 15 percent.

Permeability of this Harstine soil is moderate to the hardpan and very slow through the pan. The available water capacity is low. The effective rooting depth ranges from 25 to 40 inches. Surface runoff is slow, and the hazard of water erosion is slight. A perched water table develops for short periods during the rainy season in winter and spring.

This Harstine soil is used mainly for woodland, cropland, and urban development (fig. 4). Hay and pasture are the main crops; strawberries and caneberries, principally raspberries, are minor crops. The compact and cemented pan limits the suitability of this soil for deep-rooted crops.

Brush picking for floral arrangements is an important minor industry.

This soil is fairly productive if practices that reduce erosion and maintain tilth and fertility are used. Prevention of overgrazing, weed control, fertilization, and supplemental irrigation help to maximize forage yields.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is 5 or 6 years of orchardgrass and white clover for hay or pasture and 1 year of oats or 3 years of strawberries. Most crops respond to applications of nitrogen, phosphcrus, and potassium. Legumes benefit from applications of agricultural lime.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 139 with CMAI of 144 cubic feet per acre. The site index based on a 50-year site curve is 105 with MAI of 127 cubic feet per acre at 50 years.

During periods of heavy rainfall, a perched water table develops. However, it is generally of short duration and has little or no effect on root growth. Some windthrow can be expected when winds are strong and the soil is saturated.

Slope and depth to the seasonal perched water table are the main limitations for use of this soil for urban development. In areas of moderate or high population density, onsite sewage disposal systems fail or do not function properly during periods of heavy rainfall in winter. Excavation for basements and utility lines is difficult. Topsoil needs to be stockpiled and subsequently used to cover excavated soil material. This soil has adequate strength to support a heavy load.

This Harstine soil is in capability subclass IVe.

16—Harstine gravelly sandy loam, 15 to 30 percent slopes. This moderately deep, moderately well drained soil is on broad uplands (fig. 3). It formed in sandy glacial till. Mapped areas are long and narrow, and are along drainageways and on breaks between areas of other less sloping Harstine soils. Slopes are about 150 to 300 feet in length. The vegetation is conifers.

The elevation ranges from 0 to 400 feet. The average annual air temperature is about 51 degrees F, and the average frost-free season is about 180 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments about 2 inches thick. The surface layer is very dark grayish brown gravelly sandy loam about 1/2 inch thick. The subsoil is brown and dark yellowish brown gravelly sandy loam about 32 inches thick. The substratum is grayish brown, strongly-silica-cemented gravelly loamy sand about 5 inches thick over compact, weakly cemented glacial till. Depth to the hardpan ranges from 25 to 40 inches.

Included with this soil in mapping on the lower parts of slopes are 5 percent Neilton, Indianola, and Ragnar soils. Some areas of Harstine soils that have slopes of less than 15 percent are also included.

Permeability of this Harstine soil is moderate to the hardpan and very slow through the pan. The available water capacity is low. The effective rooting depth ranges from 25 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. A perched water table develops for short periods during the rainy season in winter and spring. However, the seasonal perched water table is of short duration because water flows laterally above the cemented pan and seeps at the bottom of slopes. Slumping of soil material occurs occasionally, particularly on the more sloping areas of this soil.

This Harstine soil is used mainly for woodland, pasture, and urban development.

Brush picking for floral arrangements is an important minor industry.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 139 with CMAI of 144 cubic feet per acre. The site index based on a 50-year site curve is 105 with MAI of 127 cubic feet per acre at 50 years.

Some windthrow can be expected when winds are strong and the soil is saturated.

Prevention of overgrazing, weed control, fertilization, and supplemental irrigation help to maximize forage yields for pasture.

Slope and depth to a perched water table are the main limitations for the use of this soil for urban development. Excavation involves ripping the weakly cemented pan. Topsoil needs to be stockpiled and subsequently used to cover excavated soil material. A site preparation system that controls runoff and maintains the esthetic value is needed. During the rainy season, in winter and spring, septic effluent from onsite sewage disposal units may seep at points downslope.

This Harstine soil is in capability subclass IVe.

17—Harstine gravelly sandy loam, 30 to 45 percent slopes. This moderately deep, moderately well drained soil is on broad uplands. It formed in sandy glacial till. Mapped areas are long and narrow along drainageways and oriented north to south. The vegetation is conifers.

The elevation ranges from 0 to 400 feet. The average annual precipitation is 40 to 50 inches, the mean annual air temperature is about 51 degrees F, and the average frost-free season is about 180 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments about 2 inches thick. The surface layer is very dark grayish brown gravelly sandy loam about 1/2 inch thick. The subsoil is brown and dark yellowish brown gravelly sandy loam about 32 inches thick. The substratum is grayish brown, weakly-silica-cemented gravelly loamy sand about 5 inches thick over compact, weakly cemented glacial till. Depth to the hardpan ranges from 25 to 40 inches.

Included with this soil in mapping on the lower parts of slopes are 5 percent Neilton, Indianola, and Kitsap soils. Some areas, particularly along Puget Sound, have inclusions of Dystric Xerorthents.

Permeability of this Harstine soil is moderate to the hardpan and very slow through the pan. The available water capacity is low. Effective rooting depth ranges from 25 to 40 inches. Runoff is rapid, and the hazard of water erosion is high. A perched water table develops for short periods during the rainy season in winter and spring. However, the seasonal perched water table is of short duration because water flows laterally above the cemented pan and seeps at the bottom of slopes. Slumping of soil material is common.

This Harstine soil is used mainly for woodland and for wildlife habitat.

Brush picking for floral arranagements is an important minor industry.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 139 with CMAI of 144 cubic feet per acre. The site index based on a 50-year site curve is 105 with MAI of 127 cubic feet per acre at 50 years.

Some windthrow can be expected when winds are strong and the soil is saturated.

Slope and depth to a perched water table are the main limitations for use of this soil for homesites. Drainage fields for septic tanks are difficult to lay out and construct. During the rainy season in winter and spring, septic effluent from onsite sewage disposal units may seep at points downslope.

This Harstine soil is in capability subclass VIe.

18—Indianola loamy sand, 0 to 6 percent slopes. This deep, somewhat excessively drained soil is on broad uplands. It formed in sandy glacial outwash. Mapped areas range from 5 to 150 acres. The vegetation is conifers.

The elevation ranges from 50 to 400 feet. The average annual precipitation is 30 to 55 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is dark brown loamy sand about 7 inches thick. The subsoil is dark yellowish brown loamy sand 22 inches thick. The substratum to a depth of 60 inches is olive brown sand.

Included with this soil in mapping, and making up about 10 percent of the map unit, are Alderwood and Neilton soils. Some long, narrow strips of Norma soils are also included. Included in some areas are as much as 5 percent Indianola soils that have slopes of more than 6 percent.

Permeability of this Indianola soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This Indianola soil is used for urban development, cropland, and woodland. Hay and pasture are the main crops. Strawberries and caneberries, principally raspberries, are minor crops.

This soil is moderately productive if practices that maintain fertility are used. Prevention of overgrazing, weed control, and supplemental irrigation help to maximize forage yields.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is a pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 year or strawberries for 3 years. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

This soil is suited to Douglas-fir and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 131 with CMAI of 132 cubic feet per acre. The site index based on a 50-year site curve is 99 with MAI of 116 cubic feet per acre at 50 years. The site index for red alder is 95.

This soil can support high density housing units and onsite sewage disposal systems. The soil is easily excavated. However, cutbanks cave easily and should be shored up as a safety precaution.

This Indianola soil is in capability subclass IVs.

19—Indianola loamy sand, 6 to 15 percent slopes. This deep, somewhat excessively drained soil is on broad uplands. It formed in sandy glacial outwash. Some areas of this soil, particularly along Puget Sound, are unstable lake sediments. Mapped areas range from 5 to 60 acres. The vegetation is conifers.

The elevation ranges from 50 to 400 feet. The average annual precipitation is 30 to 55 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is dark brown loamy sand about 7 inches thick. The subsoil is dark yellowish brown loamy sand 22 inches thick. The substratum to a depth of 60 inches is olive brown sand.

Included with this soil in mapping, and making up about 10 percent of the map unit, are Alderwood, Neilton, and Kitsap soils. A small percentage of Ragnar soils is also included. Also included are small areas of

Indianola soils that have slopes of less than 5 percent or more than 15 percent.

Permeability of this Indianola soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This Indianola soil is used for urban development, cropland, and woodland. Hay and pasture are the main crops. Strawberries and caneberries, principally raspberries, are minor crops.

This soil is moderately productive if practices that maintain fertility and reduce erosion are used. Grasses seeded in bare areas protect the soil during the rainy season. Prevention of overgrazing, weed control, and supplemental irrigation help to maximize forage yields.

The organic matter content can be maintained by using all crop residue, adding barnyard manure, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is orchardgrass and white clover for 5 or 6 years followed by oats for 1 year or strawberries for 3 years. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

This soil is suited to Douglas-fir and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 131 with CMAI of 132 cubic feet per acre. The site index based on a 50-year site curve is 99 with MAI of 116 cubic feet per acre at 50 years. The site index for red alder is 95.

This soil is well suited to homesites and onsite sewage disposal systems. Slope is the main limitation. The soil is easily excavated. However, cutbanks cave easily and should be shored up as a safety precaution.

This Indianola soil is in capability subclass IVs.

20—Indianola loamy sand, 15 to 30 percent slopes. This deep, somewhat excessively drained soil is on broad uplands and side slopes of broad uplands. It formed in sandy glacial outwash. The average slope is about 20 percent. The vegetation is conifers.

The elevation ranges from 50 to 400 feet. The average annual preciptation is 30 to 55 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is dark brown loamy sand about 7 inches thick. The subsoil is dark yellowish brown loamy sand 22 inches thick. The substratum to a depth of 60 inches is olive brown sand.

Included with this soil in mapping, and making up as much as 10 percent of the map unit, are Alderwood and Kitsap soils, small areas of Neilton soils, and Indianola soils that have slopes of less than 15 percent.

Permeability of this Indianola soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This Indianola soil is used mainly for woodland and urban development.

This soil is suited to Douglas-fir and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 131 with CMAI of 132 cubic feet per acre. The site index based on a 50-year site curve is 99 with MAI of 116 cubic feet per acre at 50 years. The site index for red alder is 95.

Bare soil areas erode easily. Soil losses are minimized by diverting runoff from skid trails and roads.

Slope is the main limitation for homesites. Cutbanks cave easily and should be shored up as a safety precaution. Site preparation systems should control runoff and maintain the esthetic value.

This Indianola soil is in capability subclass IVs.

21—Indianola-Kitsap complex, 45 to 70 percent slopes. These soils are on dissected terraces of broad uplands and on side slopes of major valleys oriented mainly north to south. They formed in glacial outwash and glacial lake sediment. The vegetation is mainly conifers and hardwoods.

The elevation ranges from 0 to 300 feet. The average annual precipitation is 30 to 55 inches, the mean annual air temperature averages about 50 degrees F, and the average frost-free season is about 180 days.

This complex is 50 percent Indianola loamy sand, 45 to 70 percent slopes, and 35 percent Kitsap silt loam, 45 to 70 percent slopes. The Indianola soils are on the upper slopes and the Kitsap soils are on the lower, steeper slopes. The soils of this complex are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this complex are small areas of steeply sloping Kitsap, Indianola, Harstine, and Poulsbo soils that make up the rest of the complex. In soil areas adjacent to Puget Sound, vertical escarpments devoid of vegetation are also included.

The Indianola soil is deep and somewhat excessively drained. It formed in sandy glacial outwash. Typically, the surface layer is dark brown loamy sand about 7 inches thick. The subsoil is dark yellowish brown loamy sand about 22 inches thick. The substratum to a depth of more than 60 inches is olive brown sand.

Permeability of the Indianola soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

The Kitsap soil is deep and moderately well drained. It formed in glacial lake sediment. Typically, the surface layer is very dark grayish brown silt loam about 5 inches thick. The upper part of the subsoil is dark yellowish brown silt loam about 8 inches thick. The lower part of the subsoil is mottled, light olive brown silty clay loam about 22 inches thick. The substratum to a depth of more than 60 inches is stratified, mottled, olive silt loam, silty clay loam, and silt.

Permeability of the Kitsap soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is very rapid, and the hazard of water erosion is high. A perched water table is at a depth of 1.5 to 2.5 feet during the rainy season in winter and spring. This soil is subject to hillside slippage. Springs and seeps are common.

The soils of this complex are used mainly for woodland.

The Indianola soil is suited to Douglas-fir and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 131 with CMAI of 132 cubic feet per acre. The site index based on a 50-year site curve is 99 with MAI of 116 cubic feet per acre at 50 years. The site index for red alder is 95.

Cable yarding is the most practical harvest method on these steep slopes.

The Kitsap soil is suited to Douglas-fir, western hemlock, western redcedar, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 164 with CMAI of 174 cubic feet per acre. The site index based on a 50-year site curve is 123 with MAI of 161 cubic feet per acre at 50 years. Red alder has a site index of 102.

The main limitations for use of this soil for timber production are slope, a slowly permeable substratum, and a seasonal perched water table during the rainy season in winter and spring. Some windthrow can be expected when winds are strong and the soil is saturated. Soil losses are minimized by shifting road building activities to more stable soils and by exercising care in the selection of sites for landings and skid trails.

The soils of this complex are in capability subclass VIIe.

22—Kapowsin gravelly loam, 0 to 6 percent slopes. This moderately deep, moderately well drained soil is on broad uplands and terraces. It formed in glacial till. Mapped areas range from 5 to more than 300 acres. Native vegetation is conifers and hardwoods.

The elevation ranges from 0 to 300 feet. The average annual precipitation is 30 to 45 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is dark brown gravelly loam about 5 inches thick. The subsoil is brown and dark yellowish brown gravelly loam about 18 inches thick. The substratum is weakly-silica-cemented, compact, mottled, olive brown, gravelly loam glacial till to a depth of 60 inches. Depth to the hardpan ranges from 20 to 32 inches.

Included with this soil in mapping are as much as 10 percent Harstine and Poulsbo soils and about 5 percent Kapowsin Variant soil. Also included is up to 10 percent Kapowsin soils that have slopes of more than 6 percent.

Permeability of this Kapowsin soil is moderate above the hardpan and very slow through the pan. The available water capacity is moderate. The effective rooting depth is 20 to 32 inches. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 1 to 2 feet during the rainy season.

This Kapowsin soil is used mainly for woodland, cropland, and urban development.

Brush picking for floral arrangements is an important minor industry.

This soil is suited to Douglas-fir, western redcedar, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 159 with CMAI of 169 cubic feet per acre. The site index based on a 50-year site curve is 119 with MAI of 154 cubic feet per acre at 50 years.

During the rainy season, the soil is saturated. Some windthrow can be expected when the soil is saturated and the winds are strong. Red alder quickly invades clear-cut areas. Hand planting of Douglas-fir helps to establish a more uniform stand than natural seeding.

This Kapowsin soil is productive cropland if practices that maintain tilth and fertility are used. Prevention of overgrazing, weed control, fertilization, and supplemental irrigation help to maximize forage yields.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is 5 or 6 years of orchardgrass and white clover for hay or pasture and 1 year of oats or corn for silage or 3 years of strawberries. Most crops respond to applications of nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

Depth to the cemented pan and wetness are the main limitations for urban development on this soil. Community sewage systems are needed because septic tank drainage fields fail or do not function properly during the rainy season. Excavation for basements, utility lines, and drainageways is difficult because of the cemented pan. Topsoil needs to be stockpiled and subsequently used to cover excavated soil material. Proper site preparation includes planning for the safe disposal of runoff.

This Kapowsin soil is in capability subclass IIIw.

23—Kapowsin gravelly loam, 6 to 15 percent slopes. This moderately deep, moderately well drained soil is on broad uplands and terraces. It formed in glacial till. Mapped areas range from 10 to more than 150 acres. Native vegetation is conifers and hardwoods.

The elevation ranges from 0 to 300 feet. The average annual precipitation is 30 to 45 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is dark brown gravelly loam about 5 inches thick. The subsoil is brown and dark yellowish brown gravelly loam about 18 inches thick. The substratum is weakly-silica-cemented, compact, mottled, olive brown, gravelly loam glacial till to a depth of 60 inches. Depth to the hardpan ranges from 20 to 30 inches.

Included with this soil in mapping are about 10 percent Harstine and Poulsbo soils that have steeper slopes and as much as 10 percent Kapowsin soils that have slopes of less than 6 percent.

Permeability of this Kapowsin soil is moderate above the hardpan and very slow through the pan. The available water capacity is moderate. The effective rooting depth is 20 to 32 inches. Runoff is medium, and the hazard of water erosion is moderate. A perched water table is at a depth of 1 to 2 feet during the rainy season.

This Kapowsin soil is used mainly for woodland, cropland, and urban development.

Brush picking for floral arrangements is an important minor industry.

This soil is suited to Douglas-fir, western redcedar, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 159 with CMAI of 169 cubic feet per acre. The site index based on a 50-year site curve is 119 with MAI of 154 cubic feet per acre at 50 years.

During the rainy season, the soil is saturated. Some windthrow can be expected when the soil is saturated and winds are strong. Red alder quickly invades clear-cut areas. Hand planting of Douglas-fir helps to establish a more uniform stand than natural seeding.

This soil is productive cropland if practices that reduce erosion and maintain tilth and fertility are used. Prevention of overgrazing, weed control, fertilization, and supplemental irrigation help to maximize forage yields.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. Cultivation and seeding should be across the slope. A suitable cropping system is 5 or 6 years of orchardgrass and white clover for hay or pasture and 1 year of oats or corn for silage or 3 years of strawberries. Most crops respond to applications of nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

Depth to the cemented pan and wetness are the main limitations for urban development on this soil. Community sewage systems are needed because septic tank drainage fields fail or do not function properly during the rainy season. Excavation for basements, utility lines, and drainageways is difficult because of the cemented pan. Topsoil needs to be stockpiled and subsequently used to cover excavated soil material. Proper site preparation includes planning for the safe disposal of runoff.

This Kapowsin soil is in capability subclass IIIe.

24—Kapowsin Variant gravelly clay loam, 0 to 5 percent slopes. This moderately deep, moderately well drained soil is on terraces. It formed in thin lacustrine sediment over glacial till. Most mapped areas range from 20 to 300 acres. Native vegetation is conifers and hardwoods.

The elevation ranges from 0 to 160 feet. The average annual precipitation is 40 to 50 inches, the mean annual air temperature is about 51 degrees F, and the average frost-free season is about 200 days.

Typically, the surface layer is dark reddish brown gravelly clay loam about 7 inches thick. The subsoil is mottled, brown gravelly silty clay loam about 13 inches thick. The substratum is a weakly-silica-cemented hardpan about 4 inches thick over very compact, gravelly sandy loam glacial till. Depth to the hardpan ranges from 20 to 35 inches.

Included with this soil in mapping are as much as 8 percent Kapowsin soils, about 3 percent Kitsap soils, and 4 percent Norma and Shalcar soils.

Permeability of this Kapowsin soil is moderately slow to the hardpan and very slow through the pan. The available water capacity is low. The effective rooting depth is 20 to 35 inches. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 1.5 to 2 feet during the rainy season.

This Kapowsin Variant soil is used for woodland, cropland, and urban development.

Brush picking for floral arrangements is an important minor industry.

This soil is suited to Douglas-fir, western red cedar, red alder, and bigleaf maple. Based on a 100-year site curve, the average site index for Douglas-fir is 144 with CMAI of 150 cubic feet per acre. The site index based on a 50-year site curve is 109 with MAI of 135 cubic feet per acre at 50 years.

During the rainy season, the soil is saturated. Some windthrow can be expected when the soil is saturated and winds are strong. Red alder quickly invades clear-cut areas. Hand planting of Douglas-fir helps to establish a more uniform stand than natural seeding.

This Kapowsin Variant soil is productive cropland, hayland, and pasture if practices that maintain tilth and fertility are used. Prevention of overgrazing, weed control, fertilization, and supplemental irrigation help to maximize forage yields.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is 5 or 6 years of orchardgrass and white clover for hay or pasture and 1 year of oats or corn for silage or 3 years of strawberries. Most crops respond to applications of nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

Depth to the cemented pan and wetness are the main limitations for urban development on this soil. Community sewage systems are needed because septic tank drainage fields fail or do not function properly during the rainy season. Excavation for basements, utility lines, and drainageways is difficult because of the cemented pan. The compact layer is rippable. Topsoil needs to be stockpiled and subsequently used to cover excavated soil material. Proper site preparation includes planning for the safe disposal of runoff.

This Kapowsin Variant soil is in capability subclass IIIw.

25—Kilchis very gravelly sandy loam, 15 to 30 percent slopes. This shallow, well drained soil is on ridge crests and side slopes. It formed in residuum from basalt. Native vegetation is conifers.

The elevation ranges from 300 to 1,700 feet. The average annual precipitation is 65 to 80 inches, the mean annual air temperature is about 47 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is dark reddish brown very gravelly sandy loam about 5 inches thick. The subsoil is dark reddish brown extremely gravelly loam about 14 inches thick over fractured basalt. Depth to the basalt ranges from 16 to 20 inches.

Included with this soil in mapping is about 5 percent Schneider soils in concave pockets. At the contact line with glacial till sediment, there is about 10 percent Shelton soils in concave pockets. Also included are small areas of Kilchis soils that have slopes of more than 30 percent.

Permeability of this Kilchis soil is moderately rapid. The available water capacity is low. The effective rooting depth is 16 to 20 inches. Runoff is rapid, and the hazard of water erosion is moderate.

This Kilchis soil is used for woodland, recreation, watershed, and wildlife habitat. Recreation is limited to hiking trails and hunting.

This Kilchis soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 134 with CMAI of 136 cubic feet per acre. The site index based on a 50-year site curve is 101 with MAI of 120 cubic feet per acre at 50 years.

Some windthrow can be expected when winds are strong and the soil is saturated.

Slope and depth to rock are the main limitations for use of this soil for urban development.

This Kilchis soil is in capability subclass VIe.

26—Kilchis very gravelly sandy loam, 30 to 70 percent slopes. This shallow, well drained soil is on ridge crests and side slopes. It formed in residuum from basalt. Native vegetation is conifers.

The elevation ranges from 300 to 1,700 feet. The average annual precipitation is 65 to 80 inches, the mean annual air temperature is about 47 degrees F, and the average frost-free season is about 160 days.

Typically, the surface layer is dark reddish brown very gravelly sandy loam about 5 inches thick. The subsoil is dark reddish brown extremely gravelly loam about 14 inches thick over fractured basalt. Depth to the basalt ranges from 16 to 20 inches.

Included with this Kilchis soil in mapping, and making up about 5 percent of the map unit, are Schneider soils in concave pockets. Also included are small areas of Kilchis soils with slopes of less than 30 percent.

Permeability of this Kilchis soil is moderately rapid. Available water capacity is low. Effective rooting depth is 16 to 20 inches. Runoff is very rapid, and the hazard of water erosion is severe.

This Kilchis soil is used for recreation, watershed, and wildlife habitat. Recreation is limited to hiking trails and hunting.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 134 with CMAI of 136 cubic feet per acre. The site index based on a 50-year site curve is 101 with MAI of 120 cubic feet per acre at 50 years.

Some windthrow can be expected when winds are strong and soil is saturated. Cable yarding is more practical than tractor logging on this soil.

This Kilchis soil is in capability subclass VIIs.

27—Kilchis-Shelton complex, 30 to 50 percent slopes. The soils of this complex are on ridge crests, side slopes, moraines, and till plains of uplands. The soils formed in material weathered from basalt or glacial till. Native vegetation is mainly conifers.

Elevation ranges from 600 to about 1,400 feet. The average annual precipitation is 65 to 80 inches, the mean annual air temperature is about 47 degrees F, and the average frost-free season is about 170 days.

This map unit is about 50 percent Kilchis very gravelly sandy loam, 30 to 50 percent slopes, and 35 percent Shelton very gravelly sandy loam, 30 to 50 percent slopes. The Kilchis soil is on sharp ridges and convex slopes, and the Shelton soil is on smooth, concave slopes. The soils of this complex are so intricately intermingled that it was not practical to map them separately at the scale used.

Included with this complex in mapping are small areas of Schneider soils, and Kilchis soils that have slopes of less than 30 percent along narrow drainageways.

The Kilchis soil is shallow and well drained. It is on ridge crests and side slopes and formed in material weathered from basalt. Typically, the surface layer is dark reddish brown very gravelly sandy loam about 5 inches thick. The subsoil is dark reddish brown extremely gravelly loam about 14 inches thick over fractured basalt. Depth to basalt ranges from 16 to 20 inches.

Permeability of this Kilchis soil is moderately rapid. Available water capacity is low. Effective rooting depth is 16 to 20 inches. Runoff is very rapid and the hazard of water erosion is severe.

The Shelton soil is moderately deep and moderately well drained on moraines and till plains. It formed in glacial till. Typically, the surface is covered by a mat of needles, leaves, and wood fragments. The subsoil is dark reddish brown and dark brown very gravelly sandy loam about 25 inches thick. The substratum is weakly-silica-cemented, very compact glacial till to a depth of 60 inches or more. Depth to the cemented pan ranges from 23 to 35 inches.

Permeability of this Shelton soil is rapid to the cemented pan and very slow in the pan. Available water capacity is low. Effective rooting depth is 23 to 35 inches. Runoff is very rapid, and the hazard of water erosion is severe. A perched water table is at a depth of 2 to 3 feet during the rainy season.

The soils of this complex are used for woodland and wildlife habitat.

The Kilchis soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 134 with CMAI of 136 cubic feet per acre. The site index based on a 50-year site curve is 101 with MAI of 120 cubic feet per acre at 50 years. Windthrow can be expected when winds are strong and the soil is saturated.

The Shelton soil is also suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 141 with CMAI of 146 cubic feet per acre. The site index based on a 50-year site curve is 107 with MAI of 130 cubic feet per acre at 50 years.

The soils of this complex are in capability subclass VIIe.

28—Kitsap silt loam, 2 to 8 percent slopes. This deep, moderately well drained soil is on terraces. It formed in glacial lake sediment on remnant terraces. The vegetation is conifers and hardwoods. Most mapped areas average about 30 acres.

The elevation ranges from 0 to 400 feet. The average annual precipitation is 30 to 45 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is very dark grayish brown silt loam about 5 inches thick. The upper part of the subsoil is mottled, dark yellowish brown silt loam about 8 inches thick. The lower part of the subsoil is mottled, light olive brown silty clay loam about 22 inches thick. The substratum to a depth of 60 inches is stratified, mottled, olive silt loam and silty clay loam.

Included with this soil in mapping are up to 12 percent Alderwood, Harstine, Poulsbo, Kapowsin, Kapowsin Variant, Indianola, and Ragnar soils, and up to 3 percent Bellingham and Norma soils in depressions.

Permeability of this Kitsap soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 1.5 to 2.5 feet during the rainy season.

This Kitsap soil is used for cropland and urban development. Some areas are used for woodland.

Hay and pasture are the main crops (fig. 5). Strawberries and caneberries, principally raspberries, are well suited to this soil.

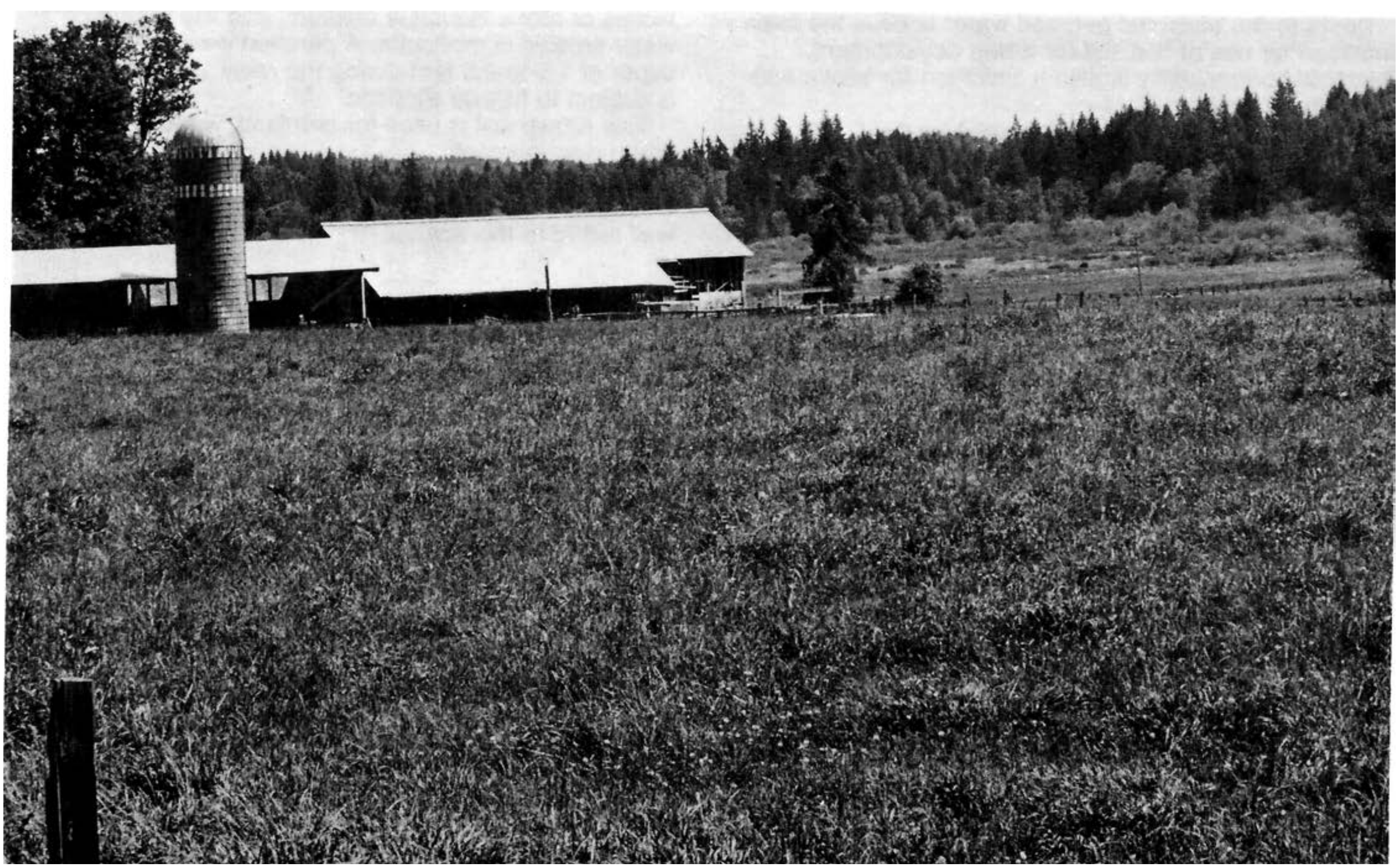

Figure 5.—Kitsap silt loam, 2 to 8 percent slopes, used for pasture.

This soil is highly productive cropland if practices that protect the soil from erosion and maintain soil structure and fertility are used. Proper grazing, weed control, and supplemental irrigation help to maximize forage yields.

A suitable cropping system is 5 or 6 years of orchardgrass and white clover for hay and pasture followed by 1 year of oats or 3 years of strawberries. Other cropping systems are hay and pasture for 5 or 6 years followed by a row crop or caneberries for 1 or 2 years. Row crops should be planted across the slope. The organic matter content can be maintained by utilizing all crop residue and plowing under cover crops. Most crops respond to fertilization. Legumes benefit from applications of agricultural lime.

This soil is suited to Douglas-fir, western hemlock, red alder, bigleaf maple, and western redcedar. Based on a 100-year site curve, the average site index for Douglas-fir is 164 with CMAI of 174 cubic feet per acre. The site index based on a 50-year site curve is 123 with MAI of 161 cubic feet per acre at 50 years. Red alder has a site index of 102.

Windthrow can be expected when winds are strong and the soil is saturated.

Depth to the seasonal perched water table is the main limitation for use of this soil for urban development. Restricted permeability is also a limitation for septic tank absorption fields.

This Kitsap soil is in capability subclass IIe.

29—Kitsap silt loam, 8 to 15 percent slopes. This deep, moderately well drained soil is on terraces. It formed in glacial lake sediment on remnant terraces. Most mapped areas are about 30 acres. The vegetation is conifers and hardwoods.

The elevation ranges from 0 to 400 feet. The average annual precipitation is 30 to 45 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is very dark grayish brown silt loam about 5 inches thick. The upper part of the subsoil is dark yellowish brown silt loam about 8 inches thick. The lower part of the subsoil is mottled, light olive brown silty clay loam about 22 inches thick. The substratum to a depth of 60 inches is stratified, mottled, olive silt loam and silty clay loam.

Included with this soil in mapping, and making up as much as 10 percent of the map unit, are Alderwood, Harstine, Poulsbo, Kapowsin, Ragnar, and Indianola soils. Also included are about 2 percent Bellingham and Norma soils in depressions. In places this Kitsap soil breaks into deep, narrow drainageways containing Kitsap soils that have slopes of more than 15 percent.

Permeability of this Kitsap soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. A perched water table is at a depth of 1.5 to 2.5 feet during the rainy season. The soil is subject to hillside slippage.

This Kitsap soil is used for cropland, woodland, and urban development.

Hay and pasture are the main crops (fig. 6). Strawberries and caneberries, principally raspberries, are well suited to this soil.

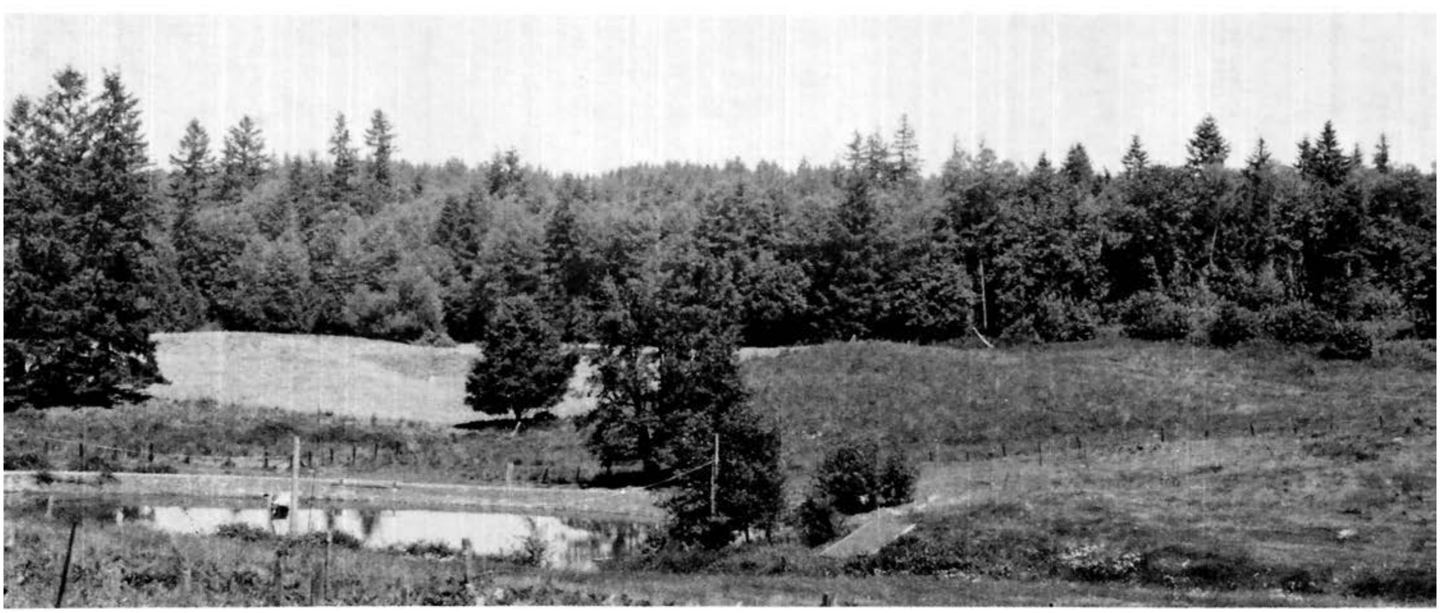

Figure 6.—Kitsap silt loam, 8 to 15 percent slopes, used for pasture and a water storage pond.

This Kitsap soil is highly productive cropland if practices that protect the soil from erosion and maintain soil structure and fertility are used. Proper grazing, weed control, and supplemental irrigation help to maximize forage yields.

A suitable cropping system is 5 or 6 years of orchardgrass and white clover for hay and pasture followed by 1 year of oats or 3 years of strawberries. Row crops should be planted across the slope. The organic matter content can be maintained by utilizing all crop residue and plowing under cover crops. Most crops respond to fertilization. Legumes benefit from applications of agricultural lime.

This soil is suited to Douglas-fir, western hemlock, western redcedar, bigleaf maple, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 164 with CMAI of 174 cubic feet per acre. The site index based on a 50-year curve is 123 with MAI of 161 cubic feet per acre at 50 years. Red alder has a site index of 102.

Windthrow can be expected when winds are strong and the soil is saturated.

Slope and depth to the seasonal perched water table are the main limitations for use of this soil for urban development. Restricted permeability is also a limitation for septic tank absorption fields. Effluent from absorption fields can surface in downslope areas and create a hazard to health. A proper site preparation system is one that controls runoff, considers the slippage potential, and maintains the esthetic value. Springs or seeps are exposed on cut slopes during road construction.

This Kitsap soil is in capability subclass IIIe.

30—Kitsap silt loam, 15 to 30 percent slopes. This deep, moderately well drained soil is on terraces. It formed in glacial lake sediment on side slopes of terraces. Mapped areas are commonly less than 50 acres. The average slope is about 18 to 20 percent. The vegetation is conifers and hardwoods.

The elevation ranges from 0 to 400 feet. The average annual precipitation is 30 to 45 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is very dark grayish brown silt loam about 5 inches thick. The upper part of the subsoil is dark yellowish brown silt loam about 8 inches thick. The lower part of the subsoil is mottled, light olive brown silty clay loam about 22 inches thick. The substratum to a depth of 60 inches is stratified, mottled, olive silt loam and silty clay loam.

Included with this soil in mapping are up to 10 percent Alderwood, Kapowsin, Harstine, and Poulsbo soils, and about 5 percent Indianola and Ragnar soils. In places, sloping areas have developed from soil slumping under wet conditions. As a result of this soil movement, a clean vertical or nearly vertical slope is exposed uphill.

Permeability of this Kitsap soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is severe. A perched water table is at a depth of 1.5 to 2.5 feet during the rainy season. This soil is subject to hillside slippage.

This Kitsap soil is used mainly for woodland and homesites.

This soil is suited to Douglas-fir, western hemlock, western redcedar, bigleaf maple, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 164 with CMAI of 174 cubic feet per acre. The site index based on a 50-year site curve is 123 with MAI of 161 cubic feet per acre at 50 years. Red alder has a site index of 102.

During logging, soil losses are minimized by special erosion control practices and by exercising care in the selection of landings and skid trails. Springs and seeps are common on cut slopes. Some windthrow can be expected when the winds are strong and the soil is saturated.

Slope and depth to the seasonal perched water table are the main limitations for use of this soil for urban development. Restricted permeability is also a limitation for septic tank absorption fields. Effluent from absorption fields can surface in downslope areas and create a hazard to health. In areas of moderate population density, the use of onsite sewage disposal systems creates a definite health hazard. A proper site preparation system is one that controls runoff, considers the slippage potential, and maintains the esthetic value. Springs or seeps are exposed, in places, during site preparation.

This Kitsap soil is in capability subclass IVe.

31—Kitsap silt loam, 30 to 45 percent slopes. This deep, moderately well drained soil is on terraces. It formed in glacial lake sediment in steep-sided drainageways. The vegetation is conifers and hardwoods.

The elevation ranges from 0 to 400 feet. The average annual precipitation is 40 to 45 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is very dark grayish brown silt loam about 5 inches thick. The upper part of the subsoil is dark yellowish brown silt loam about 8 inches thick. The lower part of the subsoil is mottled, light olive brown silty clay loam about 22 inches thick. The substratum to a depth of 60 inches is stratified, mottled, olive silt loam and silty clay loam.

Included with this soil in mapping are up to 4 percent Indianola and Ragnar soils, and 3 percent Kitsap soils that have slopes of less than 30 percent. Vertical escarpments devoid of vegetation are also included.

Permeability of this Kitsap soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is severe. A perched water table is at a depth of 1.5 to 2.5 feet during the rainy season. This soil is subject to hillside slippage. Springs and seeps are common.

This Kitsap soil is used mainly for woodland.

This soil is suited to Douglas-fir, western hemlock, western redcedar, bigleaf maple, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 164 with CMAI of 174 cubic feet per acre. The site index based on a 50-year site curve is 123 with MAI of 161 cubic feet per acre at 50 years. Red alder has a site index of 102.

Some windthrow can be expected when the winds are strong and the soil is saturated. Soil losses are minimized by shifting road building to more stable soils and by exercising care in the selection of landings and skid trails.

Slope and depth to the seasonal perched water table are the main limitations for use of this soil for urban development. Slippage potential must be considered in site preparation. Restricted permeability is also a limitation for septic tank absorption fields. Effluent from absorption fields can surface in downslope areas and create a hazard to health. Springs or seeps are exposed during site preparation. In most places, springs are used as domestic water supply for beach homes.

This Kitsap soil is in capability subclass VIe.

32—McKenna gravelly loam. This moderately deep over compact glacial till, poorly drained soil formed in glacial till. It is on uplands in low lying depressions and along drainageways. Native vegetation is hardwoods, conifers, sedges, and grasses. Slopes are 0 to 6 percent.

The elevation ranges from 50 to 500 feet. The average annual precipitation is 35 to 50 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is dark reddish brown gravelly loam about 6 inches thick. The subsoil is grayish brown very gravelly loam and very gravelly silt loam about 22 inches thick. The upper part of the substratum is mottled grayish brown very gravelly loam about 9 inches thick. The lower part of the substratum to a depth of 60 inches is mottled, compacted, gravelly silty clay glacial till. Depth to the compact glacial till ranges from 30 to 40 inches.

Included with this soil in mapping are as much as 10 percent Norma soils and 3 percent Kapowsin Variant soils.

Permeability of this McKenna soil is slow to the compact glacial till and very slow in it. The available water capacity is moderate. The effective rooting depth is limited by the seasonal perched water table and the depth to compact glacial till. Runoff is ponded during the winter months, and water erosion is not a hazard.

This McKenna soil is used mainly for woodland, pasture, and wildlife habitat.

This McKenna soil is moderately productive for pasture if practices that maintain soil tilth and fertility are used. Artificial drainage can be provided by tile or open ditches if outlets are available. Weed control, proper grazing, and fertilization help to maximize forage yields.

The organic matter content can be maintained by utilizing all crop residue, plowing under cover crops, and using a suitable cropping system. Where the soil is drained, a typical cropping system is a pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 or 2 years. A pasture of meadow foxtail, timothy, big trefoil, and white clover is suitable for undrained areas. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

The poor drainage limits the suitability of this soil to water-tolerant trees, such as red alder, western redcedar, and western hemlock. Based on a 50-year site curve, the average site index for red alder is 90 with CMAI of 101 cubic feet per acre. The site index for western redcedar is 90.

The perched water table remains close to the surface throughout the rainy season. When winds are strong and the soil is saturated, windthrow can be expected. Unless logging roads constructed on this soil use extra roadfill and have adequate drainage, movement of equipment is restricted to the dry season.

Undrained areas of the McKenna soil provide ideal habitat for such waterfowl as mallard, pintail, and wood ducks. Seeding of water-tolerant plants helps to improve the habitat for wildlife.

This soil is poorly suited to homesites because of a perched water table and ponding during the rainy season. Restricted permeability is also a limitation for use of this soil for septic tank absorption fields.

This McKenna soil is in capability subclass IVw.

33—Mukilteo peat. This deep, very poorly drained soil is on long, narrow, backwater depressions of the major river valleys and upland depressional areas. It formed in organic material mostly of partly decomposed plant remains. The remains are mainly reeds, sedges, and water-tolerant shrubs and grasses. Slopes are 0 to 1 percent.

The elevation ranges from 0 to 300 feet. The average annual precipitation is 40 to 70 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is dark reddish brown peat about 6 inches thick. The underlying material to a depth of 60 inches is dark reddish brown peat.

Included with this soil in mapping are as much as 10 percent Shalcar soils and about 2 percent Semiahmoo soils.

Permeability of this Mukilteo soil is moderate. The available water capacity is high. The effective rooting depth is limited by a high water table. Runoff is ponded during the winter months, and water erosion is not a hazard or is a slight hazard.

This Mukilteo soil is used mainly for migratory waterfowl habitat. A few areas are drained and used mainly for pasture, hay, and silage.

This soil is productive as pasture and cropland only if dikes are constructed to control ponding, the water table is lowered during the growing season by pumping, and proper management practices are used. Subsidence is minimized if the water table is maintained immediately below the root zone and allowed to return to the surface during the nongrowing season. Where the soil is drained, a suitable cropping system is a pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 or 2 years; or continuous cropping with vegetables, including an annual winter cover crop utilized as green manure. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

In undrained areas, this soil provides ideal habitat for waterfowl, such as mallard, pintail, and wood ducks. Seeding of water-tolerant plants helps to improve the habitat for wildlife.

This soil is poorly suited to homesites because of depth to the high water table, ponding, and subsidence. It is unable to support a load without settling. Onsite sewage disposal systems function improperly or fail because of the high water table and ponding.

This Mukilteo soil is in capability subclass IIw.

34—Neilton gravelly loamy sand, 0 to 3 percent slopes. This deep, excessively drained soil is on terraces, benches, and uplands. It formed in stratified, gravelly and sandy glacial outwash. Mapped areas are about 10 to 200 acres. The vegetation is conifers.

The elevation ranges from 40 to 400 feet. The average annual precipitation is 30 to 55 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is dark brown gravelly loamy sand about 4 inches thick. The subsoil is brown very gravelly loamy sand about 15 inches thick. The substratum to a depth of 60 inches is very gravelly sand.

Included with this soil in mapping are about 5 percent Neilton soils that have slopes of more than 3 percent, and about 10 percent Indianola soils.

Permeability of this Neilton soil is rapid to a depth of 19 inches and very rapid in the substratum. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight.

This Neilton soil is used for woodland and urban development. Some small areas are used for pasture.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 125 with CMAI of 122 cubic feet per acre. The site index based on a 50-year site curve is 95 with MAI of 108 cubic feet per acre at 50 years.

Trees can be harvested throughout the year by using proper equipment. This soil is capable of moderate production of floral greenery, such as salal, evergreen huckleberry, and western swordfern. Douglas-fir responds to nitrogen fertilizer.

Proper grazing, weed control, and supplemental irrigation help to maximize forage yields for pasture.

This soil is well suited to urban development. Cutbanks may cave in excavations.

This Neilton soil is in capability subclass VIs.

35—Neilton gravelly loamy sand, 3 to 15 percent slopes. This deep, excessively drained soil is on terraces, benches, and uplands. It formed in stratified, gravelly and sandy glacial outwash. Mapped areas are about 5 to 100 acres. The vegetation is conifers.

Elevation ranges from 50 to 400 feet. The average annual precipitation is 30 to 55 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is dark brown gravelly loamy sand about 4 inches thick. The subsoil is brown very gravelly loamy sand about 15 inches thick. The substratum to a depth of 60 inches is very gravelly sand.

Included with this soil in mapping are about 5 percent Neilton soils that have slopes of more than 15 percent and about 5 percent Indianola and Ragnar soils.

Permeability of this Neilton soil is rapid to a depth of 19 inches and very rapid in the substratum. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This Neilton soil is used for woodland and urban development (fig. 7). Some small areas are used for pasture.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 125 with CMAI of 122 cubic feet per acre. The site index based on a 50-year site curve is 95 with MAI of 108 cubic feet per acre at 50 years.

Trees may be harvested throughout the year by using proper equipment. This soil is capable of moderate production of floral greenery, such as salal, evergreen huckleberry, and western swordfern. Douglas-fir responds to nitrogen fertilizer.

Proper grazing, weed control, and supplemental irrigation help to maximize forage yields for pasture. All tillage operations in preparing seedbeds for pasture should be across the slope or on the contour.

The main limitation for urban development is slope. Cutbanks may cave in excavations.

This Neilton soil is in capability subclass VIs.

Figure 7.—Neilton gravelly loamy sand, 3 to 15 percent slopes. Douglas-fir is the dominant tree.

36—Neilton gravelly loamy sand, 15 to 30 percent slopes. This deep, excessively drained soil is on terraces, benches, and uplands. It formed in stratified, gravelly and sandy glacial outwash. Mapped areas are about 15 to 160 acres. The vegetation is conifers.

The elevation ranges from 50 to 400 feet. The average annual precipitation is 30 to 55 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is dark brown gravelly loamy sand about 4 inches thick. The subsoil is brown very gravelly loamy sand about 15 inches thick. The substratum to a depth of 60 inches is very gravelly sand.

Included with this soil in mapping are about 10 percent Neilton soils that have slopes of more than 30 percent or less than 15 percent. Also included are about 5 percent Indianola and Ragnar soils.

Permeability of this Neilton soil is rapid to a depth of 19 inches and very rapid in the substratum. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This Neilton soil is used mainly for woodland. A few areas are used for urban development.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 125 with CMAI of 122 cubic feet per acre. The site index based on a 50-year site curve is 95 with MAI of 108 cubic feet per acre at 50 years.

In places, trees are harvested throughout the year by using proper equipment. This soil is capable of moderate production of floral greenery, such as salal, evergreen huckleberry, and western swordfern. Douglas-fir responds to nitrogen fertilizer.

The main limitation for urban development is slope. In places, cutbanks cave in excavations.

This Neilton soil is in capability subclass VIs.

37—Norma fine sandy loam. This deep, poorly drained soil is on long, narrow stream bottoms and on till plain depressions in the uplands. It formed in mixed glacial alluvium. Slopes are mainly 0 to 3 percent. Native vegetation is sedges, grasses, conifers, and hardwoods.

The elevation ranges from 0 to 300 feet. The average annual precipitation is 35 to 60 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 170 days.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is distinctly mottled, light olive brown fine sandy loam about 14 inches thick. The substratum to a depth of 60 inches is mottled, olive gray and dark yellowish brown stratified sandy loam, clay loam, and loamy sand.

Included with this soil in mapping, and making up about 10 percent of the map unit, are Bellingham, McKenna, and Shalcar soils. Also included are small areas that have an organic surface layer as thick as 5 inches, and small areas that have a sand substratum.

Permeability of this Norma soil is moderately rapid. The available water capacity is high. The effective rooting depth is limited by a high water table. Runoff is ponded, and the hazard of water erosion is slight. This soil is ponded during the winter months.

This Norma soil is used for woodland, pasture, and wildlife habitat.

This soil is moderately productive for pasture if practices that maintain tilth and fertility are used. Drainage can be provided by tile or open ditch methods if outlets are available. Weed control, prevention of overgrazing, and fertilization help to maximize forage yields.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. If the soil is artificially drained, a typical cropping system is pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 or 2 years. A pasture of meadow foxtail, timothy, alsike clover, and white clover is suitable for undrained areas. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

This soil provides excellent habitat for such waterfowl as mallard, pintail, and wood ducks. Seeding of selected plants helps to improve the wetland wildlife habitat.

This soil is suited to red alder, western redcedar, and western hemlock. Based on a 50-year site curve, the average site index for red alder is 90 with CMAI of 101 cubic feet per acre.

Logging roads constructed on this soil require additional ballast and drainage; otherwise, the movement of equipment is restricted to the dry season. Windthrow can be expected when winds are strong and the soil is saturated.

This soil is poorly suited to homesites because of the depth to the high water table and ponding. Onsite sewage disposal systems do not function properly because of the wetness and ponding.

This Norma soil is in capability subclass IVw.

38—Pits. This miscellaneous area is open pits from which gravel and sand have been excavated. The pits are 5 to 50 acres. Most gravel pits are in areas of Kilchis, Schneider, Neilton, Grove, Indianola, and Ragnar soils, and a few are in Alderwood soils. The excavated gravelly material and some sandy material is used mainly for road construction and ballast.

39—Poulsbo gravelly sandy loam, 0 to 6 percent slopes. This moderately deep, moderately well drained soil is on broad uplands. It formed in glacial till. Most mapped areas are long and narrow and oriented north to south. Areas average about 100 acres. Native vegetation is conifers and hardwoods.

The elevation ranges from 0 to 450 feet. The average annual precipitation is 30 to 40 inches, the mean annual air temperature is about 51 degrees F, and the average frost-free season is about 210 days.

Typically, the surface of this soil is covered by a 2-inch mat of undecomposed and partially decomposed needles, leaves, and wood fragments. The subsurface layer is dark grayish brown gravelly sandy loam 2 inches thick. The subsoil is dark brown and dark yellowish brown gravelly sandy loam 22 inches thick. The substratum is a weakly-silica-cemented hardpan about 4 inches thick over very compact, gravelly sandy loam glacial till. Depth to the hardpan ranges from 20 to 40 inches.

Included with this soil in mapping, and making up as much as 10 percent of the map unit, are Ragnar soils and small pockets of Sinclair soils. Also included is a soil similar to this Poulsbo soil that has a compact sandy till layer at a depth of about 30 inches.

Permeability of this Poulsbo soil is moderately rapid above the hardpan and very slow through the pan. The available water capacity is low. The effective rooting depth ranges from 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 1 to 2.5 feet during the rainy season.

This Poulsbo soil is used mainly for woodland. Some areas are used for cropland, hay, pasture, and urban development.

Brush picking for floral arrangements is an important minor industry.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 161 with CMAI of 171 cubic feet per acre. The site index based on a 50-year site curve is 121 with MAI of 158 cubic feet per acre at 50 years.

During periods of heavy rainfall, a perched water table is at a shallow depth for a short time. Trees are subject to windthrow when winds are strong and the soil is saturated. Rooting depth is limited by the cemented pan.

Crop yields are moderate if practices that maintain soil tilth and fertility are used. Proper grazing practices, weed control, and supplemental irrigation increase forage yields.

The organic matter content can be maintained by using crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is a pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 year. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

This soil is suited to urban development if community sewage systems are built. Wetness and the cemented pan are the main limitations. In areas of moderate and high population density, onsite septic tank absorption systems often fail or do not function properly during periods of high rainfall because of wetness and depth to the pan.

This Poulsbo soil is in capability subclass IVw.

40—Poulsbo gravelly sandy loam, 6 to 15 percent slopes. This moderately deep, moderately well drained soil is on broad uplands. It formed in glacial till. Most mapped areas are long and narrow and oriented north to south. Areas average about 80 acres. Native vegetation is conifers and hardwoods.

The elevation ranges from 0 to 450 feet. The average annual precipitation is 30 to 40 inches, the mean annual air temperature is about 51 degrees F, and the average frost-free season is about 210 days.

Typically, the surface of this soil is covered by a 2-inch mat of undecomposed and partially decomposed needles, leaves, and wood fragments. The subsurface layer is dark grayish brown gravelly sandy loam 2 inches thick. The subsoil is dark brown and dark yellowish brown gravelly sandy loam 22 inches thick. The substratum is a weakly-silica-cemented hardpan about 4 inches thick over very compact gravelly sandy loam glacial till. Depth to the hardpan ranges from 20 to 40 inches.

Included with this soil in mapping are as much as 10 percent Ragnar soils and about 5 percent Poulsbo soils that have slopes of more than 15 percent or less than 6 percent. Also included is a soil similar to this Poulsbo soil that has a compact sandy till layer at a depth of about 30 inches.

Permeability of this Poulsbo soil is moderately rapid above the hardpan and very slow through the pan. The available water capacity is low. The effective rooting depth ranges from 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 1 to 2.5 feet during the rainy season.

This Poulsbo soil is used mainly for woodland. Small areas are used for cropland, hay, pasture, and urban development.

Brush picking for floral arrangements is an important minor industry.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 161 with CMAI of 171 cubic feet per acre. The site index based on a 50-year site curve is 121 with MAI of 158 cubic feet per acre at 50 years.

During periods of heavy rainfall, a perched water table is at a shallow depth for a short time. Trees are subject to windthrow when winds are strong and the soil is saturated. Rooting depth is limited by the cemented pan.

Crop yields are moderate if practices that maintain soil tilth and fertility are used. All tillage operations should be across the slope or on the contour. Proper grazing practices, weed control, and supplemental irrigation increase forage yields.

The organic matter content can be maintained by using crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 year. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

This soil is suited to urban development if community sewage systems are built. Slope, wetness, and the cemented pan are the main limitations. In areas of moderate and high population density, onsite septic tank absorption systems often fail or do not function properly during periods of high rainfall because of wetness and depth to the pan.

This Poulsbo soil is in capability subclass IVe.

41—Poulsbo gravelly sandy loam, 15 to 30 percent slopes. This moderately deep, moderately well drained soil is on broad uplands. It formed in glacial till. Most mapped areas are long and narrow and oriented north to south. Areas average about 50 acres. Native vegetation is conifers and hardwoods.

The elevation ranges from 0 to 450 feet. The average annual precipitation is 30 to 40 inches, the mean annual air temperature is about 51 degrees F, and the average frost-free season is about 210 days.

Typically, the surface of this soil is covered by a 2-inch mat of undecomposed and partially decomposed needles, leaves, and wood fragments. The subsurface layer is dark grayish brown gravelly sandy loam 2 inches thick. The subsoil is dark brown and dark yellowish brown gravelly sandy loam 22 inches thick. The substratum is a weakly-silica-cemented hardpan about 4 inches thick over very compact, gravelly sandy loam glacial till. Depth to the hardpan ranges from 20 to 40 inches.

Included with this soil in mapping are as much as 10 percent Ragnar soils, and about 5 percent Poulsbo soils that have slopes of more than 30 percent or less than 15 percent. Also included is a soil similar to this Poulsbo soil that has a compact sandy till layer at a depth of about 30 inches.

Permeability of this Poulsbo soil is moderately rapid above the hardpan and very slow through the pan. The available water capacity is low. The effective rooting depth ranges from 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. A perched water table is at a depth of 1 to 2.5 feet during the rainy season.

This Poulsbo soil is used mainly for woodland. Small areas are used for cropland, hay, pasture, and urban development.

Brush picking for floral arrangements is an important minor industry.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 161 with CMAI of 171 cubic feet per acre. The site index based on a 50-year site curve is 121 with MAI of 158 cubic feet per acre at 50 years.

During periods of heavy rainfall, a perched water table is at a shallow depth for a short time. Trees are subject to windthrow when winds are strong and the soil is saturated. Rooting depth is limited by the cemented pan.

Crop yields are moderate if practices that maintain soil tilth and fertility are used. All tillage operations should be across the slope or on the contour. Proper grazing practices, weed control, and supplemental irrigation increase forage yields.

The organic matter content can be maintained by using crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is a pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 year. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

This soil is poorly suited to urban development because of slope, wetness, and depth to the pan. In areas of moderate and high population density, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall because of wetness and the depth to the pan.

This Poulsbo soil is in capability subclass IVe.

42—Poulsbo-Ragnar complex, 0 to 6 percent slopes. The soils of this complex are on broad uplands and terraces. They formed in glacial till and glacial outwash. Native vegetation is a mixed stand of conifers and hardwoods.

The elevation ranges from 0 to about 400 feet. The average annual precipitation is 30 to 40 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 190 days.

This complex is about 40 percent Poulsbo gravelly sandy loam, 0 to 6 percent slopes, and about 30 percent Ragnar fine sandy loam, 0 to 6 percent slopes. The soils of this complex are so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping, and making up about 30 percent of the complex, is a soil similar to the Poulsbo soil that has a compact sandy till layer at a depth of about 30 inches. Small areas of soils that have slopes of more than 6 percent are also included in this complex.

The Poulsbo soil is moderately deep and moderately well drained. It formed in glacial till. Typically, the surface of the soil is covered by a 2-inch mat of undecomposed and partially decomposed needles, leaves, and wood fragments. The subsurface layer is dark grayish brown gravelly sandy loam 2 inches thick. The subsoil is dark brown and dark yellowish brown gravelly sandy loam 22 inches thick. The substratum is a weakly-silica-cemented hardpan about 4 inches thick over very compact, gravelly sandy loam glacial till. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Poulsbo soil is moderately rapid above the hardpan and very slow through the pan. The available water capacity is low. The effective rooting depth ranges from 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 1 to 2.5 feet during the rainy season.

The Ragnar soil is deep and well drained. It formed on glacial outwash terraces. Typically, the soil has a surface layer of dark brown fine sandy loam 4 inches thick. The subsoil is dark yellowish brown fine sandy loam about 17 inches thick. The substratum to a depth of 60 inches is grayish brown and light brownish gray loamy sand.

Permeability of this Ragnar soil is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate.

The soils of this complex are used mainly for woodland. A few small areas are used for pasture, hay, cropland, and homesites.

Brush picking for floral arrangements is an important minor industry.

The Poulsbo soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 161 with CMAI of 171 cubic feet per acre. The site index based on a 50-year site curve is 121 with MAI of 158 cubic feet per acre at 50 years.

During periods of heavy rainfall, a perched water table is at a shallow depth in this Poulsbo soil for a short time. Trees are subject to windthrow when winds are strong and the soil is saturated. Rooting depth is limited by the cemented pan.

The Ragnar soil is well suited to Douglas-fir, western hemlock, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 167 with CMAI of 178 cubic feet per acre. The site index based on a 50-year site curve is 125 with MAI of 165 cubic feet per acre at 50 years.

This Ragnar soil is capable of producing moderate amounts of floral greenery, such as salal, evergreen huckleberry, and western swordfern.

Crop yields are moderate if practices that maintain soil tilth and fertility are used. Proper grazing practices, weed control, and supplemental irrigation increase forage yields.

The organic matter content can be maintained by using crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is a pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 year. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

The main limitations of the Poulsbo soil for homesites are the depth to the cemented pan and wetness. Septic tank absorption fields may not function properly during periods of high rainfall because of wetness and depth to the pan. The Ragnar soil is well suited to urban development, but cutbanks may cave.

The soils of this complex are in capability subclass IVw.

43—Poulsbo-Ragnar complex, 6 to 15 percent slopes. The soils of this complex are on broad uplands. They formed in glacial till and glacial outwash. Native vegetation is a mixed stand of conifers and hardwoods.

The elevation ranges from 0 to about 400 feet. The average annual precipitation is 30 to 40 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 190 days.

This complex is about 40 percent Poulsbo gravelly sandy loam, 6 to 15 percent slopes, and about 30 percent Ragnar fine sandy loam, 6 to 15 percent slopes. The soils of this complex are so intricately intermingled that it was not practical to map them separately at the scale used.

Included with these soils in mapping, and making up about 30 percent of the complex, is a soil similar to Poulsbo soil that has a compact sandy till layer at a depth of about 30 inches. Small areas of soils that have slopes of more than 15 percent are also included in this complex.

The Poulsbo soil is moderately deep and moderately well drained. It formed in glacial till. Typically, the surface of the soil is covered by a 2-inch mat of undecomposed and partially decomposed needles, leaves, and wood fragments. The subsurface layer is dark grayish brown gravelly sandy loam 2 inches thick. The subsoil is dark brown and dark yellowish brown gravelly sandy loam 22 inches thick. The substratum is a weakly-silica-cemented hardpan about 4 inches thick over very compact, gravelly sandy loam glacial till. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Poulsbo soil is moderately rapid above the hardpan and very slow through the pan. The available water capacity is low. The effective rooting depth ranges from 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 1 to 2.5 feet during the rainy season.

The Ragnar soil is deep and well drained. It formed on glacial outwash terraces. Typically, the Ragnar soil has a surface layer of dark brown fine sandy loam 4 inches thick. The subsoil is dark yellowish brown fine sandy loam about 17 inches thick. The substratum to a depth of 60 inches is grayish brown and light brownish gray loamy sand.

Permeability of this Ragnar soil is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is severe.

The soils of this complex are used mainly for woodland. Small areas are used for pasture, hay, cropland, and homesites. Brush picking for floral arrangements is an important minor industry.

The Poulsbo soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 161 with CMAI of 171 cubic feet per acre. The site index based on a 50-year site curve is 121 with MAI of 158 cubic feet per acre at 50 years. During periods of heavy rainfall, a perched water table is at a shallow depth for a short time. Trees are subject to windthrow when winds are strong and the soil is saturated. Rooting depth is limited by the cemented pan.

This Ragnar soil is well suited to Douglas-fir, western hemlock, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 167 with CMAI of 178 cubic feet per acre. Based on a 50-year site curve, the average site index is 125 with MAI of 165 cubic feet per acre at 50 years.

Crop yields are moderate if practices that maintain soil tilth and fertility are used. All tillage operations should be on the contour or across the slope. Proper grazing practices, weed control, and supplemental irrigation increase forage yields.

The organic matter content can be maintained by using all crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is a pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 year. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

The main limitation of the Poulsbo and Ragnar soils for homesites is slope. Depth to the cemented pan and wetness are limitations of the Poulsbo soil. Excavation is limited by the cemented pan. Septic tank absorption fields may not function properly during periods of high rainfall because of wetness and depth to the pan. The Ragnar soil is well suited to urban development, but cutbanks may cave.

The soils of this complex are in capability subclass IVe.

44—Ragnar fine sandy loam, 0 to 6 percent slopes. This deep, well drained soil is on terraces and uplands. It formed in glacial outwash. Native vegetation is conifers and hardwoods.

The elevation ranges from 0 to 500 feet. The average annual precipitation is 35 to 65 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is dark brown fine sandy loam 4 inches thick. The subsoil is dark yellowish brown fine sandy loam about 17 inches thick. The substratum to a depth of 60 inches is grayish brown and light brownish gray loamy sand.

Included with this soil in mapping are as much as 8 percent Poulsbo and Indianola soils, and about 6 percent Ragnar soils that have slopes of more than 6 percent.

Permeability of this Ragnar soil is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate.

This Ragnar soil is used mainly for woodland and urban land. Some areas are used for hay, pasture, and cropland.

This soil is suited to Douglas-fir, western hemlock, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 167 with CMAI of 178 cubic feet per acre. The site index based on a 50-year site curve is 125 with MAI of 165 cubic feet per acre at 50 years.

This Ragnar soil is moderately productive cropland if practices that maintain soil tilth and fertility are used. Weed control, proper grazing, and fertilization help to maximize forage yields.

The organic matter content can be maintained by utilizing crop residue, plowing under cover crops, and using a suitable cropping system. A suitable cropping system is pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 year or strawberries for 3 years. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

This soil is well suited to urban development. Cutbanks may cave in excavations.

This Ragnar soil is in capability subclass IVs.

45—Ragnar fine sandy loam, 6 to 15 percent slopes. This deep, well drained soil is on terraces and uplands. It formed in glacial outwash. Native vegetation is conifers and hardwoods.

The elevation ranges from 0 to 500 feet. The average annual precipitation is 35 to 65 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is dark brown fine sandy loam 4 inches thick. The subsoil is dark yellowish brown fine sandy loam about 17 inches thick. The substratum to a depth of 60 inches is grayish brown and light brownish gray loamy sand.

Included with this soil in mapping are as much as 10 percent Poulsbo and Indianola soils, and about 5 percent Ragnar soils that have slopes of more than 15 percent or less than 6 percent.

Permeability of this Ragnar soil is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is severe.

This Ragnar soil is used mainly for woodland. Some areas are used for hay, pasture, cropland, and homesites.

This soil is suited to Douglas-fir, western hemlock, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 167 with CMAI of 178 cubic feet per acre. The site index based on a 50-year site curve is 125 with MAI of 165 cubic feet per acre at 50 years.

This Ragnar soil is moderately productive cropland if practices that maintain soil tilth and fertility are used. Weed control, proper grazing, and fertilizer help to maximize forage yields.

The organic matter content can be maintained by utilizing all crop residue, plowing under cover crops, and using suitable cropping systems. All tillage operations should be on the contour or across the slope. A suitable cropping system is a pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 year or strawberries for 3 years. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

The main limitation for use of this soil for urban development is slope. Cutbanks may cave in excavations.

This Ragnar soil is in capability subclass IVe.

46—Ragnar fine sandy loam, 15 to 30 percent slopes. This deep, well drained soil is on terraces and uplands. It formed in glacial outwash. Native vegetation is conifers and hardwoods.

The elevation ranges from 0 to 500 feet. The average annual precipitation is 35 to 65 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is dark brown fine sandy loam 4 inches thick. The subsoil is dark yellowish brown fine sandy loam about 17 inches thick. The substratum to a depth of 60 inches is grayish brown and light brownish gray loamy sand.

Included with this soil in mapping are as much as 10 percent Poulsbo and Indianola soils, and about 5 percent Ragnar soils that have slopes of more than 30 percent and rolling slopes of less than 15 percent.

Permeability of this Ragnar soil is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is severe.

This Ragnar soil is used mainly for woodland. Some areas are used for urban development.

This soil is suited to Douglas-fir, western hemlock, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 139 with CMAI of 144 cubic feet per acre. The site index based on a 50-year site curve is 105 with MAI of 127 cubic feet per acre at 50 years.

The main limitation for urban development on this soil is slope. Deep cuts made during road construction expose unstable soil material. Cutbanks may cave. A site preparation system that controls runoff and maintains the esthetic value is needed.

This Ragnar soil is in capability subclass IVe.

47—Ragnar-Poulsbo complex, 15 to 30 percent slopes. The soils of this complex are on broad uplands. They formed in glacial till and glacial outwash. Native vegetation is a mixed stand of conifers and hardwoods.

The elevation ranges from 0 to about 400 feet. The average annual precipitation is 25 to 40 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 190 days.

This complex is about 45 percent Ragnar fine sandy loam, 15 to 30 percent slopes, and about 30 percent Poulsbo gravelly sandy loam, 15 to 30 percent slopes. The soils of this complex are so intricately intermingled that it was not practical to map them separately at the scale used.

Included with this complex is about 25 percent of a soil similar to the Poulsbo soil that has a compact sandy till layer at a depth of about 30 inches. Small areas of soils that have slopes of more than 30 percent are also included.

The Ragnar soil is deep and well drained. It formed in glacial outwash. Typically, the soil has a surface layer of dark brown fine sandy loam 4 inches thick. The subsoil is dark yellowish brown fine sandy loam about 17 inches thick. The substratum to a depth of 60 inches or more is grayish brown and light brownish gray loamy sand.

Permeability of this Ragnar soil is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is severe.

The Poulsbo soil is moderately deep and moderately well drained. It formed in glacial till. Typically, the surface of this soil is covered by a 2-inch mat of undecomposed and partially decomposed needles, leaves, and wood fragments. The subsurface layer is dark grayish brown gravelly sandy loam 2 inches thick. The subsoil is dark brown and dark yellowish brown gravelly sandy loam 22 inches thick. The substratum is a weakly-silica-cemented hardpan about 4 inches thick over very compact, gravelly sandy loam glacial till. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of this Poulsbo soil is moderately rapid above the hardpan and very slow through the hardpan. The available water capacity is low. The effective rooting depth ranges from 20 to 40 inches. Runoff is medium, and the hazard of water erosion is severe. A perched water table is at a depth of 1 to 2.5 feet during the rainy season.

The soils of this complex are used mainly for woodland.

This Ragnar soil is suited to Douglas-fir, western hemlock, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 139 with CMAI of 144 cubic feet per acre. The site index based on a 50-year site curve is 105 with MAI of 127 cubic feet per acre at 50 years.

Based on a 100-year site curve for Poulsbo soil, the average site index for Douglas-fir is 161 with CMAI of 171 cubic feet per acre. Based on a 50-year site curve, the average site index is 121 with MAI of 158 cubic feet per acre at 50 years.

Windthrow can be expected when winds are strong and the soil is saturated.

The soils in this complex are in capability subclass IVe.

48—Schneider very gravelly loam, 45 to 70 percent slopes. This deep, well drained soil is on uplands. It formed in colluvium from basalt. Native vegetation is conifers and shrubs.

The elevation ranges from 100 to 1,500 feet. The average annual precipitation is 60 to 75 inches, the mean annual air temperature is about 49 degrees F, and the average frost-free season is about 170 days.

Typically, the upper part of the surface layer is dark reddish brown very gravelly loam about 6 inches thick. The lower part of the surface layer is dark reddish brown extremely gravelly loam about 17 inches thick. The subsoil is dark brown extremely gravelly silt loam about 25 inches thick over basalt. Depth to the basalt is 40 inches or more.

Included with this soil in mapping, and making up about 10 percent of the map unit, are Kilchis soils on rocky knolls. Also included are small areas that have slopes of less than 30 percent or more than 70 percent. There are small inclusions of Shelton soils at lower elevation.

Permeability of this Schneider soil is moderate. The available water capacity is moderate. The effective rooting depth is 40 inches or more. Runoff is rapid, and the hazard of water erosion is severe.

This soil is used mainly for woodland, recreation, watershed, and wildlife habitat. Recreation is limited to hiking and hunting.

This soil is suited to Douglas-fir. Based on a 100-year site curve, the average site index for Douglas-fir is 151 with CMAI of 159 cubic feet per acre. The site index based on a 50-year site curve is 115 with MAI of 146 cubic feet per acre at 50 years.

Because this very steep colluvial soil is unstable, special care is needed in logging and road construction.

This Schneider soil is in capability subclass VIIe.

49—Semiahmoo muck. This deep, very poorly drained soil is in depressional backwater areas of flood plains. It formed in decaying organic material. Slopes are 0 to 1 percent. The native vegetation is mainly sedges, reeds, and water-tolerant shrubs and grasses.

The elevation ranges from 0 to 200 feet. The average annual precipitation is 35 to 50 inches, the mean annual air temperature is about 49 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is black muck 8 inches thick. The underlying material to a depth of 66 inches is black muck.

Included with this soil in mapping are as much as 10 percent Shalcar soil and about 5 percent Mukilteo soil. Also included are areas that have thin lenses of diatomaceous earth and volcanic ash in the subsoil.

Permeability of this Semiahmoo soil is moderately slow. The available water capacity is high. The effective rooting depth is limited by the high water table. Runoff is ponded, and water erosion is not a hazard. This soil is subject to ponding during the winter months.

This Semiahmoo soil is used mainly for pasture. With the construction of dikes to control ponding, pumping to lower the water table during the growing season, and good management, this soil is very productive. Practices that maintain tilth and fertility are necessary. Drainage can be provided by tile or open ditch methods if outlets are available. Weed control, prevention of overgrazing, and fertilizer help to maximize forage yields.

Subsidence is minimized if the water table is maintained immediately below the root zone and allowed to return to the surface during the nongrowing season. When the soil is drained, a suitable cropping system is pasture of orchardgrass and white clover for 5 or 6 years followed by oats for 1 or 2 years. Most crops respond to nitrogen, phosphorus, and potassium. Legumes benefit from applications of agricultural lime.

In undrained areas, this soil provides excellent habitat for waterfowl, such as mallard, pintail, and wood ducks. Seeding of water-tolerant plants helps to improve the habitat for wildlife.

This soil is poorly suited to homesites because of depth to the high water table, ponding, and subsidence. It is not able to support a load without settling. Onsite sewage disposal systems function improperly or fail because of the high water table, ponding, and restricted permeability.

This Semiahmoo soil is in capability subclass IIw.

50—Shalcar muck. This deep, very poorly drained soil is on backwater depressions in valley and uplands. It formed in decaying organic material over alluvium. Slopes are 0 to 1 percent. The native vegetation is mainly reeds, sedges, and water-tolerant shrubs and grasses.

The elevation ranges from 0 to 400 feet. The average annual precipitation is 35 to 60 inches, mean annual air temperature is about 49 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is very dark brown muck about 32 inches thick. The underlying material to a depth of 60 inches is grayish brown stratified silt loam, silty clay loam, sandy loam, and loamy sand.

Included with this soil in mapping are about 10 percent Semiahmoo soil and about 5 percent Norma soil.

Permeability of this Shalcar soil is moderately slow. The available water capacity is high. The effective rooting depth is limited by a high water table. Runoff is ponded, and water erosion is not a hazard or is a slight hazard. This soil is subject to ponding during the winter months.

This Shalcar soil is used mainly for migratory waterfowl habitat and for pasture. With construction of dikes to control ponding, pumping to lower the water table during the growing season, and good management, this soil is very productive. Practices that maintain tilth and fertility are necessary. Drainage can be provided by tile or open ditch methods if outlets are available. Weed control, prevention of overgrazing, and fertilization help to maximize forage yields.

Subsidence is minimized if the water table is maintained immediately below the root zone and allowed to return to the surface during the nongrowing season.

In undrained areas, this soil provides excellent habitat for waterfowl, such as mallard, pintail, and wood ducks. Seeding of water-tolerant plants helps to improve the habitat for wildlife.

This soil is poorly suited to homesites because of depth to the high water table, ponding, and subsidence. The soil is unable to support a load without settling. Onsite sewage disposal systems function improperly or fail because of the high water table, ponding, and restricted permeability.

This Shalcar soil is in capability subclass IIw.

51—Shelton very gravelly sandy loam, 0 to 6 percent slopes. This moderately deep, moderately well drained soil is on moraines and till plains. It formed in glacial till. Mapped areas average 65 acres and are long and narrow and oriented north to south. The vegetation is conifers.

The elevation ranges from 100 to 800 feet. The average annual precipitation is 50 to 70 inches, the mean annual air temperature is about 49 degrees F, and the average frost-free season is about 170 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments. The subsoil is dark reddish brown and dark brown very gravelly sandy loam about 25 inches thick. The substratum is weakly-silica-cemented, very compact glacial till to a depth of 60 inches or more. Depth to the hardpan ranges from 20 to 35 inches.

Included with this soil in mapping are about 10 percent Shelton extremely gravelly sandy loam and about 5 percent McKenna soils in small potholes. Also included in the western part of the county are small areas where the cemented pan overlies gravelly and sandy glacial outwash.

Permeability of this Shelton soil is rapid to the cemented pan and very slow in the pan. The available water capacity is low. The effective rooting depth is 20 to 35 inches. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 2 to 3 feet during the rainy season.

This Shelton soil is used mainly for woodland and homesites. Some small areas are used for pasture.

The picking of evergreen huckleberry, western swordfern, and salal is an important minor industry.

This soil is well suited to Douglas-fir and Christmas trees. The major trees are Douglas-fir and western hemlock. Trees may be pale unless nitrogen fertilizer is added.

Based on a 100-year site curve, the average site index for Douglas-fir is 141 with CMAI of 146 cubic feet per acre. The site index based on a 50-year site curve is 107 with MAI of 130 cubic feet per acre at 50 years.

Douglas-fir responds to nitrogen fertilizer. Some windthrow can be expected when winds are strong and the soil is saturated.

Weed control, proper grazing, and fertilization help to maximize forage yields for pasture.

The main limitation for use of this soil for homesites is wetness. The cemented pan and wetness are the main limitations for septic tank absorption fields.

This Shelton soil is in capability subclass IVw.

52—Shelton very gravelly sandy loam, 6 to 15 percent slopes. This moderately deep, moderately well drained soil is on moraines and till plains. It formed in glacial till. Mapped areas average 65 acres and are long and narrow and oriented north to south. The vegetation is conifers.

The elevation ranges from 100 to 800 feet. The average annual precipitation is 50 to 70 inches, the mean annual air temperature is about 49 degrees F, and the average frost-free season is about 170 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments. The subsoil is dark reddish brown and dark brown very gravelly sandy loam about 25 inches thick. The substratum is weakly-silica-cemented, very compact glacial till to a depth of 60 inches or more. Depth to the hardpan ranges from 20 to 35 inches.

Included with this soil in mapping are about 10 percent Shelton extremely gravelly sandy loam and about 5 percent McKenna soils in small potholes. Also included in the western part of the county are small areas where the cemented pan overlies gravelly and sandy glacial outwash.

Permeability of this Shelton soil is rapid to the cemented pan and very slow in the pan. The available water capacity is low. The effective rooting depth is 20 to 35 inches. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 2 to 3 feet during the rainy season.

This Shelton soil is used mainly for woodland and homesites. Small areas are used for pasture.

The picking of evergreen huckleberry, western swordfern, and salal is an important minor industry.

This soil is well suited to Douglas-fir and Christmas trees. The major trees are Douglas-fir and western hemlock. Trees may be pale unless nitrogen fertilizer is added. Windthrow can be expected when winds are strong and the soil is saturated.

Based on a 100-year site curve, the average site index for Douglas-fir is 141 with CMAI of 146 cubic feet per acre. The site index based on a 50-year site curve is 107 with MAI of 130 cubic feet per acre at 50 years.

Weed control, proper grazing, and fertilization help to maximize forage yields for pasture.

The main limitations for use of this soil for homesites are slope and wetness. The cemented pan, slope, and wetness are the main limitations for septic tank absorption fields.

This Shelton soil is in capability subclass IVe.

53—Shelton very gravelly sandy loam, 15 to 30 percent slopes. This moderately deep, moderately well drained soil is on moraines and till plains. It formed in glacial till. Mapped areas average 50 acres and are long and narrow and oriented north to south. The vegetation is conifers.

The elevation ranges from 100 to 800 feet. The average annual precipitation is 50 to 70 inches, the mean annual air temperature is about 49 degrees F, and the average frost-free season is about 170 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments. The subsoil is dark reddish brown and dark brown very gravelly sandy loam about 25 inches thick. The substratum is weakly-silica-cemented, very compact glacial till to a depth of 60 inches or more. Depth to the hardpan ranges from 20 to 35 inches.

Included with this soil in mapping are about 5 percent Shelton extremely gravelly sandy loam and about 5 percent Shelton soils that have slopes of more than 30 percent or less than 15 percent. Also included are small areas of soils that have a substratum of glacial outwash gravel and sand.

Permeability of this Shelton soil is rapid to the cemented pan and very slow in the pan. The available water capacity is low. The effective rooting depth is 20 to 35 inches. Runoff is medium, and the hazard of water erosion is moderate. A perched water table is at a depth of 2 to 3 feet during the rainy season.

This Shelton soil is used mainly for woodland, pasture, and homesites.

The picking of evergreen huckleberry, western swordfern, and salal is an important minor industry.

This soil is well suited to Douglas-fir and Christmas trees. The major trees are Douglas-fir and western hemlock. Trees may be pale unless nitrogen fertilizer is added. Windthrow can be expected when winds are strong and the soil is saturated.

Based on a 100-year site curve, the average site index for Douglas-fir is 141 with CMAI of 146 cubic feet per acre. The site index based on a 50-year site curve is 107 with MAI of 130 cubic feet per acre at 50 years.

Weed control, proper grazing, and fertilization help to maximize forage yields for pasture.

The main limitation for use of this soil for homesites is slope. The cemented pan, slope, and wetness are the main limitations for septic tank absorption fields.

This Shelton soil is in capability subclass IVe.

54—Shelton very gravelly sandy loam, 30 to 45 percent slopes. This moderately deep, moderately well drained soil is on moraines and till plains. It formed in glacial till. Mapped areas average 40 acres and are long and narrow and oriented north to south. The vegetation is conifers.

The elevation ranges from 100 to 800 feet. The average annual precipitation is 50 to 70 inches, the mean annual air temperature is about 49 degrees F, and the average frost-free season is about 170 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments. The subsoil is dark reddish brown and dark brown very gravelly sandy loam about 25 inches thick. The substratum is weakly-silica-cemented, very compact glacial till to a depth of 60 inches or more. Depth to the hardpan ranges from 20 to 35 inches.

Included with this soil in mapping are about 10 percent Shelton soils that have slopes of less than 30 percent and soils that have slopes of more than 45 percent.

Permeability of this Shelton soil is rapid to the cemented pan and very slow in the pan. The available water capacity is low. The effective rooting depth is 20 to 35 inches. Runoff is medium, and the hazard of water erosion is severe. A perched water table is at a depth of 2 to 3 feet during the rainy season.

This Shelton soil is used mainly for woodland.

Christmas trees are grown in a few areas, mainly on the less sloping areas. Windthrow can be expected when winds are strong and the soil is saturated.

The picking of evergreen huckleberry, western swordfern, and salal is an important minor industry.

Based on a 100-year site curve, the average site index for Douglas-fir is 141 with CMAI of 146 cubic feet per acre. The site index based on a 50-year site curve is 107 with MAI of 130 cubic feet per acre at 50 years.

The main limitations for use of this soil for homesites are slope and wetness. The cemented pan, slope, and wetness are the main limitations for septic tank absorption fields.

This Shelton soil is in capability subclass VIe.

55—Shelton extremely gravelly sandy loam, 0 to 6 percent slopes. This moderately deep, moderately well drained soil is on moraines and till plains. It formed in glacial till. Mapped areas average 100 acres and are long and narrow and oriented north to south. The vegetation is conifers.

The elevation ranges from 300 to 600 feet. The average annual precipitation is 55 to 65 inches, the mean annual air temperature is about 49 degrees F, and the average frost-free season is about 170 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments. The surface layer is dark reddish brown extremely gravelly sandy loam 11 inches thick. The subsoil is dark reddish brown and dark brown extremely gravelly sandy loam 11 inches thick. The substratum is weakly-silica-cemented, very compact glacial till to a depth of 60 inches or more. Depth to the hardpan ranges from 20 to 35 inches.

Included with this soil in mapping are about 10 percent Shelton very gravelly sandy loam and about 10 percent McKenna soils. Also included are small areas of a soil similar to this Shelton soil which is over glacial sand and gravel outwash, and small, isolated pockets of Kapowsin soils.

Permeability of this Shelton soil is rapid to the cemented pan and very slow in the pan. The available water capacity is very low. The effective rooting depth is 20 to 35 inches. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 2 to 3 feet during the rainy season.

This Shelton soil is used mainly for woodland and Christmas trees. Small areas are used for pasture.

The major trees are Douglas-fir, western hemlock, and lodgepole pine. The main limitation for Christmas trees is the droughtiness. The evergreen trees grown on this soil tend to be pale unless nitrogen fertilizer is added. Windthrow can be expected when winds are strong and the soil is saturated.

Based on a 100-year site curve, the average site index for Douglas-fir is 112 with CMAI of 101 cubic feet per acre. The site index based on a 50-year site curve is 86 with MAI of 91 cubic feet per acre at 50 years.

Weed control, proper grazing, and fertilization help to maximize forage yields for pasture.

The main limitation for use of this soil for homesites is wetness. The cemented pan and wetness are the main limitations for septic tank absorption fields.

This Shelton soil is in capability subclass VIs.

56—Shelton extremely gravelly sandy loam, 6 to 15 percent slopes. This moderately deep, moderately well drained soil is on moraines and till plains. It formed in glacial till. Mapped areas average 100 acres and are long and narrow and oriented north to south. The vegetation is conifers.

The elevation ranges from 300 to 600 feet. The average annual precipitation is 55 to 65 inches, the mean annual air temperature is about 49 degrees F, and the average frost-free season is about 170 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments. The surface layer is dark reddish brown extremely gravelly sandy loam 11 inches thick. The subsoil is dark reddish brown and dark brown extremely gravelly sandy loam 11 inches thick. The substratum is weakly-silica-cemented, very compact glacial till to a depth of 60 inches or more. Depth to the hardpan ranges from 20 to 35 inches.

Included with this soil in mapping are about 10 percent Shelton very gravelly sandy loam and about 5 percent Shelton soils that have slopes of more than 15 percent or less than 6 percent. Also included are small areas of a soil similar to the Shelton soil which is over moderately cemented glacial outwash, and small, isolated pockets of Kapowsin soils.

Permeability of this Shelton soil is rapid to the cemented pan and very slow in the pan. The available water capacity is very low. The effective rooting depth is 20 to 35 inches. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 2 to 3 feet during the rainy season.

This Shelton soil is used mainly for woodland and Christmas trees. Small areas are used for pasture.

The major trees are Douglas-fir, western hemlock, and lodgepole pine. The main limitation for Christmas trees is the droughtiness of the soil. The evergreen trees grown on this soil tend to be pale unless nitrogen fertilizer is used. Windthrow can be expected when winds are strong and the soil is saturated.

Based on a 100-year site curve, the average site index for Douglas-fir is 112 with CMAI of 101 cubic feet per acre. The site index based on a 50-year site curve is 86 with MAI of 91 cubic feet per acre at 50 years.

Weed control, proper grazing, and fertilization help to maximize forage yields for pasture.

The main limitation for use of this soil for homesites is slope. The cemented pan, slope, and wetness are the main limitations for septic tank absorption fields.

This Shelton soil is in capability subclass VIe.

57—Shelton extremely gravelly sandy loam, 15 to 30 percent slopes. This moderately deep, moderately well drained soil is on moraines and till plains. It formed in glacial till. Mapped areas average 30 acres and are long and narrow and oriented north to south. The vegetation is conifers.

The elevation ranges from 300 to 600 feet. The average precipitation is 55 to 65 inches, the mean annual air temperature is about 49 degrees F, and the average frost-free season is about 170 days.

Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments. The surface layer is dark reddish brown extremely gravelly sandy loam 11 inches thick. The subsoil is dark reddish brown and dark brown extremely gravelly sandy loam 11 inches thick. The substratum is weakly-silica-cemented, very compact glacial till to a depth of 60 inches or more. Depth to the hardpan ranges from 20 to 35 inches.

Included with this soil in mapping are about 8 percent Shelton very gravelly sandy loam and about 6 percent Shelton extremely gravelly sandy loam that has slopes of more than 30 percent or less than 15 percent.

Permeability of this Shelton soil is rapid to the cemented pan and very slow in the pan. The available water capacity is very low. The effective rooting depth is 20 to 35 inches. Runoff is medium, and the hazard of water erosion is moderate. A perched water table is at a depth of 2 to 3 feet during the rainy season.

This Shelton soil is used for woodland, pasture, and Christmas trees.

This soil is suited to Douglas-fir, western hemlock, and lodgepole pine. The main limitation for Christmas trees is the droughtiness of the soil. The evergreen trees grown on this soil tend to be pale unless nitrogen fertilizer is used. Windthrow can be expected when winds are strong and the soil is saturated.

Based on a 100-year site curve, the average site index for Douglas-fir is 112 with CMAI of 101 cubic feet per acre. The site index based on a 50-year site curve is 86 with MAI of 91 cubic feet per acre at 50 years.

Weed control, proper grazing, and fertilization help to maximize forage yields for pasture.

The main limitations for use of this soil for homesites is slope and wetness. The cemented pan, slope, and wetness are the main limitations for septic tank absorption fields.

This Shelton soil is in capability subclass VIe.

58—Shelton-McKenna complex, 0 to 10 percent slopes. These soils are on moraines and till plains, in upland and terrace depressions, and along drainageways. They formed in glacial till. Mapped areas average about 100 acres and are long and narrow and oriented north to south. Native vegetation is a mixed stand of conifers and hardwoods.

The elevation ranges from 100 to 600 feet. The average annual precipitation is 55 to 65 inches, the mean annual air temperature is about 49 degrees F, and the average frost-free season is about 170 days.

This complex is about 60 percent Shelton extremely gravelly sandy loam, 0 to 10 percent slopes, and about 25 percent McKenna gravelly loam, 0 to 6 percent slopes. The soils of this complex are so intricately intermingled that it was not practical to map them separately at the scale used.

Included with this complex in mapping are small areas of Shalcar soil, and Shelton soils that have slopes of more than 10 percent.

The Shelton soil is moderately deep and moderately well drained. It formed on moraines and till plains in glacial till. Typically, the surface of this soil has a thin mat of undecomposed needles and wood fragments. The surface layer is dark reddish brown extremely gravelly sandy loam 11 inches thick. The subsoil is dark reddish brown and dark brown extremely gravelly sandy loam 11 inches thick. The substratum is weakly-silica-cemented, very compact glacial till to a depth of 60 inches or more. Depth to the hardpan ranges from 20 to 35 inches.

Permeability of this Shelton soil is rapid to the cemented pan and very slow in the pan. The available water capacity is very low. The effective rooting depth is 20 to 35 inches. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 2 to 3 feet during the rainy season.

The McKenna soil is moderately deep over compact glacial till and poorly drained. It is on uplands in low lying depressions and along drainageways. Typically, the surface layer is dark reddish brown gravelly loam about 6 inches thick. The subsoil is dark grayish brown and grayish brown very gravelly loam and very gravelly silt loam about 22 inches thick. The upper part of the substratum is mottled, grayish brown very gravelly loam about 9 inches thick. The lower part of the substratum to a depth of 60 inches is mottled, compact gravelly silty clay. Depth to the compact glacial till is 30 to 40 inches.

Permeability of this McKenna soil is slow to the compact substratum and very slow in the substratum. The available water capacity is moderate. The effective rooting depth is limited by the seasonal perched water table and depth to compact glacial till. Runoff is ponded, and water erosion is not a hazard. This soil is subject to ponding on the flatter areas during the winter months.

The soils of this complex are used for woodland, Christmas trees, and wildlife habitat.

The Shelton soil is suited to Douglas-fir, western hemlock, and lodgepole pine. Based on a 100-year site curve, the average site index for Douglas-fir is 112 with CMAI of 101 cubic feet per acre. The site index based on a 50-year site curve is 86 with MAI of 91 cubic feet per acre at 50 years.

Windthrow can be expected when winds are strong and the soil is saturated. Christmas trees tend to pale unless nitrogen fertilizer is added. The main limitation of this soil for this use is droughtiness.

The McKenna soil is used mainly for wildlife habitat. It is well suited to red alder, western redcedar and western hemlock. Based on a 50-year site curve, the average site index for red alder is 90 with CMAI of 101 cubic feet per acre.

This soil provides ideal habitat for such waterfowl as mallard, pintail, and wood ducks. Seeding of water-tolerant plants helps to improve the habitat for wetland wildlife.

The main limitation for use of the Shelton soil for homesites is wetness. The cemented pan, slope, and wetness are the main limitations for septic tank absorption fields.

The main limitation for use of the McKenna soil for homesites is wetness and ponding. Restricted permeability is also a limitation for septic tank absorption fields.

The soils of this complex are in capability subclass VIw.

59—Sinclair very gravelly sandy loam, 2 to 8 percent slopes. This moderately deep, moderately well drained soil is on till plains. It formed in glacial till. Mapped areas are somewhat block-shaped and average about 50 acres. Native vegetation is mainly conifers.

The elevation ranges from 0 to 500 feet. The average annual precipitation is 30 to 40 inches, the mean annual air temperature is about 51 degrees F, and the average frost-free season is about 200 days.

Typically, the surface layer after mixing is grayish brown very gravelly sandy loam about 8 inches thick. The subsoil is yellowish brown very gravelly sandy loam 17 inches thick. The substratum to a depth of 60 inches is weakly-silica-cemented, very compact glacial till. Depth to the hardpan ranges from 20 to 30 inches.

Included with this soil in mapping are as much as 10 percent Poulsbo soils, and about 5 percent Sinclair soils that have slopes of more than 8 percent.

Permeability of this Sinclair soil is moderately rapid above the hardpan and very slow in the pan. The available water capacity is low. The effective rooting depth is 20 to 30 inches. Occasional fractures allow root penetration to 40 inches. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 1.5 to 2.5 feet during the rainy season.

This Sinclair soil is used mainly for woodland. Small areas are used for hay and pasture.

This soil is suited to Douglas-fir, western hemlock, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 136 with CMAI of 139 cubic feet per acre. The site index based on a 50-year site curve is 103 with MAI of 123 cubic feet per acre at 50 years.

Windthrow can be expected when winds are strong and the soil is saturated.

Hay and pasture production is fair if practices that maintain soil tilth and fertility are used. Proper grazing practices, weed control, and supplemental irrigation increase forage yields.

The main limitation for use of this soil for homesites is wetness. Depth to the cemented pan and wetness are the main limitations for septic tank absorption fields.

This Sinclair soil is in capability subclass IVe.

60—Sinclair very gravelly sandy loam, 8 to 15 percent slopes. This moderately deep, moderately well drained soil is on till plains. It formed in glacial till. Mapped areas are somewhat block-shaped and average about 30 acres. Native vegetation is mainly conifers.

The elevation ranges from 0 to 500 feet. The average annual precipitation is 30 to 40 inches, the mean annual air temperature is about 51 degrees F, and the average frost-free season is about 200 days.

Typically, the surface layer after mixing is grayish brown very gravelly sandy loam about 8 inches thick. The subsoil is yellowish brown very gravelly sandy loam 17 inches thick. The substratum to a depth of 60 inches is weakly-silica-cemented, very compact glacial till. Depth to the hardpan ranges from 20 to 30 inches.

Included with this soil in mapping are as much as 10 percent Poulsbo soils, and about 5 percent Sinclair soils that have slopes of more than 15 percent or less than 8 percent.

Permeability of this Sinclair soil is moderately rapid above the hardpan and very slow in the pan. The available water capacity is low. The effective rooting depth is 20 to 30 inches. Occasional fractures allow root penetration to 40 inches. Runoff is slow, and the hazard of water erosion is moderate. A perched water table is at a depth of 1.5 to 2.5 feet during the rainy season.

This Sinclair soil is used mainly for woodland. Small areas are used for hay and pasture.

This soil is suited to Douglas-fir, western hemlock, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 136 with CMAI of 139 cubic feet per acre. The site index based on a 50-year site curve is 103 with MAI of 123 cubic feet per acre at 50 years.

During periods of heavy rainfall, a perched water table is at a shallow depth for a short time. Trees are subject to windthrow when winds are strong and the soil is saturated.

Hay and pasture production is fair if practices that maintain soil tilth and fertility are used. Proper grazing practices, weed control, and supplemental irrigation increase forage yields.

The main limitations for use of this soil for homesites are wetness and slope. Depth to the cemented pan and wetness are the main limitations for septic tank absorption fields.

This Sinclair soil is in capability subclass IVe.

61—Sinclair very gravelly sandy loam, 15 to 30 percent slopes. This moderately deep, moderately well drained soil is on till plains. It formed in glacial till. Mapped areas are somewhat block-shaped and average about 30 acres. Native vegetation is mainly conifers.

The elevation ranges from 0 to 500 feet. The average annual precipitation is 30 to 40 inches, the mean annual air temperature is about 51 degrees F, and the average frost-free season is about 200 days.

Typically, the surface layer after mixing is grayish brown very gravelly sandy loam about 8 inches thick. The subsoil is yellowish brown very gravelly sandy loam 17 inches thick. The substratum to a depth of 60 inches is weakly-silica-cemented, very compact glacial till. Depth to the hardpan ranges from 20 to 30 inches.

Included with this soil in mapping are as much as 8 percent Poulsbo soils, and about 5 percent Sinclair soils that have slopes of more than 30 percent or less than 15 percent.

Permeability of this Sinclair soil is moderately rapid above the hardpan and very slow in the pan. The available water capacity is low. The effective rooting depth is 20 to 30 inches. Occasional fractures allow root penetration to 40 inches. Runoff is medium, and the hazard of water erosion is severe. A perched water table is at a depth of 1.5 to 2.5 feet during the rainy season.

This Sinclair soil is used mainly for woodland. Some small areas are used for hay and pasture.

This soil is suited to Douglas-fir, western hemlock, and red alder. Based on a 100-year site curve, the average site index for Douglas-fir is 136 with CMAI of 139 cubic feet per acre. The site index based on a 50-year site curve is 103 with MAI of 123 cubic feet per acre at 50 years.

During periods of heavy rainfall, a perched water table is at a shallow depth for a short time. Trees are subject to windthrow when winds are strong and the soil is saturated.

Production of pasture and hay is fair if practices that maintain soil tilth and fertility are used. Proper grazing practices, weed control, and supplemental irrigation increase forage yields.

The main limitations for use of this soil for homesites are slope and wetness. Depth to the cemented pan, wetness, and slope are the main limitations for septic tank absorption fields.

This Sinclair soil is in capability subclass IVe.

62—Tacoma silt loam. This deep, very poorly drained soil is on deltas. It formed in alluvium and organic material. Slopes are 0 to 1 percent. The vegetation is grass and sedges.

The elevation ranges from 0 to 20 feet. The average annual precipitation is 35 to 60 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

Typically, the surface layer is very dark grayish brown silt loam 6 inches thick. The upper part of the underlying material is stratified, very dark grayish brown, dark grayish brown, and dark brown loam, silty clay loam, and very fine sandy loam about 30 inches thick. The lower part of the underlying material to a depth of 60 inches is olive gray very gravelly coarse sand. In some places thin organic lenses occur at various depths.

Permeability of this Tacoma soil is moderately slow. The available water capacity is high. The effective rooting depth is limited by a seasonal high water table which is at a depth of 0 to 2 feet during the rainy season. Runoff is slight, and water erosion is not a hazard. This soil is frequently flooded for brief to very long periods throughout the year.

This Tacoma soil is used mainly for wildlife habitat. Some areas are diked and drained and used for improved pasture.

Seeding water-tolerant plants helps to improve the wildlife habitat.

This soil is poorly suited to homesites because of wetness and flooding. Flooding, wetness, and restricted permeability are the main limitations for septic tank absorption fields.

This Tacoma soil is in capability subclass IVw.

63—Urban land-Alderwood complex, 0 to 8 percent slopes. This complex is on beaches and low terraces on broad uplands. The Alderwood soils formed in glacial till. Native vegetation is mainly conifers and hardwoods.

The elevation ranges from 0 to 200 feet. The average annual precipitation is 40 to 55 inches, the mean annual air temperature is about 50 degrees F, and the average frost-free season is about 180 days.

This complex is about 70 percent Urban land and 20 percent Alderwood very gravelly sandy loam, 0 to 6 percent slopes. The components of this complex are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this complex are small areas of Alderwood soil that has slopes of more than 8 percent and Dystric Xerorthents, 45 to 70 percent slopes.

Urban land is land covered by streets, parking lots, buildings, and other structures typical of urban areas.

The Alderwood soil is moderately deep and moderately well drained. Typically, the surface of this soil is covered by a thin mat of undecomposed needles and wood fragments. The subsurface layer is brown very gravelly sandy loam about 1/2 inch thick. The subsoil is brown very gravelly loam about 21 inches thick. The substratum to a depth of 60 inches or more is grayish brown gravelly sandy loam that is weakly-silica-cemented in the upper part. Depth to the silica-cemented hardpan ranges from 20 to 40 inches.

Permeability of this Alderwood soil is moderately rapid above the hardpan and very slow in the pan. The available water capacity is low. The effective rooting depth ranges from 20 to 40 inches. Matting of the roots directly above the hardpan is common. Runoff is slow, and the hazard of water erosion is slight. A perched water table is at a depth of 2.5 to 3 feet during the rainy season in winter and spring.

The soils in this complex are used mainly for urban development. The main limitations of the Alderwood soil for this use are the depth to the cemented hardpan and the seasonal perched water table. In areas of moderate and high population density, onsite sewage disposal systems often fail or do not function properly during periods of high rainfall because of these limitations.

Topsoil needs to be stockpiled and subsequently used to cover the excavated material.

The soils in this complex are in capability subclass IVe.

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss. Supplemental irrigation is used by many farmers during dry periods in summer. The proper interval between irrigations can be determined by frequent checks of soil moisture in the field.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops (*14*). Crops that require special management are excluded.

The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

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

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

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

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation. The capability subclass is identified in the description of each soil map unit in the section "Detailed soil map units."

woodland management and productivity

Robert J. Olson, State woodland specialist, Soil Conservation Service, helped prepare this section.

The soils of the Kitsap County Area are predominantly used for woodland. Because of the proximity of densely populated areas and of the waters of Puget Sound, the use of these soils for timber production is decreasing. Recreation use and urban development have rapidly increased, and have had an adverse effect on timber production and on the floral greenery industry.

Douglas-fir is the dominant species and productivity is good. Red alder is common in moist areas and disturbed areas. Western redcedar is present in depressional areas. Western hemlock, bigleaf maple, and Pacific madrone are often part of the stand, but in minor and varying amounts. Lodgepole pine is common in the southwestern part of the survey area. Because of the geologic formation of this area, slight variations in elevation result in different soils and different vegetation. Rate of timber production also changes with altitude.

Table 6 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for common trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 6, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted or become established during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that a few trees may be blown down by normal winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

Ratings of *plant competition* indicate the degree to which undesirable plants are expected to invade where there are openings in the tree canopy. The invading plants compete with native plants or planted seedlings. A rating of *slight* indicates little or no competition from other plants; *moderate* indicates that plant competition is expected to hinder the development of a fully stocked stand of desirable trees; *severe* indicates that plant competition is expected to prevent the establishment of a desirable stand unless the site is intensively prepared, weeded, or otherwise managed to control undesirable plants.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index for Douglas-fir and red alder listed in table 6 is based on a 50-year site curve (*5, 18*). The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production. Also listed, in some cases, are species suitable for natural reforestation.

woodland understory vegetation

Kitsap County has long been famous for production of floral greenery. The Puget Sound climate and the soils of this area result in excellent production of high quality greenery. Floral greenery, such as western swordfern, evergreen huckleberry, and salal are a part of the forest understory. Management of the forest overstory is important in floral greenery production.

Understory vegetation consists of grasses, forbs, shrubs, and other plants. The quantity and quality of understory vegetation vary with the kind of soil, the age and kind of trees in the canopy, the density of the canopy, and the depth and condition of the litter. The density of the canopy determines the amount of light that understory plants receive.

Table 7 shows, for each soil suitable for woodland use, the potential for producing understory vegetation for floral greenery. Table 7 also lists the common names of the characteristic vegetation on each soil and the percentage incidence, by visual observation, of each kind of plant. The table shows the kind and percentage of understory plants expected under a canopy density that is most nearly typical of woodland in which the production of wood crops is highest.

recreation

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

wildlife habitat

C. B. Clement, Jr., biologist, Soil Conservation Service, assisted in preparing this section.

Kitsap County, part of the Kitsap Peninsula, is bordered on the west by Hood Canal and on the east and north by Puget Sound. Kitsap County Area has hundreds of miles of saltwater shoreline and thousands of acres of tideland. Most of this land is privately owned, but there are numerous public parks and beach access points.

Salt water habitat is an important part of the wildlife and fisheries resources of the Kitsap County Area. Oysters, clams, and crabs are found on the tidelands. Many kinds of shore birds and waterfowl, such as great blue heron, killdeer, plovers, sandpipers, gulls, brant geese, and mallard and wigeon ducks, are in this area.

Second growth timber stands of Douglas-fir and red alder, with intermixed lodgepole pine, bigleaf maple, cottonwood, dogwood, western redcedar, and Pacific madrone, make up the woodland that covers most of the county area. The understory is salal, oregon-grape, huckleberry, and rhododendron. Such wildlife as black-tailed deer, bobcat, coyote, mountain beaver, ruffed grouse, owls, and woodpeckers are in this woodland habitat.

Numerous small farms and "mini farms" cleared from the woodland grow mainly pasture or hay crops, such as reed canarygrass, orchardgrass, fescue, and clover. A small acreage is in wheat and corn. Most of these crops are used to feed dairy cows or beef cattle. These areas support openland wildlife, such as pheasant, California quail, and rabbits.

Many small lakes and ponds are used for both trout and warm-water fishing. Many of the streams that run into Hood Canal and Puget Sound once supported large runs of salmon and sea run cutthroat trout. Although many runs have been severely reduced or eliminated, some streams still produce moderate numbers of anadromous fish.

Because of the existence of large and expanding naval support facilities in Kitsap County and the proximity of the Seattle metropolitan area, there has been an explosion of urban, suburban, and recreational development. The result has been the elimination and degradation of terrestrial and aquatic habitat. Management of this development is a determining factor in the future quality of wildlife and fisheries resources of the Kitsap County Area.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, orchardgrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are brackenfern, western swordfern, lupine, thistle, and dandelion.

Coniferous plants are cone-bearing trees and associated deciduous trees, shrubs, or ground cover plants that furnish browse, seeds, buds, catkins, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of these plants are Douglas-fir, Sitka-spruce, western hemlock, western redcedar, bigleaf maple, dogwood, Pacific madrone, and huckleberry.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are salmonberry, Oregon-grape, salal, and red elderberry.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, rushes, sedges, and cattails.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include California quail, pheasant, meadowlark, robin, crow, killdeer, and rabbit.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include ruffed grouse, band-tailed pigeons, thrushes, woodpeckers, tree squirrels, black-tailed deer, and black bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, kingfishers, muskrat, mink, otter, and beaver.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology;

(6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, and depth to a high water table affect the traffic supporting capacity.

sanitary facilities

Table 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface (*16*). There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, and terraces and diversions.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory testing. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution and plasticity.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*). Both systems are described in the PCA Soil Primer (*8*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The estimated classification, without group index numbers, is given in table 14.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms (*13*).

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Cemented pans are cemented or indurated subsurface layers within a depth of 5 feet. Such pans cause difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence results from either dessication and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 16 shows the expected initial subsidence, which usually is a result of drainage, and annual subsidence, which usually is a result of oxidation.

Not shown in the table is subsidence caused by an imposed surface load or by the withdrawal of ground water throughout an extensive area as a result of lowering the water table.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*15*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 17, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Inceptisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ochrept (*Ochr*, meaning pale, plus *ept*, from Inceptisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Durochrepts (*Dur*, meaning duripan plus *ochrept*, the suborder of the Inceptisols have a pale color).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. An example is Dystric Entic Durochrepts. Dystric infers low base saturation and Entic infers weak expression of the duripan.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is loamy-skeletal, mixed, mesic Dystric Entic Durochrepts.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series. An example is the Alderwood series, which is classified as loamy-skeletal, mixed, mesic Dystric Entic Durochrepts.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*12*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*15*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Alderwood series

The Alderwood series consists of moderately deep, moderately well drained soils that formed in glacial till. Alderwood soils are on uplands and have slopes of 0 to 30 percent. The average annual precipitation is 40 to 55 inches and the mean annual air temperature is about 50 degrees F.

Typical pedon of Alderwood very gravelly sandy loam, 0 to 6 percent slopes, 2,400 feet east and 200 feet north of the southwest corner of sec. 28, T. 24 N., R. 2 E.

O1—1 to 1/2 inch; needles, leaves, bark, and wood fragments.
O2—1/2 inch to 0; black (10YR 2/1) partially decomposed needles, leaves, and wood fragments, dark gray (10YR 4/1) dry; abrupt smooth boundary.
A2—0 to 1/2 inch; brown (10YR 5/3) very gravelly sandy loam, neutral (N 8/0) dry; weak fine granular structure; soft, very friable; common coarse, medium, and fine roots; 40 percent pebbles and iron concretions; medium acid; abrupt smooth boundary.
B2cn—1/2 inch to 22 inches; brown (10YR 4/3) very gravelly loam, yellowish brown (10YR 5/4) dry; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common coarse, medium, and fine roots; 40 percent pebbles and iron concretions; medium acid; abrupt wavy boundary.
Csim—22 to 60 inches; grayish brown (2.5Y 5/2) gravelly sandy loam, light brownish gray (2.5Y 6/2) dry; massive; weakly-silica-cemented; very hard, extremely firm; medium acid.

Depth to the weakly-silica-cemented Csim horizon ranges from 20 to 40 inches. Content of rock fragments in the control section averages 35 to 45 percent.

The A2 horizon has hue of 10YR, 2.5Y, or neutral; value of 4 or 5 moist and 5 through 8 dry; and chroma of 0 through 3. The A2 horizon is as thick as 1 inch. It is lacking in some pedons. An A1 horizon, 1 to 2 inches thick, is present in some pedons.

The B horizon has hue of 10YR or 7.5YR, value of 4 through 6, and chroma of 3 or 4 moist. It is very gravelly loam or very gravelly sandy loam.

The Csim horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 2 or 3.

Belfast series

The Belfast series consists of deep, moderately well drained soils that formed in stratified alluvium. The nearly level Belfast soils are on flood plains and have slopes of 0 to 2 percent. The average annual precipitation is 50 to 70 inches and the mean annual air temperature is about 50 degrees F.

Typical pedon of Belfast loam, 2,200 feet east and 1,800 feet north of the southwest corner of sec. 3, T. 23 N., R. 1 W.

A1—0 to 5 inches; very dark brown (10YR 2/2) loam, grayish-brown (2.5Y 5/2) dry; weak fine granular structure; soft, very friable, nonsticky and slightly plastic; many fine roots; medium acid; abrupt wavy boundary.
C1—5 to 11 inches; olive (5Y 5/3) fine sandy loam, grayish brown (2.5Y 5/2) dry; massive; soft, very friable, nonsticky and slightly plastic; many fine roots; medium acid; abrupt wavy boundary.
C2—11 to 22 inches; olive gray (5Y 5/2) fine sandy loam, light gray (2.5Y 7/2) dry; massive; soft, very friable, nonsticky and slightly plastic; common fine roots; iron stains in root channels; medium acid; abrupt wavy boundary.
C3—22 to 50 inches; dark brown (10YR 3/3) fine sandy loam, brown (10YR 5/3) dry; common medium distinct iron stains; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; medium acid; abrupt smooth boundary.
C4—50 to 64 inches; dark yellowish brown (10YR 4/4) silt loam, pale brown (10YR 6/3) dry; many medium distinct strong brown (7.5YR 5/8) mottles; massive; hard, very friable, slightly sticky and slightly plastic; medium acid.

Content of rock fragments in the control section ranges from 5 to 15 percent.

The A or Ap horizon has hue of 10YR or 2.5Y and value and chroma of 2 or 3.

The upper part of the C horizon has hue of 5Y through 10YR. It is loam or fine sandy loam. Some pedons have dark brown stains in root channels. The lower part of the C horizon has hue of 10YR through 5Y, value of 3 through 5 moist, and chroma of 3 or 4 moist or dry. Some pedons have strong brown mottles below a depth of 50 inches. The lower part of the C horizon is stratified silt loam, loam, fine sandy loam, and sandy loam. Thin strata of gravel are present in some pedons.

Bellingham series

The Bellingham series consists of deep, poorly drained soils that formed in mixed alluvium. Bellingham soils are on valley floors and have slopes of 0 to 3 percent. The average annual precipitation is 35 to 60 inches and the mean annual air temperature is about 50 degrees F.

Typical pedon of Bellingham silty clay loam, 50 feet west and 1,300 feet north of the southeast corner of sec. 10, T. 23 N., R. 1 E.

Ap—0 to 8 inches; very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; common fine distinct grayish brown (2.5Y 5/2) mottles; moderate coarse granular structure; hard, friable, sticky and plastic; many fine roots; many coarse tubular pores; medium acid; abrupt smooth boundary.
B21g—8 to 24 inches; grayish brown (2.5Y 5/2) silty clay, light gray (5Y 7/1) dry; many fine distinct yellowish red (5YR 4/6) mottles; moderate coarse prismatic structure; very hard, firm, sticky and plastic; few fine roots; common large tubular pores; continuous pressure faces on peds; slightly acid; abrupt smooth boundary.
B22g—24 to 60 inches; grayish brown (2.5Y 5/2) silty clay, light gray (5Y 7/1) dry; many medium distinct yellowish red (5YR 4/6) and light gray (5Y 7/1) mottles; weak coarse prismatic structure; hard, firm,

sticky and plastic; common medium tubular and interstitial pores; slightly acid.

The Ap horizon has value of 2 or 3 moist and 4 or 5 dry and chroma of 1 or 2 moist or dry.

The B21g horizon has value of 5 through 7 and chroma of 1 or 2. It contains many yellowish red (5YR 4/6) and gray (5/Y 5/1) mottles. The B22g horizon has hue of 2.5Y, 5Y, 5GY or 5BG; value of 4 through 6; and chroma of 1 or 2. It contains common to many yellowish red (5YR 4/6) or strong brown (7.5YR 5/8) mottles.

Cathcart series

The Cathcart series consists of deep, moderately well drained soils that formed in glacial drift over weathered siltstone. Cathcart soils are on glaciated uplands and have slopes of 2 to 30 percent. The average annual precipitation is 40 to 50 inches and the mean annual air temperature is about 49 degrees F.

Typical pedon of Cathcart silt loam, 8 to 15 percent slopes, 1,500 feet east and 5 feet north of the southwest corner of sec. 9, T. 24 N., R. 2 E.

Ap—0 to 9 inches; dark brown (7.5YR 3/2) silt loam, light brownish gray (2.5Y 6/2) dry; moderate fine angular blocky structure; soft, friable, slightly sticky and slightly plastic; many fine roots; 5 percent pebbles; very strongly acid; abrupt smooth boundary.

B21—9 to 14 inches; dark yellowish brown (10YR 4/4) loam, light brownish gray (2.5Y 6/2) dry; moderate fine angular blocky structure; slightly hard, friable, sticky and plastic; weakly smeary; common fine roots; 10 percent pebbles; pressure faces on peds; very strongly acid; gradual wavy boundary.

B22—14 to 38 inches; yellowish brown (10YR 5/4) loam, pale yellow (2.5Y 7/4) dry; strong fine angular blocky structure; slightly hard, firm, sticky and plastic; weakly smeary; common fine roots; 65 percent weathered siltstone fragments; pressure faces on peds; very strongly acid; gradual wavy boundary.

C—38 to 60 inches; pale yellow (2.5Y 7/4) clay loam, white (2.5Y 8/2) dry; strong brown (7.5YR 5/8) stain coatings on peds and fractured soft siltstone fragments; strong thin platy structure; hard, firm; few fine roots along fractures to a depth of 48 inches; continuous pressure faces on peds; 65 percent fractured soft siltstone; very strongly acid.

Depth to the siltstone ranges from 40 to more than 60 inches.

The Ap horizon has hue of 7.5YR or 10YR, value of 2 or 3 moist and 4 through 6 dry, and chroma of 2 or 3 moist or dry. The Ap horizon contains 5 to 20 percent pebbles and soft siltstone chips.

The B horizon has value of 3 through 5 moist and 5 through 7 dry and chroma of 2 through 4 moist or dry. It has less than 10 percent pebbles and 10 to 65 percent soft siltstone fragments. The B horizon is loam or silt loam. Some pedons are mottled in the lower part of the B horizon.

The C horizon has hue of 2.5Y, 5Y, or 10YR; value of 5 through 7; and chroma of 4 and 5. It consists of more than 60 percent fractured soft siltstone.

Grove series

The Grove series consists of deep, somewhat excessively drained soils that formed in glacial outwash. Grove soils are on outwash plains and terraces and have slopes of 0 to 30 percent. The average annual precipitation is 55 to 70 inches and the mean annual air temperature is about 50 degrees F.

Typical pedon of Grove very gravelly sandy loam, 0 to 3 percent slopes (fig. 8), 1,100 feet east and 300 feet north of the southwest corner of sec. 5, T. 24 N., R. 1 W.

Figure 8.—A profile of Grove very gravelly sandy loam, 0 to 3 percent slopes.

O1—1 to 1/2 inch; needles, leaves, bark, and wood fragments.
O2—1/2 inch to 0; black (10YR 2/1) partially decomposed needles, leaves, and wood fragments, dark gray (10YR 4/1) dry; abrupt smooth boundary.
A1—0 to 2 inches; dark grayish brown (10YR 4/2) very gravelly sandy loam, brown (10YR 5/3) dry; weak fine granular structure; soft, very friable; many coarse, medium, and fine roots; 40 percent pebbles; strongly acid; clear smooth boundary.
B21ir—2 to 12 inches; brown (7.5YR 4/4) very gravelly sandy loam, light brown (7.5YR 6/4) dry; massive; soft, very friable; loose; many coarse, medium, and fine roots; 50 percent pebbles and concretions, silt coated; strongly acid; clear smooth boundary.
B22ir—12 to 17 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brownish yellow (10YR 6/6) dry; massive; soft, very friable; loose; many coarse, medium, and fine roots; 60 percent pebbles, silt coated; strongly acid; clear smooth boundary.
B3—17 to 30 inches; brown (10YR 4/3) extremely gravelly loamy sand, light yellowish brown (2.5Y 6/4) dry; single grain; loose; many medium and fine roots; 65 percent pebbles; strongly acid; abrupt smooth boundary.
C—30 to 60 inches; olive gray (5Y 4/2) very gravelly sand; single grain; loose; few fine roots; 40 percent pebbles; medium acid.

Content of rock fragments in the control section ranges from 55 to 75 percent.

The A1 horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma 2 or 3. Some pedons lack an A1 horizon, and some pedons have a trace of an A2 horizon.

The B2ir horizon has hue of 5YR or 7.5YR, value of 3 through 6 moist and 5 or 6 dry, and chroma of 3 or 4 moist and 4 through 6 dry. Pebbles and concretions are silt coated.

The C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 2 or 3. It is very gravelly loamy sand or very gravelly sand.

Harstine series

The Harstine series consists of moderately deep, moderately well drained soils that formed in glacial till. Harstine soils are on uplands and have slopes of 0 to 45 percent. The average annual precipitation is 35 to 55 inches and the mean annual air temperature is about 51 degrees F.

Typical pedon of Harstine gravelly sandy loam, 0 to 6 percent slopes (fig. 9), 100 feet south and 1,500 feet west of the northeast corner of sec. 28, T. 25 N., R. 2 E.
O1—2 inches to 1 inch; twigs and needles; very strongly acid (pH 4.8); abrupt wavy boundary.
O2—1 inch to 0; decayed needles; very strongly acid (pH 4.8); abrupt wavy boundary.

Figure 9.—A profile of Harstine gravelly sandy loam, 0 to 6 percent slopes. The hardpan prevents normal root penetration.

A1—0 to 1/2 inch; very dark grayish brown (10YR 3/2) gravelly sandy loam, light brownish gray (2.5Y 6/2) dry; weak fine granular structure; soft, very friable; many roots; very strongly acid; abrupt smooth boundary.
B21—1/2 inch to 14 inches; brown (10YR 4/3) gravelly sandy loam, light yellowish brown (2.5Y 6/4) dry; weak fine granular structure; soft, very friable; many fine roots; strongly acid; gradual wavy boundary.
B22—14 to 26 inches; dark yellowish brown (10YR 4/4) gravelly sandy loam, pale yellow (2.5Y 7/4) dry; weak fine granular structure; soft, very friable; many fine roots; strongly acid; clear wavy boundary.
B23—26 to 32 inches; dark yellowish brown (10YR 4/4) gravelly sandy loam, pale yellow (2.5Y 7/4) dry; weak fine granular structure; soft, very friable; many fine roots; strongly acid; abrupt smooth boundary.
C1sim—32 to 37 inches; grayish brown (2.5Y 5/2) gravelly loamy sand, light brownish gray (10YR 6/2) dry; weakly cemented, hard; few fine roots in fractures; medium acid; gradual wavy boundary.

C2—37 inches; compact, weakly cemented glacial till, many feet thick.

Depth to the cemented Csim horizon is 25 to 40 inches. Content of rock fragments ranges from 15 to 35 percent. Some pedons have a trace of an A2 horizon and faint mottles in the lower part of the B2 horizon.

The B horizon has hue of 10YR or 7.5YR, value of 3 or 4 moist and 5 through 7 dry, and chroma of 3 or 4 moist or dry.

The Csim horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 2 through 4. In some pedons the Csim horizon has mottles along fractures.

Indianola series

The Indianola series consists of deep, somewhat excessively drained soils that formed in sandy glacial outwash. Indianola soils are on eskers and kames on broad uplands and have slopes of 0 to 70 percent. The average annual precipitation is 30 to 55 inches and the mean annual air temperature is about 50 degrees F.

Typical pedon of Indianola loamy sand, 0 to 6 percent slopes, 900 feet north and 600 feet west of the southeast corner of sec. 36, T. 24 N., R. 1 E.

O1—1/2 inch to 0; undecomposed needles, twigs, leaves, and bark; medium acid.

B21ir—0 to 7 inches; dark brown (7.5YR 3/4) loamy sand, brownish yellow (10YR 6/6) dry; weak fine subangular blocky structure; soft, very friable; many fine roots; medium acid; clear smooth boundary.

B22ir—7 to 18 inches; dark yellowish brown (10YR 4/4) loamy sand, light yellowish brown (2.5Y 6/4) dry; weak fine subangular blocky structure; soft, very friable; many fine roots; medium acid; clear smooth boundary.

B3—18 to 29 inches; dark yellowish brown (10YR 4/4) loamy sand, pale yellow (2.5Y 7/4) dry; single grain; loose; many fine roots; medium acid; clear smooth boundary.

C1—29 to 57 inches; olive brown (2.5Y 4/4) sand, pale yellow (5Y 8.4) dry; single grain; loose; many fine roots; medium acid; gradual smooth boundary.

C2—57 to 72 inches; dark grayish brown (2.5Y 4/2) sand, pale yellow (2.5Y 7/4) dry; single grain; loose; few fine roots; medium acid.

The content of rock fragments is less than 15 percent. Some pedons have a thin, dark A1 horizon.

The Bir horizon has hue of 10YR or 7.5YR, value of 3 or 4 moist, and chroma of 3 or 4. It is loamy sand or sand.

The C horizon has hue of 2.5Y or 5 Y, value of 4 through 6, and chroma of 2 through 4. It is loamy fine sand or sand.

Kapowsin series

The Kapowsin series consists of moderately deep, moderately well drained soils that formed in glacial till (fig. 10). Kapowsin soils are on broad uplands and

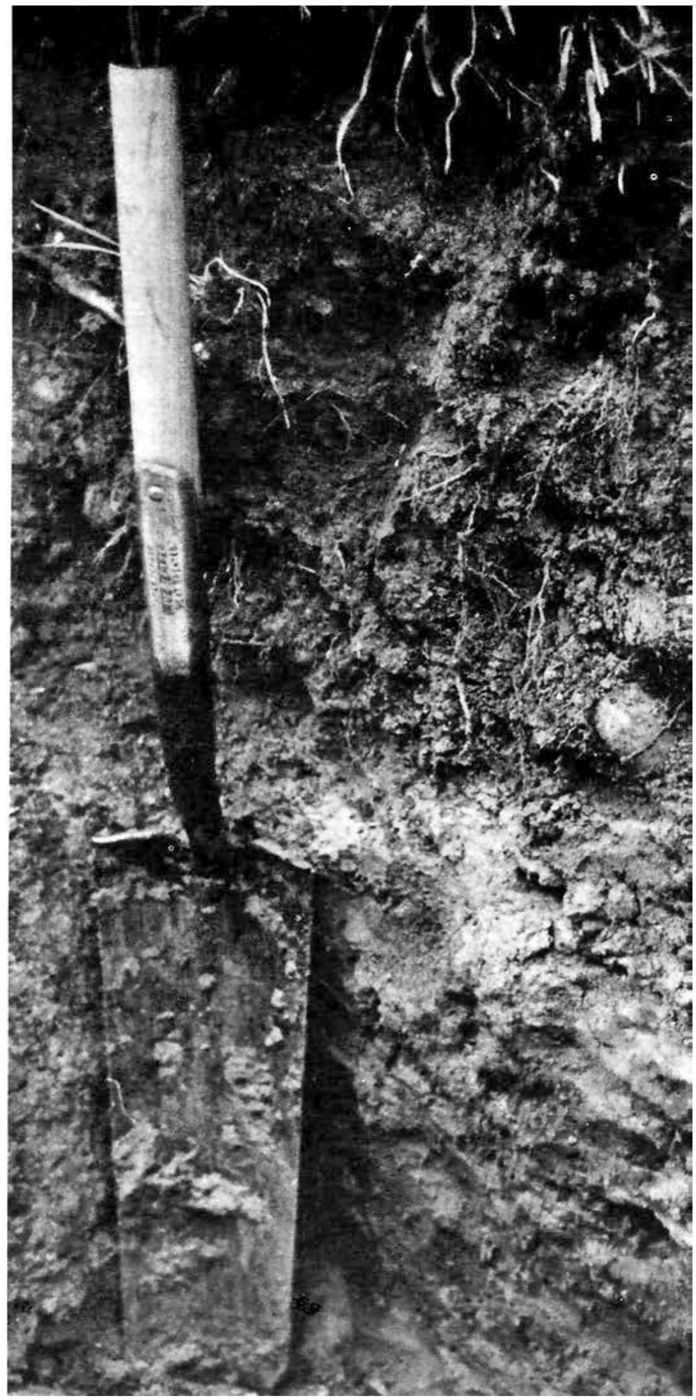

Figure 10.—A profile of Kapowsin gravelly loam, 6 to 15 percent slopes.

terraces and have slopes of 0 to 15 percent. The average annual precipitation is 30 to 45 inches and the mean annual air temperature is about 50 degrees F.

Typical pedon of Kapowsin gravelly loam, 0 to 6 percent slopes, 2,100 feet east and 1,300 feet south of the northwest corner of sec. 12. T. 25 N., R. 1 E.

A1—0 to 5 inches; dark brown (7.5YR 3/2) gravelly loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; loose, friable, nonsticky and nonplastic; many fine roots; many hard, dark brown concretions, 2 to 5 millimeters; 10 percent gravel, few cobbles; medium acid; abrupt smooth boundary.

B2cn—5 to 19 inches; brown (7.5YR 4/4) gravelly loam, pale brown (10YR 6/3) dry; weak fine subangular blocky structure; soft, friable, nonsticky and slightly plastic; common fine roots; many hard, dark brown concretions, 2 to 5 millimeters; medium acid; gradual smooth boundary.

B3—19 to 23 inches; dark yellowish brown (10YR 4/4) gravelly loam, pale yellow (2.5Y 7/4) dry; weak fine subangular blocky structure; soft, friable, nonsticky and slightly plastic; common fine roots; medium acid; abrupt smooth boundary.

Csim—23 to 60 inches; olive brown (2.5Y 4/4, rubbed) gravelly loam, white (5Y 8/1) dry; common medium distinct strong brown (7.5YR 5/8) mottles; weakly cemented; hard, very firm; breaks into medium, rough plates; slightly acid.

A few stones and cobbles occur throughout the soil. Depth to the Csim horizon ranges from 20 to 32 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 or 3. Some pedons lack an A horizon.

The B horizon has hue of 7.5YR or 10YR, value of 3 through 5 moist and 5 through 7 dry, and chroma of 3 or 4 moist or dry. Some pedons have mottles in the lower part of the B horizon. The B horizon is gravelly loam or gravelly sandy loam.

Kapowsin Variant

The Kapowsin Variant consists of moderately deep, moderately well drained soils that formed in thin lacustrine sediment over glacial till. Kapowsin Variant soils are on low terraces and have slopes of 0 to 5 percent. The average annual precipitation is 40 to 50 inches and the mean annual air temperature is about 51 degrees F.

Typical pedon of Kapowsin Variant gravelly clay loam, 0 to 5 percent slopes, 1,200 feet east and 800 feet south of the northwest corner of sec. 4, T. 24 N., R. 1 E.

O1—1 to 1/2 inch; twigs and needles; abrupt smooth boundary.

O2—1/2 inch to 0; decayed needles, leaves, and wood fragments; abrupt smooth boundary.

A1—0 to 7 inches; dark reddish brown (5YR 3/2) gravelly clay loam, light brownish gray (10YR 6/2) dry; strong fine granular structure; hard, friable, sticky and plastic; many coarse, medium, and fine roots; 15 percent hard, dark brown concretions, 2 to 5 millimeters; medium acid; abrupt smooth boundary.

B21—7 to 13 inches; brown (10YR 4/3) gravelly silty clay loam, very pale brown (10YR 7/3) dry; moderate fine subangular blocky structure; slightly hard, friable, sticky and plastic; many coarse, medium, and fine roots; 20 percent pebbles, many concretions, 2 to 5 millimeters; medium acid; clear smooth boundary.

B22—13 to 20 inches; brown (10YR 5/3) gravelly silty clay loam, light brownish gray (2.5Y 6/2) dry; common medium distinct gray (5Y 6/1) and strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; many coarse, medium, and fine roots; 25 percent pebbles; medium acid; abrupt smooth boundary.

C1sim—20 to 24 inches; yellowish brown (10YR 5/4) gravelly loam, light brownish gray (2.5Y 6/2) dry; common medium distinct light gray (2.5Y 7/2) and strong brown (7.5YR 5/8) mottles; strong medium platy structure; weakly-silica-cemented; very hard, very firm; few fine roots along fractures; 30 percent pebbles; medium acid.

C2sim—24 to 60 inches; dark grayish brown (2.5Y 4/2) gravelly loam, light gray (2.5Y 7/2) dry; massive; compact and weakly cemented in places.

Depth to the weakly-silica-cemented Csim horizon is 20 to 35 inches. The content of rock fragments ranges from 10 to 30 percent.

The A1 horizon has hue of 5YR or 10YR, value of 2 or 3, and chroma of 2 or 3.

The B horizon has hue of 7.5YR or 10YR, value of 3 through 5, and chroma of 2 through 4. It is loam, silt loam, silty clay loam, gravelly silt loam, or gravelly silty clay loam.

The upper part of Csim horizon has hue of 2.5Y, 5Y, or 10YR moist and 2.5Y or 5Y dry; value of 5 or 6 moist or dry; and chroma of 3 or 4 moist. It is gravelly loam or gravelly silt loam and is weakly cemented to moderately cemented.

Kilchis series

The Kilchis series consists of shallow, well drained soils that formed in material weathered from basalt. Kilchis soils are on ridge crests and side slopes and have slopes of 15 to 70 percent. The average annual precipitation is 65 to 80 inches and the mean annual air temperature is about 47 degrees F.

Typical pedon of Kilchis very gravelly sandy loam, 15 to 30 percent slopes, 1,900 feet east and 20 feet south of the northwest corner of sec. 29, T. 24 N., R. 1 E.

O1—2 inches to 1/2 inch; twigs and needles; abrupt wavy boundary.
O2—1/2 inch to 0; decayed needles and plant material; abrupt wavy boundary.
A1—0 to 5 inches; dark reddish brown (5YR 3/2) very gravelly sandy loam, reddish gray (5YR 5/2) dry; weak fine granular structure; soft, very friable; many fine roots; mixed subangular and angular pebbles with a few cobbles; very strongly acid; abrupt smooth boundary.
B2—5 to 19 inches; dark reddish brown (5YR 3/3) extremely gravelly loam, reddish brown (5YR 4/3) dry; moderate fine granular structure; soft, very friable; many fine roots; 60 percent mixed subangular and angular pebbles, a few cobbles; very strongly acid; clear wavy boundary.
R—19 inches; fractured basalt.

Depth to bedrock is 16 to 20 inches. Some pedons have a thin A2 horizon. The soils have umbric epipedons 7 to 20 inches thick.

The A1 horizon has hue of 5YR or 7.5YR and value of 2 or 3 moist and 4 or 5 dry.

The B horizon has hue of 5YR or 7.5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 3 or 4 moist or dry. It is extremely gravelly silt loam or extremely gravelly loam.

Kitsap series

The Kitsap series consists of deep, moderately well drained soils that formed in glacial lake sediment. Kitsap soils are on terraces and have slopes of 0 to 70 percent. The average annual precipitation is 30 to 45 inches and the mean annual air temperature is about 50 degrees F.

Typical pedon of Kitsap silt loam, 8 to 15 percent slopes, 20 feet west and 600 feet south of the northeast corner of sec. 31, T. 24 N., R 1 E.

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) silt loam, light yellowish brown (10YR 6/4) dry; weak fine granular structure; soft, friable, slightly sticky and slightly plastic; common coarse, medium, and fine roots; 5 percent concretions, 2 to 5 millimeters; medium acid; abrupt smooth boundary.
B21—5 to 13 inches; dark yellowish brown (10YR 4/4) silt loam, light yellowish brown (2.5Y 6/4) dry; many large faint olive gray (5Y 5/2) and distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few coarse and medium roots; 5 percent concretions, 2 to 5 millimeters; medium acid; gradual wavy boundary.
B22—13 to 35 inches; light olive brown (2.5Y 5/4) silty clay loam, pale olive (5Y 6/3) dry; common medium prominent strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few fine roots; medium acid; gradual wavy boundary.
C1—35 to 48 inches; olive (5Y 5/3) heavy silt loam, pale yellow (5Y 7/3) dry; common medium distinct pale olive (5Y 6/3) and strong brown (7.5 YR 5/8) mottles; fine stratification; soft, friable, slightly sticky and slightly plastic; medium acid; abrupt smooth boundary.
C2—48 to 56 inches; olive (5Y 5/3) silty clay loam, pale yellow (5Y 7/3) dry; common medium distinct pale olive (5Y 6/3) and strong brown (7.5Y 5/8) mottles; fine stratification; slightly hard, friable, slightly sticky and slightly plastic; medium acid; abrupt smooth boundary.
C3—56 to 63 inches; olive (5Y 5/3) silt, pale yellow (5Y 8/3) dry; medium to coarse stratification; soft, friable, nonsticky and nonplastic; medium acid.

The content of rock fragments in the soil averages less than 5 percent. Depth to prominent mottles ranges from 13 to 24 inches.

The A horizon has value of 2 through 4 moist and 4 through 6 dry, and chroma of 2 or 3 moist and 2 to 4 dry.

The upper part of the B horizon has value of 3 or 4 moist and 5 or 6 dry and chroma of 3 or 4 moist or dry. It is silt loam or silty clay loam.

The lower part of the B horizon has hue of 10YR or 2.5Y, value of 4 through 6 moist and 6 through 8 dry, and chroma of 2 through 4 moist or dry. It is silt loam or silty clay loam.

The C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 through 4. It is silt loam or silty clay loam. Some pedons contain thin to coarse strata of silty clay, silt, or fine sand.

McKenna series

The McKenna series consists of moderately deep, poorly drained soils that formed in glacial till. McKenna soils are in upland and terrace depressions and along drainageways and have slopes of 0 to 6 percent. The average annual precipitation is 35 to 50 inches and the mean annual air temperature is about 50 degrees F.

Typical pedon of McKenna gravelly loam, 1,900 feet east and 1,150 feet south of the northwest corner of sec. 1, T. 22 N., R. 1 E.

O1—3 to 2 inches; twigs, needles, bark, and wood fragments; abrupt wavy boundary.
O2—2 inches to 0; partially decomposed needles, leaves, and wood fragments; abrupt wavy boundary.
A1—0 to 6 inches; dark reddish brown (5YR 2/2) gravelly loam, dark gray (10YR 4/1) dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many coarse, medium, and fine roots; 20

percent pebbles; strongly acid; abrupt smooth boundary.

B21—6 to 8 inches; dark grayish brown (10YR 4/2) gravelly silt loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few coarse, medium, and fine roots; 25 percent pebbles; strongly acid; clear smooth boundary.

B22—8 to 16 inches; grayish brown (10YR 5/2) very gravelly loam, light brownish gray (10YR 6/2) dry; moderate medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; very few fine roots; 40 percent pebbles; medium acid; gradual smooth boundary.

B23—16 to 28 inches; dark grayish brown (10YR 4/2) very gravelly loam, light brownish gray (2.5Y 6/2) dry; common medium distinct strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; 45 percent pebbles; medium acid; abrupt smooth boundary.

C1g—28 to 37 inches; grayish brown (2.5Y 5/2) very gravelly loam, light gray (5Y 7/1) dry; common medium distinct dark olive gray (5Y 3/2) and yellowish brown (10YR 5/4) mottles; compact glacial till; hard, firm, nonsticky and nonplastic; 45 percent pebbles; medium acid; abrupt smooth boundary.

C2—37 to 60 inches; dark greenish gray (5BG 4/1) gravelly silty clay, gray (N 6/0) dry; massive; compact glacial till; extremely hard, firm, very sticky and very plastic; medium acid.

Depth to the compact glacial till is 30 to 40 inches. Content of rock fragments in the control section averages 35 to 50 percent.

The A1 horizon has hue of 5YR through 10YR, value of 2 or 3 moist and 2 through 4 dry, and chroma of 1 or 2 moist or dry.

The B2 horizon has hue of 10YR or 2.5Y, value of 3 through 5 moist and 5 through 7 dry, and chroma of 2 through 4 moist or dry. It has fine faint to coarse prominent mottles. The B2 horizon is very gravelly loam, gravelly silt loam, or gravelly clay loam.

The C horizon is compact glacial till. In the lower part, it is gravelly loam, gravelly silty clay, or very gravelly sandy loam.

Mukilteo series

The Mukilteo series consists of deep, very poorly drained soils that formed in organic material. Mukilteo soils are in depressions on upland terraces and along river valleys and have slopes of 0 to 1 percent. The average annual precipitation is 40 to 70 inches and the mean annual air temperature is about 50 degrees F.

Typical pedon of Mukilteo peat, 1,800 feet east and 2,100 feet south of the northwest corner of sec. 8, T. 23 N., R. 2 E.

Oe1—0 to 4 inches; dark reddish brown (5YR 2/2) hemic material, dark grayish brown (10YR 4/2) dry; about 50 percent fibers, about 6 percent rubbed; massive; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; very strongly acid; abrupt smooth boundary.

Oe2—4 to 44 inches; dark reddish brown (5YR 3/2) hemic material, dark grayish brown (10YR 4/2) dry; about 65 percent fibers, about 20 percent rubbed; hard, very friable, nonsticky and slightly plastic; few fine roots; very strongly acid; clear smooth boundary.

Oe3—44 to 72 inches; dark reddish brown (5YR 3/2) hemic material, dark grayish brown (10YR 4/2) dry; about 60 percent fibers, about 25 percent rubbed; hard, friable, nonsticky and slightly plastic; very strongly acid.

Some pedons have a thin layer of sapric material at the surface. Hue is 5YR or 7.5YR and value and chroma range from 2 through 4.

Neilton series

The Neilton series consists of deep, excessively drained soils that formed in gravelly and sandy glacial outwash. Neilton soils are on terraces, beaches, and uplands and have slopes of 0 to 30 percent. The average annual precipitation is 30 to 55 inches and the mean annual air temperature is about 50 degrees F.

Typical pedon of Neilton gravelly loamy sand, 15 to 30 percent slopes, 2,100 feet west and 600 feet south of the northeast corner of sec. 9, T. 22 N., R. 1 E.

O1—1/2 inch to 0; undecomposed needles, twigs, and moss.

A1—0 to 4 inches; dark brown (10YR 3/3) gravelly loamy sand, brown (10YR 5/3) dry; single grain; loose; many coarse, medium, and fine roots; about 30 percent pebbles; strongly acid; clear smooth boundary.

B2ir—4 to 19 inches; dark brown (7.5YR 3/4) very gravelly loamy sand, light yellowish brown (10YR 6/4) dry; single grain; loose; many coarse, medium, and fine roots; 35 percent pebbles; strongly acid; clear wavy boundary.

C—19 to 60 inches; multicolored, very gravelly sand; single grain; loose; few fine roots to a depth of 36 inches; 60 percent pebbles; medium acid.

Content of rock fragments in the control section averages 35 to 70 percent.

The A1 horizon has hue of 7.5YR or 10YR, value of 3 or 4 moist and 4 or 5 dry, and chroma of 2 or 3 moist or dry.

The B2ir horizon has hue of 7.5YR or 10YR, value of 3 or 4 moist and 5 or 6 dry, and chroma of 3 or 4 moist or dry.

In some pedons the C horizon has lenses of sand and gravelly sand.

Norma series

The Norma series consists of deep, poorly drained soils that formed in mixed glacial alluvium. Norma soils are on till plain depressions and along drainageways in the uplands and have slopes of 0 to 3 percent. The average annual precipitation is 35 to 60 inches and the mean annual air temperature is about 50 degrees F.

Typical pedon of Norma fine sandy loam, 1,900 feet east and 400 feet north of the southwest corner of sec. 9, T. 25 N., R. 1 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (2.5Y 5/2) dry; moderate fine granular structure; soft, friable, nonsticky and nonplastic; many fine roots; medium acid; abrupt smooth boundary.

B21g—8 to 13 inches; light olive brown (2.5Y 5/4) fine sandy loam, pale yellow (5Y 7/3) dry; common medium distinct strong brown (7.5YR 5/8) and light olive brown (2/5Y 5/4) mottles; weak fine subangular blocky structure; soft, friable, nonsticky and nonplastic; common fine roots; medium acid; clear smooth boundary.

B22g—13 to 22 inches; light olive brown (2/5Y 5/4) fine sandy loam, pale yellow (5Y 8/3) dry; common medium distinct strong brown (7.5YR 5/8) and grayish brown (2/5Y 5/2) mottles; weak fine subangular blocky structure; soft, friable, nonsticky and nonplastic; common fine roots; medium acid; abrupt smooth boundary.

C1g—22 to 32 inches; olive gray (5Y 5/2) sandy loam, pale yellow (5Y 8/3) dry; many large distinct strong brown (7.5YR 5/8) mottles; massive; soft, very friable, nonsticky and nonplastic; few fine roots; medium acid; abrupt smooth boundary.

C2g—32 to 36 inches; olive gray (5Y 5/2) clay loam, pale yellow (5Y 8/3) dry; many large distinct strong brown (7.5YR 5/8) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; medium acid; abrupt smooth boundary.

C3—36 to 43 inches; dark yellowish brown (10YR 4/4) loamy sand, light yellowish brown (2.5Y 6/4) dry; massive; loose; medium acid; abrupt smooth boundary.

C4—43 to 60 inches; dark yellowish brown (10YR 4/4) loamy sand, pale yellow (5Y 8/3) dry; massive, slightly compact; hard, firm, nonsticky and nonplastic; neutral.

Gravel content in the control section ranges from 0 to 15 percent.

The A horizon has value of 2 or 3 moist and chroma of 1 or 2 moist or dry.

The B horizon has hue of 2.5Y or 5Y and has common to many distinct and prominent mottles. It is fine sandy loam or sandy loam.

The C horizon is fine sandy loam, sandy loam, or loamy sand. Some pedons contain strata of silt, silt loam, clay loam, or gravelly sand in the lower part of the C horizon.

Poulsbo series

The Poulsbo series consists of moderately deep, moderately well drained soils that formed in glacial till. Poulsbo soils are on broad uplands and have slopes of 0 to 30 percent. The average annual precipitation is 30 to 40 inches and the mean annual air temperature is about 51 degrees F.

Typical pedon of Poulsbo gravelly sandy loam, 0 to 6 percent slopes, 750 feet east and 750 feet north of the southwest corner of sec. 20, T. 26 N., R. 2 E.

O1—2 inches to 1 inch; twigs, needles, bark, and wood fragments; abrupt wavy boundary.

O2—1 inch to 0; decomposed needles, leaves, bark, and wood fragments; abrupt wavy boundary.

A2—0 to 2 inches; dark grayish brown (2.5Y 4/2) gravelly sandy loam, light brownish gray (2.5Y 6/2) dry; single grain; loose; many fine, medium, and coarse roots; 35 percent gravel and fine concretions; strongly acid; abrupt wavy boundary.

B21ir—2 to 9 inches; dark brown (10YR 3/3) gravelly sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; soft, very friable; many fine, medium, and coarse roots; 30 percent gravel; very strongly acid; clear wavy boundary.

B22ir—9 to 24 inches; dark yellowish brown (10YR 4/4) gravelly sandy loam, light yellowish brown (2.5Y 6/4) dry; weak fine granular structure; soft, friable; common fine, medium, and coarse roots; 30 percent gravel; very strongly acid; clear wavy boundary.

C1sim—24 to 28 inches; light olive brown (2.5Y 5/4) gravelly weakly-silica-cemented sandy loam, light brownish gray (2.5Y 6/2) dry; strong thin platy structure; very hard, very firm; weakly cemented; few fine roots; 20 percent gravel; very strongly acid; clear wavy boundary.

C2—28 to 60 inches; olive (5Y 5/3) gravelly sandy loam, light gray (5Y 7/2) dry; massive; weakly cemented in the upper part and very compact; 15 percent gravel; very strongly acid.

Depth to the very compact, weakly-silica-cemented layer is 20 to 40 inches. The mean annual soil temperature ranges from 49 degrees to 52 degrees F. The control section has 50 to 75 percent content of sand and 10 to 35 percent content of rock fragments.

The A2 horizon has hue of 10YR or 2.5Y and value of 4 or 5 moist and 6 or 7 dry. It is 1 to 4 inches thick and is gravelly sandy loam or gravelly loam.

The B2ir horizon has hue of 10YR or 7.5YR in the upper part and 10YR or 2.5Y in the lower part. It has value of 3 or 4 moist and chroma of 3 or 4 moist or dry. The B2ir horizon is gravelly sandy loam or gravelly loam. Some pedons have common fine faint and distinct mottles.

The C horizon has hue of 2.5Y or 5Y. In some pedons, there are common medium distinct mottles along fracture planes.

Ragnar series

The Ragnar series consists of deep, well drained soils that formed in sandy glacial outwash. Ragnar soils are on terraces and rolling uplands and have slopes of 0 to 30 percent. The average annual precipitation ranges from 35 to 65 inches and the mean annual temperature is about 50 degrees F.

Typical pedon of Ragnar fine sandy loam, 6 to 15 percent slopes, 2,000 feet west and 2,500 feet north of the southeast corner of sec. 31, T. 24 N., R. 1 E.

O1—3 to 1-1/2 inches; twigs, needles, bark, and wood fragments; abrupt wavy boundary.

O2—1-1/2 inches to 0; decomposed needles, leaves, bark, and wood fragments; abrupt wavy boundary.

A1—0 to 4 inches; dark brown (7.5YR 3/2) fine sandy loam, dark brown (10YR 3/3) dry; weak fine granular structure; soft, friable, nonsticky and nonplastic; common medium and fine roots; medium acid; abrupt smooth boundary.

B2—4 to 23 inches; dark yellowish brown (10YR 4/4) fine sandy loam, yellow (2.5Y 7/6) dry; few fine faint strong brown mottles; weak medium subangular blocky structure; soft, friable; common medium and fine roots; medium acid; gradual wavy boundary.

C1—23 to 44 inches; grayish brown (2.5Y 5/2) loamy sand, pale yellow (5Y 7/3) dry; few strong brown mottles; massive; soft, friable; few medium and fine roots; medium acid; gradual wavy boundary.

C2—44 to 52 inches; light brownish gray (2.5Y 6/2) loamy sand, pale yellow (5Y 7/3) dry; few fine yellowish red mottles; massive; soft, friable; very few fine roots; medium acid; gradual wavy boundary.

C3—52 to 66 inches; light brownish gray (2.5Y 6/2) loamy sand, light gray (5Y 7/2) dry; massive; soft, friable; medium acid.

The A horizon has hue of 7.5YR or 10YR and chroma of 2 or 3.

The B horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 3 or 4 moist and 4 through 7 dry; and chroma of 4 through 6 moist or dry.

The C horizon has hue of 5Y through 10YR, value of 5 through 7, and chroma of 2 or 3. It is loamy sand or fine sand.

Schneider series

The Schneider series consists of deep, well drained soils that formed in colluvium from basalt. Schneider soils are on uplands and have slopes of 45 to 70 percent. The average annual precipitation is 60 to 75 inches and the mean annual air temperature is about 49 degrees F.

Typical pedon of Schneider very gravelly loam, 45 to 70 percent slopes, 600 feet east and 1,900 feet south of the northwest corner of sec. 26, T. 24 N., R. 1 W.

O1—1 to 1/2 inch; needles, leaves, and twigs; scattered angular gravel and cobbles on surface.

O2—1/2 inch to 0; decomposed needles, leaves, and some ash.

A1—0 to 6 inches; dark reddish brown (5YR 3/3) very gravelly loam, brown (7.5YR 4/4) dry; moderate fine granular structure; soft, friable, nonsticky and nonplastic; many fine roots; 50 percent angular basalt fragments and 10 percent angular cobbles; medium acid; abrupt smooth boundary.

A3—6 to 23 inches; dark reddish brown (5YR 3/3) extremely gravelly loam, brown (7.5YR 5/4) dry; moderate fine granular structure; soft, friable, nonsticky and nonplastic; many coarse, medium, and fine roots; 50 percent angular gravel and 15 percent angular cobbles; medium acid; clear smooth boundary.

B2—23 to 48 inches; dark brown (7.5YR 4/4) extremely gravelly silt loam, very pale brown (10YR 7/4) dry; moderate fine granular structure; soft, friable, slightly sticky and slightly plastic; common coarse, medium, and fine roots; 55 percent angular gravel and 15 percent angular cobbles; medium acid; abrupt wavy boundary.

R—48 inches; fractured basalt.

Depth to basalt ranges from 40 to 70 inches. Content of rock fragments in the control section ranges from 50 to 80 percent.

The A1 horizon has hue of 5YR or 7.5YR, value of 2 or 3 moist and 4 or 5 dry, and chroma of 2 or 3 moist and 2 through 4 dry. It is very gravelly loam or very gravelly silt loam. The A3 horizon has hue of 5YR or 7.5YR, value of 2 or 3 moist and 3 through 5 dry, and chroma of 3 or 4 dry. It is very gravelly loam, very gravelly silt loam, or extremely gravelly loam.

The B2 horizon has hue of 5YR, 7.5YR, or 10YR. It is extremely gravelly silt loam or very gravelly silt loam.

Semiahmoo series

The Semiahmoo series consists of deep, very poorly drained soils that formed in organic material. Semiahmoo soils are in depressional backwater areas of flood plains and have slopes of 0 to 1 percent. The average annual precipitation is 35 to 50 inches and the mean annual air temperature is about 49 degrees F.

Typical pedon of Semiahmoo muck, 900 feet west and 1,200 feet south of the northeast corner of sec. 6 T. 23 N., R. 2 E.

Oap—0 to 8 inches; black (5YR 2/1) sapric material, dark gray (10YR 4/1) dry; about 15 percent fibers, less than 5 percent rubbed; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; strongly acid; clear smooth boundary.

Oa1—8 to 20 inches; black (5YR 2/1) sapric material, dark gray (10YR 4/1) dry; about 15 percent fibers, less than 5 percent rubbed; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; strongly acid; abrupt smooth boundary.

Oa2—20 to 66 inches; black (5YR 2/1) sapric material, dark gray (10YR 4/1) dry; 50 percent fibers, less than 15 percent rubbed; massive; hard, very friable, nonsticky and slightly plastic; few fine roots; very strongly acid; abrupt smooth boundary.

The organic layers below the Oap horizon have hue of 5YR through 10YR. Chroma is 1 or 2.

The organic layer ranges from 55 inches to more than 120 inches in thickness.

Shalcar series

The Shalcar series consists of deep, very poorly drained soils that formed in organic material over alluvium. Shalcar soils are in valleys and upland depressions and have slopes of 0 to 1 percent. The average annual precipitation is 35 to 60 inches and the mean annual air temperature is about 49 degrees F.

Typical pedon of Shalcar muck, 1,800 feet east and 1,750 feet south of the northwest corner of sec. 8, T. 23 N., R. 2 E.

Oap—0 to 8 inches; very dark brown (10YR 2/2) sapric material, gray (2.5Y 5/1) dry; many large prominent strong brown (7.5YR 5/6) mottles; about 15 percent fibers, less than 5 percent rubbed; moderate medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; strongly acid; abrupt smooth boundary.

Oa1—8 to 32 inches; very dark brown (10YR 2/2) sapric material, brown (10YR 4/3) dry; dark gray (5Y 4/1) pockets of fine sand; about 10 percent fibers, less than 5 percent rubbed; moderate thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; very strongly acid; clear wavy boundary.

C—32 to 60 inches; very dark gray (2.5YR 3/1) stratified loamy sand with lenses of finer material, gray (5Y 5/1) dry; common medium prominent dark yellowish brown (10YR 4/4) mottles; massive; loose; few fine roots; very strongly acid.

The organic horizons have 10 to 25 percent fibers unrubbed and less than 10 percent rubbed.

Depth to the mineral horizon ranges from 20 to 40 inches. The mineral horizons are stratified silty clay loam, silt loam, fine sandy loam, sandy loam, loamy sand, and sand.

Shelton series

The Shelton series consists of moderately deep, moderately well drained soils that formed in glacial till and has some basalt fragments. Shelton soils are on moraines and till plains and have slopes of 0 to 45 percent. The average annual precipitation is 50 to 70 inches and the mean annual air temperature is about 49 degrees F.

Typical pedon of Shelton very gravelly sandy loam, 15 to 30 percent slopes, 2,500 feet west and 1,200 feet south of the northeast corner of sec. 23, T. 24 N., R. 1 W.

O1—2 inches to 1 inch; needles, leaves, and twigs.

O2—1 inch to 0; decomposed leaves, needles, and wood fragments; burned residue; abrupt smooth boundary.

B21cn—0 to 3 inches; dark reddish brown (5YR 3/3) very gravelly sandy loam, brown (7.5YR 5/4) dry; moderate fine granular structure; soft, friable; many coarse, medium, and fine roots; 30 percent pebbles and 20 percent dark brown (7.5YR 4/4) concretions, 2 to 5 millimeters; strongly acid; clear smooth boundary.

B22cn—3 to 18 inches; dark reddish brown (5YR 3/4) very gravelly sandy loam, brown (7.5YR 5/4) dry; moderate fine granular structure; soft, friable; many coarse, medium, and fine roots; 15 percent pebbles; 20 percent dark brown (7.5YR 4/4) concretions, 2 to 5 millimeters; 20 percent angular basalt cobbles; strongly acid; gradual wavy boundary.

B3cn—18 to 25 inches; dark brown (7.5YR 3/4) very gravelly sandy loam, yellowish brown (10YR 5/4) dry; moderate fine granular structure; soft, friable; many coarse, medium, and fine roots; dense root mat in lower horizon; 55 percent pebbles and cobbles; strongly acid; abrupt smooth boundary.

Csim—25 to 60 inches; grayish brown (2.5Y 5/2) very gravelly sandy loam, light olive gray (5Y 6/2) dry; massive; extremely hard, weakly-silica-cemented, very compact glacial till; 65 percent pebbles; strongly acid.

Depth to the Csim horizon ranges from 20 to 35 inches. Content of rock fragments in the soil ranges from

40 to 75 percent. Some pedons contain a few angular basaltic fragments. Some pedons have a thin A1 horizon.

The Bcn horizon has hue of 5YR or 7.5YR, value of 3 or 4 moist, and chroma of 3 or 4 moist or dry. Some pedons have pockets of glacial flour deposited in the lower part of the B horizon. The Bcn horizon is very gravelly sandy loam or extremely gravelly sandy loam.

The Csim horizon has hue of 2.5Y or 5Y and value of 5 or 6 moist or dry.

Sinclair series

The Sinclair series consists of moderately deep, moderately well drained soils that formed in glacial till. Sinclair soils are on till plains and have slopes of 2 to 30 percent. The average annual precipitation is 30 to 40 inches and the mean annual air temperature is about 51 degrees F.

Typical pedon of Sinclair very gravelly sandy loam, 2 to 8 percent slopes, 1,900 feet west and 2,500 feet south of the northeast corner of sec. 2, T. 26 N., R. 2 E.

O1—2 to 1-1/2 inches; needles, leaves, and twigs.

O2—1-1/2 inch to 0; black (5YR 2/1) partially decayed needles, leaves, bark, and wood fragments; very strongly acid; abrupt wavy boundary.

A2—0 to 2 inches; grayish brown (10YR 5/2) sandy loam, light brownish gray (2.5Y 6/2) dry; weak fine granular structure; soft, very friable; common fine roots; 10 percent gravel and fine gravel-size concretions; very strongly acid; clear wavy boundary.

B21ir—2 to 8 inches; yellowish brown (10YR 5/4) very gravelly sandy loam, pale brown (10YR 6/3) dry; weak fine granular structure; soft, very friable; many coarse, medium, and fine roots; 30 percent gravel and 10 percent fine gravel-size concretions; very strongly acid; clear smooth boundary.

B22ir—8 to 15 inches; yellowish brown (10YR 5/4) very gravelly sandy loam, pale brown (10YR 6/3) dry; many fine faint light gray (10YR 7/2) mottles; weak medium granular structure; soft, very friable; many coarse medium and fine roots; 40 percent gravel; very strongly acid; clear smooth boundary.

B23—15 to 25 inches; yellowish brown (10YR 5/4) very gravelly sandy loam, light yellowish brown (10YR 6/4) dry; weak fine granular structure; soft, very friable; many coarse and medium roots; 40 percent gravel; strongly acid; abrupt smooth boundary.

Csim—25 to 60 inches; light olive brown (2.5Y 5/4) gravelly loamy sand, light brownish gray (2.5Y 6/2) dry; massive; hard; weakly-silica-cemented, very compact; medium acid.

Depth to the Csim horizon ranges from 20 to 30 inches. Content of rock fragments ranges from 35 to 50 percent in the control section.

The A2 horizon has hue of 10YR or 2.5Y, value of 4 or 5 moist, and chroma of 1 or 2 moist or dry.

The B2ir horizon has hue of 7.5YR or 10YR, value of 4 or 5 moist, and chroma of 3 or 4 moist or dry. It has weak granular or subangular blocky structure.

The Csim horizon has hue of 2.5Y or 10YR. It is gravelly sandy loam or gravelly loamy sand. It is weakly- to moderately-silica-cemented and very compact.

Tacoma series

The Tacoma series consists of deep, very poorly drained soils that formed in alluvial deposits and organic material. Tacoma soils are on deltas and have slopes of 0 to 3 percent. The average annual precipitation is 35 to 60 inches and the mean annual air temperature is about 50 degrees F.

Typical pedon of Tacoma silt loam, 1,050 feet east and 600 feet north of the southwest corner of sec. 17, T. 24 N., R. 2 W.

A1—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; moderate fine granular structure; soft, very friable, nonsticky and slightly plastic; many fine roots; very strongly acid; clear smooth boundary.

C1—6 to 10 inches; dark grayish brown (2.5Y 4/2) very gravelly loamy sand, grayish brown (2.5Y 5/2) dry; weak fine granular structure; loose; common fine roots; 40 percent pebbles; very strongly acid; abrupt smooth boundary.

C2g—10 to 17 inches; dark grayish brown (2.5Y 4/2) loam, light olive gray (5Y 6/2) dry; common medium distinct strong brown (7.5YR 5/8) mottles; massive; soft, very friable, nonsticky and slightly plastic; weakly smeary; few fine roots; very strongly acid; clear smooth boundary.

C3g—17 to 21 inches; very dark grayish brown (10YR 3/2) silty clay loam, light olive gray (5Y 6/2) dry; common medium distinct strong brown (7.5YR 5/8) mottles; massive; soft, very friable, slightly sticky and plastic; weakly smeary; very strongly acid; clear smooth boundary.

C4—21 to 24 inches; dark brown (10YR 3/3) loam, light olive gray (5Y 6/2) dry; massive; soft, very friable, nonsticky and slightly plastic; weakly smeary; very strongly acid; abrupt smooth boundary.

C5—24 to 36 inches; very dark grayish brown (2.5Y 3/2) very fine sandy loam, light brownish gray (2.5Y 6/2) dry; common fine distinct strong brown (7.5YR 5/8) mottles; massive; soft, very friable, nonsticky and nonplastic; weakly smeary; very strongly acid; abrupt smooth boundary.

C6—36 to 60 inches; olive gray (5Y 4/2) very gravelly coarse sand, gray (5Y 6/1) dry; common medium faint yellowish red (5YR 5/8) mottles; single grain; loose; very strongly acid.

Some pedons have layers of muck, each 1 to 4 inches thick, with a cumulative total of less than 16 inches.

The A1 horizon has hue of 10YR or 5Y, value of 3 or 4, and chroma of 1 or 2.

The C horizon has hue of 10YR through 5Y, value of 3 through 5 moist, and chroma of 2 or 3 moist or dry. Mottles range from faint to prominent. The lower part of the C horizon ranges from clay to very gravelly coarse sand and changes within short distances.

references

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Chambers, Charles J., and Franklin M. Wilson. 1972. Yield tables for the Douglas-fir zone. State of Washington Dept. Nat. Resources Report 22-R.

(4) Garling, M. E., Dee Molenaar, E. G. Bailey, A. S. Van Denburgh, and G. H. Fiedler. 1965. Water resources and geology of the Kitsap peninsula and certain adjacent islands. State of Washington Div. Water Resources Water Supply Bull. 18, 309 pp., illus.

(5) King, James E. 1966. Site curves for Douglas-fir in the Pacific Northwest. Weyerhauser Co. Forestry Paper 8.

(6) McArdle, R. E., W. H. Meyer, and D. Bruce. 1961. The yield of Douglas-fir in the Pacific Northwest. U.S. Dep. Agric. Tech. Bull. 201, 74 pp.

(7) McCreary, Fred R., and Miles L. Raver. 1975. Soil survey of Jefferson County Area, Washington. U. S. Dept. Agric.

(8) Portland Cement Association. 1973. PCA soil primer.

(9) Puget Sound Council of Governments and Kitsap County Department of Community Development. 1972, updated 1975. Land use survey.

(10) Rigg, George B. 1958. Peat resources of Washington. State of Washington Div. Mines and Geol. Bull. 44, 272 pp.

(11) Snyder, Dale E., Philip S. Gale, and Russell F. Pringle. 1973. Soil survey of King County Area, Washington. U. S. Dept. Agric.

(12) United States Department of Agriculture. 1951. Soil survey manual. U. S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]

(13) United States Department of Agriculture. 1972. National engineering handbook. Sec. 4, Hydrol., Ch. 7, pp. 7.1 to 7.2.

(14) United States Department of Agriculture. 1961. Land capability classification. U.S. Dep. Agric. Handb. 210, 21 pp.

(15) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(16) United States Department of Health, Education, and Welfare. 1957. Manual of septic tank practices. Public Health Serv. Publ. 526, 93 pp., illus.

(17) Wildermuth, Robert, S. O. Perkins, R. E. Pasco, and E. H. Hubbard. 1939. Soil survey of Kitsap County, Washington. U. S. Dept. Agric., 41 pp.

(18) Worthington, N. P., F. A. Johnson, G. R. Staebler, and W. J. Lloyd. 1960. Normal yield tables for red alder. U. S. Dept. Agric. Research Paper 36, Forest Service.

(19) Zulauf, Allen S. 1978. Soil survey of Pierce County Area, Washington. U. S. Dept. Agric.

glossary

ABC soil. A soil having an A, a B, and a C horizon.

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Basal area. The area, in square feet, of the cross section at breast height of the trees above a stated size in an acre.

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

CMAI. Culmination of the mean annual increment. The age or rotation at which growing stock of a forest produces the greatest annual growth (for that time period).

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diameter breast-high (DBH). The diameter of a tree 4.5 feet above average ground level.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial melt water. Many deposits are interbedded or laminated.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Interglacial. Pertaining to or formed during the time interval between two glaciations. Generally characterized by climates and soil forming conditions more similar to today than during times of glaciation.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

MAI (Mean annual increment). The total growth divided by the stated age.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Recharge. The absorption and addition of water to the zone of saturation.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site curve. A curve or table developed to determine site index.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Skid trails. Trail or furrow made by log skidding over ground surface.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, 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 by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Yarding. A logging term meaning to move a log from the area it was cut to a landing or loading area.

Yarding, cable. Yarding a log by a suspended cable rather than behind a wheeled or tracked vehicle.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1952-76 at Bremerton, Washington]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[1]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	44.0	33.3	38.7	57	18	72	8.82	4.87	12.05	16	4.6
February---	48.9	34.8	41.9	63	23	101	5.69	3.10	7.80	11	.5
March------	51.7	35.7	43.8	67	26	135	5.51	3.01	7.55	12	.7
April------	57.7	39.5	48.6	77	30	258	2.90	1.41	4.11	8	.0
May--------	65.4	44.8	55.1	89	33	468	1.70	.90	2.34	6	.0
June-------	69.3	49.6	59.5	88	41	585	1.52	.64	2.22	5	.0
July-------	75.2	52.7	63.9	94	45	741	.78	.18	1.24	2	.0
August-----	74.3	52.8	63.6	94	45	732	1.07	.23	1.73	3	.0
September--	69.9	49.5	59.8	88	39	594	1.92	.51	3.04	5	.0
October----	60.6	43.8	52.2	77	33	378	4.36	1.93	6.33	10	.0
November---	50.8	38.4	44.6	64	26	156	7.56	4.00	10.46	14	.6
December---	45.5	35.2	40.4	56	21	87	8.92	6.11	11.49	16	2.6
Yearly:											
Average--	59.4	42.5	51.0	---	---	---	---	---	---	---	---
Extreme--	---	---	---	96	14	---	---	---	---	---	---
Total----	---	---	---	---	---	4,307	50.75	42.83	58.33	108	9.0

[1] A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1952-76 at Bremerton, Washington]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	February 26	April 9	May 6
2 years in 10 later than--	February 14	March 26	April 28
5 years in 10 later than--	January 19	February 28	April 12
First freezing temperature in fall:			
1 year in 10 earlier than--	December 2	November 11	October 21
2 years in 10 earlier than--	December 17	November 21	October 29
5 years in 10 earlier than--	January 20	December 10	November 12

TABLE 3.--GROWING SEASON

[Recorded in the period 1952-76 at Bremerton, Washington]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	288	239	184
8 years in 10	309	255	194
5 years in 10	>365	284	213
2 years in 10	>365	314	232
1 year in 10	>365	329	241

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Alderwood very gravelly sandy loam, 0 to 6 percent slopes	18,040	7.5
2	Alderwood very gravelly sandy loam, 6 to 15 percent slopes	17,600	7.3
3	Alderwood very gravelly sandy loam, 15 to 30 percent slopes	8,080	3.3
4	Beaches	640	0.3
5	Belfast loam	530	0.2
6	Bellingham silty clay loam	880	0.4
7	Cathcart silt loam, 2 to 8 percent slopes	880	0.4
8	Cathcart silt loam, 8 to 15 percent slopes	440	0.2
9	Cathcart silt loam, 15 to 30 percent slopes	370	0.2
10	Dystric Xerorthents, 45 to 70 percent slopes	12,300	5.1
11	Grove very gravelly sandy loam, 0 to 3 percent slopes	1,510	0.6
12	Grove very gravelly sandy loam, 3 to 15 percent slopes	980	0.4
13	Grove very gravelly sandy loam, 15 to 30 percent slopes	570	0.2
14	Harstine gravelly sandy loam, 0 to 6 percent slopes	13,960	5.8
15	Harstine gravelly sandy loam, 6 to 15 percent slopes	10,610	4.4
16	Harstine gravelly sandy loam, 15 to 30 percent slopes	6,600	2.7
17	Harstine gravelly sandy loam, 30 to 45 percent slopes	1,990	0.8
18	Indianola loamy sand, 0 to 6 percent slopes	4,300	1.8
19	Indianola loamy sand, 6 to 15 percent slopes	2,710	1.1
20	Indianola loamy sand, 15 to 30 percent slopes	1,640	0.7
21	Indianola-Kitsap complex, 45 to 70 percent slopes	7,550	3.1
22	Kapowsin gravelly loam, 0 to 6 percent slopes	11,030	4.6
23	Kapowsin gravelly loam, 6 to 15 percent slopes	5,700	2.4
24	Kapowsin Variant gravelly clay loam, 0 to 5 percent slopes	1,090	0.5
25	Kilchis very gravelly sandy loam, 15 to 30 percent slopes	1,890	0.8
26	Kilchis very gravelly sandy loam, 30 to 70 percent slopes	5,100	2.1
27	Kilchis-Shelton complex, 30 to 50 percent slopes	2,390	1.0
28	Kitsap silt loam, 2 to 8 percent slopes	2,310	1.0
29	Kitsap silt loam, 8 to 15 percent slopes	1,990	0.8
30	Kitsap silt loam, 15 to 30 percent slopes	1,670	0.7
31	Kitsap silt loam, 30 to 45 percent slopes	540	0.2
32	McKenna gravelly loam	5,100	2.1
33	Mukilteo peat	1,320	0.5
34	Neilton gravelly loamy sand, 0 to 3 percent slopes	3,640	1.5
35	Neilton gravelly loamy sand, 3 to 15 percent slopes	1,410	0.6
36	Neilton gravelly loamy sand, 15 to 30 percent slopes	1,470	0.6
37	Norma fine sandy loam	7,700	3.2
38	Pits	650	0.3
39	Poulsbo gravelly sandy loam, 0 to 6 percent slopes	8,940	3.7
40	Poulsbo gravelly sandy loam, 6 to 15 percent slopes	3,980	1.6
41	Poulsbo gravelly sandy loam, 15 to 30 percent slopes	2,170	0.9
42	Poulsbo-Ragnar complex, 0 to 6 percent slopes	3,290	1.4
43	Poulsbo-Ragnar complex, 6 to 15 percent slopes	3,990	1.7
44	Ragnar fine sandy loam, 0 to 6 percent slopes	4,810	2.0
45	Ragnar fine sandy loam, 6 to 15 percent slopes	3,840	1.6
46	Ragnar fine sandy loam, 15 to 30 percent slopes	3,490	1.4
47	Ragnar-Poulsbo complex, 15 to 30 percent slopes	3,170	1.3
48	Schneider very gravelly loam, 45 to 70 percent slopes	1,490	0.6
49	Semiahmoo muck	1,320	0.5
50	Shalcar muck	960	0.4
51	Shelton very gravelly sandy loam, 0 to 6 percent slopes	4,060	1.7
52	Shelton very gravelly sandy loam, 6 to 15 percent slopes	3,640	1.5
53	Shelton very gravelly sandy loam, 15 to 30 percent slopes	3,290	1.4
54	Shelton very gravelly sandy loam, 30 to 45 percent slopes	1,440	0.6
55	Shelton extremely gravelly sandy loam, 0 to 6 percent slopes	5,300	2.2
56	Shelton extremely gravelly sandy loam, 6 to 15 percent slopes	4,610	1.9
57	Shelton extremely gravelly sandy loam, 15 to 30 percent slopes	930	0.4
58	Shelton-McKenna complex, 0 to 10 percent slopes	1,870	0.8
59	Sinclair very gravelly sandy loam, 2 to 8 percent slopes	1,560	0.6
60	Sinclair very gravelly sandy loam, 8 to 15 percent slopes	730	0.3
61	Sinclair very gravelly sandy loam, 15 to 30 percent slopes	590	0.2
62	Tacoma silt loam	350	0.1
63	Urban land-Alderwood complex, 0 to 8 percent slopes	1,330	0.6
	Water	3,400	1.4
	Total	241,730	100.0

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil. Only soils suitable for these crops are listed]

Soil name and map symbol	Grass-legume hay	Fresh chopped forage	Pasture	Oats	Raspberries	Straw-berries	Sweet corn
	Ton	Ton	AUM*	Bu	Ton	Crate	Ton
1 Alderwood	2.5	7.5	7.5	55	5.0	220	---
2 Alderwood	2.5	7.5	7.5	50	5.0	220	---
3 Alderwood	---	---	7.0	---	---	---	---
5 Belfast	---	---	8.0	---	---	---	---
6 Bellingham	4.0	12.0	12.0	75	---	---	---
7 Cathcart	3.5	10.0	10.0	60	---	270	---
8 Cathcart	3.0	---	8.0	55	---	260	---
14 Harstine	2.5	7.5	7.5	60	---	---	---
15 Harstine	2.5	7.5	7.5	55	---	---	---
16 Harstine	---	---	7.0	---	---	---	---
18 Indianola	2.0	5.0	5.0	45	4.0	220	8.0
19 Indianola	2.0	5.0	5.0	40	4.0	220	---
22 Kapowsin	3.0	9.0	9.0	60	4.5	180	---
23 Kapowsin	3.0	9.0	9.0	55	4.5	160	---
24 Kapowsin Variant	3.5	10.0	10.0	65	---	200	---
28 Kitsap	3.5	10.0	10.0	65	4.5	250	---
29 Kitsap	3.0	9.0	9.0	60	4.5	250	---
32 McKenna	---	10.0	10.0	60	---	---	---
33 Mukilteo	6.0	---	15.0	75	---	---	---
34, 35 Neilton	1.5	---	4.0	---	---	---	---

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Grass-legume hay	Fresh chopped forage	Pasture	Oats	Raspberries	Strawberries	Sweet corn
	Ton	Ton	AUM*	Bu	Ton	Crate	Ton
36----------------------- Neilton	---	---	4.0	---	---	---	---
37----------------------- Norma	---	---	10.0	---	---	---	---
39----------------------- Poulsbo	3.5	8.0	10.0	65	---	---	---
40----------------------- Poulsbo	3.5	8.0	10.0	60	---	---	---
41----------------------- Poulsbo	3.0	6.0	9.0	55	---	---	---
42----------------------- Poulsbo-Ragnar	3.0	9.0	10.0	61	---	---	---
43----------------------- Poulsbo-Ragnar	3.0	9.0	10.0	56	---	---	---
44----------------------- Ragnar	3.0	9.0	9.0	55	---	---	---
45----------------------- Ragnar	3.0	9.0	9.0	50	---	---	---
49----------------------- Semiahmoo	6.0	15.0	15.0	75	---	---	7.0
50----------------------- Shalcar	5.0	12.0	12.0	---	---	---	7.0
51----------------------- Shelton	2.5	8.0	8.0	---	---	---	---
52, 53------------------- Shelton	2.5	8.0	8.0	---	---	---	---
55----------------------- Shelton	2.5	8.0	8.0	---	---	---	---
56, 57------------------- Shelton	2.5	8.0	8.0	---	---	---	---
59, 60------------------- Sinclair	2.5	---	7.5	---	---	---	---
61----------------------- Sinclair	2.0	---	7.0	---	---	---	---
62----------------------- Tacoma	---	---	8.0	---	---	---	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
1, 2 Alderwood	3d	Slight	Slight	Moderate	Severe	Douglas-fir Western redcedar Western hemlock Red alder	104 --- --- ---	Douglas-fir.
3 Alderwood	3d	Moderate	Slight	Moderate	Severe	Douglas-fir Western redcedar Western hemlock Red alder	104 --- --- ---	Douglas-fir.
5 Belfast	2w	Moderate	Slight	Slight	Severe	Douglas-fir Black cottonwood Red alder Bigleaf maple Western redcedar	120 --- --- --- ---	Douglas-fir.
6 Bellingham	5w	Severe	Moderate	Moderate	Moderate	Red alder Bigleaf maple Western redcedar Western hemlock Douglas-fir	80 --- --- --- ---	Red alder, western redcedar.
7, 8, 9 Cathcart	2o	Moderate	Slight	Slight	Severe	Douglas-fir Western hemlock Western redcedar Pacific madrone	120 --- --- ---	Douglas-fir.
11, 12, 13 Grove	3f	Slight	Moderate	Slight	Slight	Douglas-fir Western hemlock	106 ---	Douglas-fir.
14, 15 Harstine	3d	Slight	Slight	Moderate	Moderate	Douglas-fir Red alder	105 ---	Douglas-fir.
16, 17 Harstine	3d	Moderate	Slight	Moderate	Moderate	Douglas-fir Red alder	105 ---	Douglas-fir.
18, 19, 20 Indianola	3s	Slight	Moderate	Slight	Slight	Douglas-fir Western redcedar Western hemlock Bigleaf maple Red alder	99 --- --- --- ---	Douglas-fir.
21*:								
Indianola	3r	Severe	Moderate	Slight	Slight	Douglas-fir Western redcedar Western hemlock Bigleaf maple Red alder	99 --- --- --- ---	Douglas-fir.
Kitsap	2r	Severe	Slight	Moderate	Moderate	Douglas-fir Red alder Western redcedar Western hemlock Bigleaf maple	123 --- --- --- ---	Douglas-fir, western redcedar.
22, 23 Kapowsin	2d	Slight	Slight	Moderate	Moderate	Douglas-fir Western redcedar Western hemlock Red alder Black cottonwood	119 --- --- --- ---	Douglas-fir.
24 Kapowsin Variant	2w	Moderate	Slight	Moderate	Severe	Douglas-fir Western redcedar Western hemlock Red alder	109 --- --- ---	Douglas-fir.

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
25----------------- Kilchis	4d	Slight	Moderate	Severe	Moderate	Douglas-fir--------- Western hemlock-----	101 ---	Douglas-fir.
26----------------- Kilchis	4r	Severe	Moderate	Severe	Moderate	Douglas-fir--------- Western hemlock-----	101 ---	Douglas-fir.
27*:								
Kilchis-----------	4r	Severe	Moderate	Severe	Moderate	Douglas-fir--------- Western hemlock-----	101 ---	Douglas-fir.
Shelton-----------	3r	Severe	Slight	Moderate	Moderate	Douglas-fir--------- Western hemlock-----	107 ---	Douglas-fir.
28, 29------------- Kitsap	2w	Moderate	Slight	Moderate	Moderate	Douglas-fir--------- Red alder----------- Western redcedar---- Western hemlock-----	123 --- --- ---	Douglas-fir, western redcedar.
30, 31------------- Kitsap	2r	Severe	Slight	Moderate	Moderate	Douglas-fir--------- Red alder----------- Western redcedar---- Western hemlock-----	123 --- --- ---	Douglas-fir, western redcedar.
32----------------- McKenna	4w	Severe	Moderate	Moderate	Moderate	Red alder----------- Western redcedar---- Western hemlock-----	90 --- ---	Red alder, western redcedar.
34, 35, 36--------- Neilton	3s	Slight	Moderate	Slight	Moderate	Douglas-fir--------- Red alder-----------	95 ---	Douglas-fir.
37----------------- Norma	4w	Severe	Moderate	Moderate	Moderate	Red alder----------- Douglas-fir--------- Western redcedar---- Western hemlock----- Bigleaf maple--------	90 --- --- --- ---	Red alder, western redcedar.
39, 40, 41--------- Poulsbo	2d	Slight	Slight	Moderate	Moderate	Douglas-fir--------- Red alder-----------	121 ---	Douglas-fir.
42*, 43*:								
Poulsbo-----------	2d	Slight	Slight	Moderate	Moderate	Douglas-fir--------- Red alder-----------	121 ---	Douglas-fir.
Ragnar------------	2s	Slight	Moderate	Slight	Slight	Douglas-fir--------- Western hemlock----- Red alder----------- Western redcedar----	125 --- --- ---	Douglas-fir.
44, 45------------- Ragnar	2s	Slight	Moderate	Slight	Slight	Douglas-fir--------- Western hemlock----- Red alder----------- Western redcedar----	125 --- --- ---	Douglas-fir.
46----------------- Ragnar	3s	Slight	Moderate	Slight	Slight	Douglas-fir--------- Western hemlock----- Red alder----------- Western redcedar----	105 --- --- ---	Douglas-fir.
47*:								
Ragnar------------	3s	Slight	Moderate	Slight	Slight	Douglas-fir--------- Western hemlock----- Red alder----------- Western redcedar----	105 --- --- ---	Douglas-fir.
Poulsbo-----------	2d	Moderate	Slight	Moderate	Moderate	Douglas-fir--------- Red alder-----------	121 ---	Douglas-fir.

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Common trees	Site index	
48: Schneider	3r	Severe	Slight	Slight	Moderate	Douglas-fir Western white pine Western hemlock	115 --- ---	Douglas-fir, western hemlock.
51, 52, 53: Shelton	3d	Slight	Slight	Moderate	Moderate	Douglas-fir Western hemlock	107 ---	Douglas-fir.
54: Shelton	3r	Severe	Slight	Moderate	Moderate	Douglas-fir Western hemlock	107 ---	Douglas-fir.
55, 56, 57: Shelton	4d	Slight	Moderate	Moderate	Moderate	Douglas-fir Western hemlock Lodgepole pine	86 --- ---	Douglas-fir.
58*:								
Shelton	4d	Slight	Moderate	Moderate	Moderate	Douglas-fir Western hemlock Lodgepole pine	86 --- ---	Douglas-fir.
McKenna	4w	Severe	Moderate	Moderate	Moderate	Red alder Western redcedar Western hemlock	90 --- ---	Red alder, western redcedar.
59, 60, 61: Sinclair	3d	Slight	Moderate	Moderate	Moderate	Douglas-fir Western redcedar Western hemlock Red alder	103 --- --- ---	Douglas-fir.
63*: Urban land.								
Alderwood	3d	Slight	Slight	Moderate	Severe	Douglas-fir Western redcedar Western hemlock Red alder	104 --- --- ---	Douglas-fir.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WOODLAND UNDERSTORY VEGETATION

[Only the soils suitable for production of commercial trees are listed]

Soil name and map symbol	Characteristic vegetation	Incidence
		Pct
1, 2, 3 Alderwood	Salal	42
	Evergreen huckleberry	21
	Oregon-grape	7
	Brackenfern	7
	Western swordfern	7
	Huckleberry	7
5 Belfast	Trailing blackberry	25
	Western swordfern	15
	Salmonberry	10
	Salal	10
	Oregon-grape	10
	Brackenfern	8
6 Bellingham	Trailing blackberry	25
	Western swordfern	15
	Thimbleberry	15
	Salmonberry	15
	Brackenfern	8
	Huckleberry	5
7, 8, 9 Cathcart	Western swordfern	25
	Trailing blackberry	21
	Red huckleberry	6
11, 12, 13 Grove	Salal	30
	Evergreen huckleberry	20
	Oregon-grape	20
	Brackenfern	10
	Western swordfern	10
	Salmonberry	5
	Creambush oceanspray	5
14, 15, 16, 17 Harstine	Salal	47
	Western swordfern	20
	Evergreen huckleberry	10
	Oregon-grape	7
	Kinnikinnick	6
	Red huckleberry	5
	Trailing blackberry	5
18, 19, 20 Indianola	Salal	32
	Brackenfern	16
	Huckleberry	8
	Western swordfern	7
	Trailing blackberry	5
21*:		
Indianola	Salal	32
	Brackenfern	16
	Huckleberry	8
	Western swordfern	7
	Trailing blackberry	5
Kitsap	Oregon-grape	30
	Salal	12
	Western swordfern	10
	Trailing blackberry	8
	Evergreen huckleberry	8
	Brackenfern	8

See footnote at end of table.

TABLE 7.--WOODLAND UNDERSTORY VEGETATION--Continued

Soil name and map symbol	Characteristic vegetation	Incidence
		Pct
22, 23 Kapowsin	Western swordfern	16
	Salal	14
	Oregon-grape	12
	Brackenfern	12
	Huckleberry	12
	Trailing blackberry	12
	Evergreen blackberry	12
	Red huckleberry	10
24 Kapowsin Variant	Trailing blackberry	20
	Oregon-grape	20
	Salal	10
	Brackenfern	10
	Huckleberry	8
	Western swordfern	7
25, 26 Kilchis	Salal	30
	Evergreen huckleberry	20
	Rhododendron	10
	Oregon-grape	10
	Creambush oceanspray	5
27*:		
Kilchis	Salal	30
	Evergreen huckleberry	20
	Rhododendron	10
	Oregon-grape	10
	Creambush oceanspray	5
Shelton	Salal	40
	Evergreen huckleberry	25
	Brackenfern	10
	Oregon-grape	10
	Rhododendron	5
28, 29, 30, 31 Kitsap	Oregon-grape	30
	Salal	12
	Western swordfern	10
	Trailing blackberry	8
	Evergreen huckleberry	8
	Brackenfern	8
32 McKenna	Oregon-grape	30
	Western swordfern	10
	Red huckleberry	8
	Trailing blackberry	8
	Salmonberry	5
34, 35, 36 Neilton	Salal	28
	Brackenfern	15
	Oregon-grape	12
	Trailing blackberry	8
	Western swordfern	7
	Huckleberry	5
37 Norma	Trailing blackberry	25
	Western swordfern	15
	Thimbleberry	15
	Salmonberry	15
	Brackenfern	8
	Huckleberry	5
39, 40, 41 Poulsbo	Salal	13
	Evergreen huckleberry	8
42*, 43*:		
Poulsbo	Salal	13
	Evergreen huckleberry	8

See footnote at end of table.

TABLE 7.--WOODLAND UNDERSTORY VEGETATION--Continued

Soil name and map symbol	Characteristic vegetation	Incidence
		Pct
42*, 43*:		
Ragnar	Salal	25
	Oregon-grape	20
	Brackenfern	15
	Western swordfern	10
	Trailing blackberry	10
	Huckleberry	5
	Evergreen huckleberry	5
44, 45, 46 Ragnar	Salal	25
	Oregon-grape	20
	Brackenfern	15
	Western swordfern	10
	Trailing blackberry	10
	Huckleberry	5
	Evergreen huckleberry	5
47*:		
Ragnar	Salal	25
	Oregon-grape	20
	Brackenfern	15
	Western swordfern	10
	Trailing blackberry	10
	Huckleberry	5
	Evergreen huckleberry	5
Poulsbo	Salal	13
	Evergreen huckleberry	8
48 Schneider	Brackenfern	30
	Oregon-grape	20
	Salal	20
	Salmonberry	10
	Vine maple	5
51, 52, 53, 54, 55, 56, 57 Shelton	Salal	40
	Evergreen huckleberry	25
	Brackenfern	10
	Oregon-grape	10
	Rhododendron	5
58*:		
Shelton	Salal	40
	Evergreen huckleberry	25
	Brackenfern	10
	Oregon-grape	10
	Rhododendron	5
McKenna	Oregon-grape	30
	Western swordfern	10
	Red huckleberry	8
	Trailing blackberry	8
	Salmonberry	5
59, 60, 61 Sinclair	Salal	20
	Brackenfern	15
	Evergreen huckleberry	15
	Oregon-grape	10
	Western swordfern	10
	Trailing blackberry	10
	Huckleberry	10
63*:		
Urban land.		
Alderwood	Salal	42
	Evergreen huckleberry	21
	Oregon-grape	7
	Brackenfern	7
	Western swordfern	7
	Huckleberry	7

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1 Alderwood	Slight	Slight	Severe: small stones.	Slight.
2 Alderwood	Moderate: slope.	Moderate: slope.	Severe: slope, small stones.	Slight.
3 Alderwood	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.
4* Beaches.				
5 Belfast	Severe: floods.	Slight	Moderate: floods.	Slight.
6 Bellingham	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
7 Cathcart	Moderate: dusty.	Moderate: dusty.	Moderate: slope, small stones, dusty.	Severe: erodes easily.
8 Cathcart	Moderate: slope, dusty.	Moderate: slope, dusty.	Severe: slope.	Severe: erodes easily.
9 Cathcart	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
10* Dystric Xerorthents.				
11 Grove	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.
12 Grove	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.
13 Grove	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones.
14 Harstine	Moderate: small stones, wetness.	Moderate: wetness, small stones.	Severe: small stones.	Slight.
15 Harstine	Moderate: slope, small stones, wetness.	Moderate: slope, wetness, small stones.	Severe: slope, small stones.	Slight.
16 Harstine	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.
17 Harstine	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
18 Indianola	Slight	Slight	Moderate: slope, small stones.	Severe: erodes easily.
19 Indianola	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
20 Indianola	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
21*:				
Indianola	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
Kitsap	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
22, 23 Kapowsin	Severe: wetness.	Moderate: wetness, small stones.	Severe: small stones, wetness.	Moderate: wetness.
24 Kapowsin Variant	Moderate: small stones, wetness, percs slowly.	Moderate: wetness, small stones, percs slowly.	Severe: small stones.	Moderate: wetness.
25, 26 Kilchis	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Moderate: large stones.
27*:				
Kilchis	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Moderate: large stones.
Shelton	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.
28 Kitsap	Moderate: wetness, dusty.	Moderate: wetness, dusty.	Moderate: slope, wetness, dusty.	Moderate: wetness, dusty.
29 Kitsap	Moderate: slope, wetness, dusty.	Moderate: slope, wetness, dusty.	Severe: slope.	Moderate: wetness, dusty.
30 Kitsap	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: wetness, slope, dusty.
31 Kitsap	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
32 McKenna	Severe: ponding.	Severe: ponding.	Severe: small stones, ponding.	Severe: ponding, erodes easily.
33 Mukilteo	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
34 Neilton	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
35 Neilton	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight.
36 Neilton	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.
37 Norma	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
38* Pits.				
39 Poulsbo	Severe: wetness.	Moderate: small stones.	Severe: small stones, wetness.	Moderate: wetness.
40 Poulsbo	Severe: wetness.	Moderate: slope, small stones.	Severe: slope, small stones, wetness.	Moderate: wetness.
41 Poulsbo	Severe: slope, wetness.	Severe: slope.	Severe: slope, small stones, wetness.	Moderate: wetness, slope.
42*:				
Poulsbo	Severe: wetness.	Moderate: small stones.	Severe: small stones, wetness.	Moderate: wetness.
Ragnar	Slight	Slight	Moderate: slope, small stones.	Slight.
43*:				
Poulsbo	Severe: wetness.	Moderate: slope, small stones.	Severe: slope, small stones, wetness.	Moderate: wetness.
Ragnar	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
44 Ragnar	Slight	Slight	Moderate: slope, small stones.	Slight.
45 Ragnar	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
46 Ragnar	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
47*:				
Ragnar	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Poulsbo	Severe: slope, wetness.	Severe: slope.	Severe: slope, small stones, wetness.	Moderate: wetness, slope.
48 Schneider	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
49: Semiahmoo	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
50: Shalcar	Severe: ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding.	Severe: ponding, excess humus.
51: Shelton	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.
52: Shelton	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.
53: Shelton	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones.
54: Shelton	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.
55: Shelton	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.
56: Shelton	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.
57: Shelton	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: small stones.
58*:				
Shelton	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.
McKenna	Severe: ponding.	Severe: ponding.	Severe: small stones, ponding.	Severe: ponding, erodes easily.
59: Sinclair	Severe: small stones.	Severe: small stones.	Severe: small stones.	Moderate: wetness.
60: Sinclair	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Moderate: wetness.
61: Sinclair	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Moderate: wetness, slope.
62: Tacoma	Severe: floods, wetness.	Severe: wetness.	Severe: wetness, floods.	Severe: wetness, erodes easily.
63*:				
Urban land.				
Alderwood	Slight	Slight	Severe: small stones.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1------------------ Alderwood	Fair	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor
2, 3--------------- Alderwood	Fair	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
4* Beaches.										
5------------------ Belfast	Fair	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor
6------------------ Bellingham	Fair	Fair	Good	Fair	Good	Good	Good	Fair	Good	Good
7, 8, 9------------ Cathcart	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor
10* Dystric Xerorthents.										
11, 12, 13--------- Grove	Poor	Poor	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
14----------------- Harstine	Poor	Poor	Good	Good	Good	Poor	Very poor	Poor	Good	Very poor
15, 16------------- Harstine	Poor	Poor	Good	Good	Good	Very poor	Very poor	Poor	Good	Very poor
17----------------- Harstine	Very poor	Very poor	Good	Good	Good	Very poor	Very poor	Very poor	Good	Very poor
18, 19, 20--------- Indianola	Fair	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor
21*:										
Indianola---------	Very poor	Very poor	Fair	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor
Kitsap------------	Very poor	Very poor	Good	Good	Good	Very poor	Very poor	Poor	Good	Very poor
22----------------- Kapowsin	Fair	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor
23----------------- Kapowsin	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor
24----------------- Kapowsin Variant	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
25, 26------------- Kilchis	Very poor	Very poor	Fair	Poor	Fair	Very poor	Very poor	Very poor	Poor	Very poor
27*:										
Kilchis-----------	Very poor	Very poor	Fair	Poor	Fair	Very poor	Very poor	Very poor	Poor	Very poor

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
27*: Shelton	Poor	Poor	Good	Good	Good	Very poor	Very poor	Poor	Good	Very poor
28 Kitsap	Good	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor
29 Kitsap	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor
30 Kitsap	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor
31 Kitsap	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
32 McKenna	Poor	Fair	Good	Fair	Good	Poor	Poor	Fair	Fair	Fair
33 Mukilteo	Good	Good	Good	Poor	Poor	Good	Good	Good	Poor	Good
34, 35, 36 Neilton	Poor	Poor	Fair	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor
37 Norma	Poor	Fair	Good	Fair	Good	Good	Good	Fair	Good	Good
38* Pits.										
39 Poulsbo	Fair	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor
40, 41 Poulsbo	Fair	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
42*: Poulsbo	Fair	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor
Ragnar	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
43*: Poulsbo	Fair	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
Ragnar	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
44, 45, 46 Ragnar	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
47*: Ragnar	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
Poulsbo	Fair	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
48 Schneider	Very poor	Very poor	Good	Good	Good	Very poor	Very poor	Poor	Fair	Very poor
49 Semiahmoo	Good	Good	Good	Poor	Poor	Good	Good	Good	Poor	Good

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
50 Shalcar	Good	Good	Good	Poor	Poor	Good	Good	Good	Poor	Good
51 Shelton	Fair	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor
52, 53 Shelton	Fair	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
54 Shelton	Poor	Poor	Good	Good	Good	Very poor	Very poor	Poor	Good	Very poor
55 Shelton	Poor	Poor	Fair	Fair	Fair	Poor	Poor	Poor	Fair	Poor
56, 57 Shelton	Poor	Poor	Fair	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor
58*:										
Shelton	Poor	Poor	Fair	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor
McKenna	Poor	Fair	Good	Fair	Good	Poor	Poor	Fair	Fair	Poor
59 Sinclair	Fair	Fair	Good	Good	Good	Poor	Very poor	Fair	Good	Very poor
60, 61 Sinclair	Fair	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor
62 Tacoma	Very poor	Poor	Good	Poor	Good	Good	Good	Poor	Fair	Good
63*:										
Urban land.										
Alderwood	Fair	Fair	Good	Good	Good	Poor	Very poor	Fair	Good	Very poor

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
1----------------- Alderwood	Moderate: cemented pan, wetness.	Slight-----------	Moderate: wetness, cemented pan.	Slight------------	Slight.
2----------------- Alderwood	Moderate: cemented pan, wetness, slope.	Moderate: slope.	Moderate: wetness, cemented pan, slope.	Severe: slope.	Moderate: slope.
3----------------- Alderwood	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
4* Beaches.					
5----------------- Belfast	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
6----------------- Bellingham	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
7----------------- Cathcart	Slight-----------	Slight-----------	Slight-----------	Moderate: slope.	Slight.
8----------------- Cathcart	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
9----------------- Cathcart	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
10* Dystric Xerorthents.					
11---------------- Grove	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
12---------------- Grove	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
13---------------- Grove	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
14---------------- Harstine	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
15---------------- Harstine	Severe: wetness.	Moderate: wetness, slope.	Severe: wetness.	Severe: slope.	Moderate: wetness, slope.
16, 17------------ Harstine	Severe: wetness, slope.	Severe: slope.	Severe: wetness, slope.	Severe: slope.	Severe: slope.
18---------------- Indianola	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
19---------------- Indianola	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
20----------------- Indianola	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
21*:					
Indianola---------	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Kitsap-----------	Severe: wetness, slope.	Severe: slope.	Severe: wetness, slope.	Severe: slope.	Severe: low strength, slope.
22, 23------------ Kapowsin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness.
24----------------- Kapowsin Variant	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: low strength.
25, 26------------ Kilchis	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.
27*:					
Kilchis----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Shelton----------	Severe: wetness, slope.	Severe: slope.	Severe: wetness, slope.	Severe: slope.	Severe: slope.
28----------------- Kitsap	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: low strength.
29----------------- Kitsap	Severe: wetness.	Moderate: wetness, shrink-swell, slope.	Severe: wetness.	Severe: slope.	Severe: low strength.
30, 31------------ Kitsap	Severe: wetness, slope.	Severe: slope.	Severe: wetness, slope.	Severe: slope.	Severe: low strength, slope.
32----------------- McKenna	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
33----------------- Mukilteo	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding.
34----------------- Neilton	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
35----------------- Neilton	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
36----------------- Neilton	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
37----------------- Norma	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
38* Pits.					
39 Poulsbo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness.
40 Poulsbo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, slope.	Moderate: wetness, slope.
41 Poulsbo	Severe: wetness, slope.	Severe: wetness, slope.	Severe: wetness, slope.	Severe: wetness, slope.	Severe: slope.
42*:					
Poulsbo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness.
Ragnar	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
43*:					
Poulsbo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness, slope.	Moderate: wetness, slope.
Ragnar	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
44 Ragnar	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
45 Ragnar	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
46 Ragnar	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
47*:					
Ragnar	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Poulsbo	Severe: wetness, slope.	Severe: wetness, slope.	Severe: wetness, slope.	Severe: wetness, slope.	Severe: slope.
48 Schneider	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
49 Semiahmoo	Severe: cutbanks cave, excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding.
50 Shalcar	Severe: excess humus, ponding.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding, low strength.	Severe: ponding.
51 Shelton	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
52 Shelton	Severe: wetness.	Moderate: wetness, slope.	Severe: wetness.	Severe: slope.	Moderate: wetness, slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
53, 54------------ Shelton	Severe: wetness, slope.	Severe: slope.	Severe: wetness, slope.	Severe: slope.	Severe: slope.
55---------------- Shelton	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
56---------------- Shelton	Severe: wetness.	Moderate: wetness, slope.	Severe: wetness.	Severe: slope.	Moderate: wetness, slope.
57---------------- Shelton	Severe: wetness, slope.	Severe: slope.	Severe: wetness, slope.	Severe: slope.	Severe: slope.
58*:					
Shelton----------	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Moderate: wetness.
McKenna----------	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
59---------------- Sinclair	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Moderate: wetness.
60---------------- Sinclair	Severe: wetness.	Moderate: wetness, slope.	Severe: wetness.	Severe: slope.	Moderate: wetness, slope.
61---------------- Sinclair	Severe: wetness, slope.	Severe: slope.	Severe: wetness, slope.	Severe: slope.	Severe: slope.
62---------------- Tacoma	Severe: cutbanks cave, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness, floods.
63*: Urban land.					
Alderwood---------	Moderate: cemented pan, wetness.	Slight-----------	Moderate: wetness, cemented pan.	Moderate: slope.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1: Alderwood	Severe: cemented pan, wetness.	Severe: seepage, cemented pan.	Severe: seepage.	Severe: cemented pan, seepage.	Poor: area reclaim, small stones.
2: Alderwood	Severe: cemented pan, wetness.	Severe: seepage, cemented pan, slope.	Severe: seepage.	Severe: cemented pan, seepage.	Poor: area reclaim, small stones.
3: Alderwood	Severe: cemented pan, wetness, slope.	Severe: seepage, cemented pan, slope.	Severe: seepage, slope.	Severe: cemented pan, seepage, slope.	Poor: area reclaim, small stones, slope.
4*. Beaches.					
5: Belfast	Severe: floods, wetness.	Severe: floods.	Severe: floods, wetness.	Severe: floods.	Fair: too sandy.
6: Bellingham	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
7: Cathcart	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
8: Cathcart	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
9: Cathcart	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
10*. Dystric Xerorthents					
11: Grove	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
12: Grove	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
13: Grove	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
14: Harstine	Severe: cemented pan, wetness.	Severe: cemented pan, wetness.	Moderate: cemented pan, wetness.	Severe: cemented pan.	Poor: area reclaim, small stones.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
15------------------ Harstine	Severe: cemented pan, wetness.	Severe: cemented pan, slope, wetness.	Moderate: cemented pan, wetness, slope.	Severe: cemented pan.	Poor: area reclaim, small stones.
16, 17-------------- Harstine	Severe: cemented pan, wetness, slope.	Severe: cemented pan, slope, wetness.	Severe: slope.	Severe: cemented pan, slope.	Poor: area reclaim, small stones, slope.
18------------------ Indianola	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
19------------------ Indianola	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
20------------------ Indianola	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
21*:					
Indianola----------	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Kitsap-------------	Severe: wetness, percs slowly, slope.	Severe: slope, wetness.	Severe: wetness, slope.	Severe: slope.	Poor: hard to pack, slope.
22, 23-------------- Kapowsin	Severe: cemented pan, wetness.	Severe: cemented pan, wetness.	Severe: wetness.	Severe: cemented pan, wetness.	Poor: area reclaim, wetness.
24------------------ Kapowsin Variant	Severe: cemented pan, wetness.	Severe: cemented pan, wetness.	Severe: wetness.	Severe: cemented pan.	Poor: area reclaim.
25, 26-------------- Kilchis	Severe: depth to rock.	Severe: seepage, depth to rock, large stones.	Severe: depth to rock, seepage, large stones.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones.
27*:					
Kilchis------------	Severe: depth to rock.	Severe: seepage, depth to rock, large stones.	Severe: depth to rock, seepage, large stones.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones.
Shelton------------	Severe: cemented pan, wetness, poor filter.	Severe: seepage, cemented pan, slope.	Severe: seepage, slope.	Severe: cemented pan, seepage, slope.	Poor: area reclaim, small stones, slope.
28------------------ Kitsap	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Moderate: wetness.	Poor: hard to pack.
29------------------ Kitsap	Severe: wetness, percs slowly.	Severe: slope, wetness.	Severe: wetness.	Moderate: wetness, slope.	Poor: hard to pack.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
30, 31----------- Kitsap	Severe: wetness, percs slowly, slope.	Severe: slope, wetness.	Severe: wetness, slope.	Severe: slope.	Poor: hard to pack, slope.
32----------- McKenna	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: small stones, ponding.
33----------- Mukilteo	Severe: ponding.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: ponding, excess humus.
34----------- Neilton	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
35----------- Neilton	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
36----------- Neilton	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
37----------- Norma	Severe: ponding.	Severe: seepage, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
38* Pits.					
39----------- Poulsbo	Severe: cemented pan, wetness.	Severe: seepage, cemented pan.	Severe: seepage, wetness.	Severe: cemented pan, seepage, wetness.	Poor: area reclaim, small stones.
40----------- Poulsbo	Severe: cemented pan, wetness.	Severe: seepage, cemented pan, slope.	Severe: seepage, wetness.	Severe: cemented pan, seepage, wetness.	Poor: area reclaim, small stones.
41----------- Poulsbo	Severe: cemented pan, wetness, slope.	Severe: seepage, cemented pan, slope.	Severe: seepage, wetness, slope.	Severe: cemented pan, seepage, wetness.	Poor: area reclaim, small stones, slope.
42*:					
Poulsbo-----------	Severe: cemented pan, wetness.	Severe: seepage, cemented pan.	Severe: seepage, wetness.	Severe: cemented pan, seepage, wetness.	Poor: area reclaim, small stones.
Ragnar-----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
43*:					
Poulsbo-----------	Severe: cemented pan, wetness.	Severe: seepage, cemented pan, slope.	Severe: seepage, wetness.	Severe: cemented pan, seepage, wetness.	Poor: area reclaim, small stones.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
43*:					
Ragnar	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
44 Ragnar	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
45 Ragnar	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
46 Ragnar	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
47*:					
Ragnar	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Poulsbo	Severe: cemented pan, wetness, slope.	Severe: seepage, cemented pan, slope.	Severe: seepage, wetness, slope.	Severe: cemented pan, seepage, wetness.	Poor: area reclaim, small stones, slope.
48 Schneider	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: small stones, slope.
49 Semiahmoo	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: ponding, excess humus.
50 Shalcar	Severe: ponding, percs slowly.	Severe: excess humus, ponding.	Severe: ponding, too clayey, excess humus.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
51 Shelton	Severe: cemented pan, wetness, poor filter.	Severe: seepage, cemented pan.	Severe: seepage.	Severe: cemented pan, seepage.	Poor: area reclaim, small stones.
52 Shelton	Severe: cemented pan, wetness, poor filter.	Severe: seepage, cemented pan, slope.	Severe: seepage.	Severe: cemented pan, seepage.	Poor: area reclaim, small stones.
53, 54 Shelton	Severe: cemented pan, wetness, poor filter.	Severe: seepage, cemented pan, slope.	Severe: seepage, slope.	Severe: cemented pan, seepage, slope.	Poor: area reclaim, small stones, slope.
55 Shelton	Severe: cemented pan, wetness, poor filter.	Severe: seepage, cemented pan.	Severe: seepage.	Severe: cemented pan, seepage.	Poor: area reclaim, small stones.
56 Shelton	Severe: cemented pan, wetness, poor filter.	Severe: seepage, cemented pan, slope.	Severe: seepage.	Severe: cemented pan, seepage.	Poor: area reclaim, small stones.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
57------------------ Shelton	Severe: cemented pan, wetness, poor filter.	Severe: seepage, cemented pan, slope.	Severe: seepage, slope.	Severe: cemented pan, seepage, slope.	Poor: area reclaim, small stones, slope.
58*:					
Shelton------------	Severe: cemented pan, wetness, poor filter.	Severe: seepage, cemented pan.	Severe: seepage.	Severe: cemented pan, seepage.	Poor: area reclaim, small stones.
McKenna------------	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: small stones, ponding.
59------------------ Sinclair	Severe: cemented pan, wetness.	Severe: seepage, cemented pan.	Severe: seepage, wetness.	Severe: cemented pan, seepage.	Poor: area reclaim, small stones.
60------------------ Sinclair	Severe: cemented pan, wetness.	Severe: seepage, cemented pan, slope.	Severe: seepage, wetness.	Severe: cemented pan, seepage.	Poor: area reclaim, small stones.
61------------------ Sinclair	Severe: cemented pan, wetness, slope.	Severe: seepage, cemented pan, slope.	Severe: seepage, wetness, slope.	Severe: cemented pan, seepage, slope.	Poor: area reclaim, small stones, slope.
62------------------ Tacoma	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Poor: wetness, thin layer.
63*: Urban land.					
Alderwood----------	Severe: cemented pan, wetness.	Severe: seepage, cemented pan.	Severe: seepage.	Severe: cemented pan, seepage.	Poor: area reclaim, small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1, 2 Alderwood	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
3 Alderwood	Fair: wetness, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
4* Beaches.				
5 Belfast	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
6 Bellingham	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
7 Cathcart	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
8 Cathcart	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
9 Cathcart	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
10* Dystric Xerorthents.				
11, 12 Grove	Good	Probable	Probable	Poor: small stones, area reclaim.
13 Grove	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
14, 15 Harstine	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
16 Harstine	Fair: wetness. slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
17 Harstine	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
18, 19 Indianola	Good	Probable	Improbable: too sandy.	Poor: thin layer.
20 Indianola	Fair: slope.	Probable	Improbable: too sandy.	Poor: thin layer, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
21*:				
Indianola	Poor: slope.	Probable	Improbable: too sandy.	Poor: thin layer, slope.
Kitsap	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
22, 23 Kapowsin	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
24 Kapowsin Variant	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
25, 26 Kilchis	Poor: area reclaim.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, small stones.
27*:				
Kilchis	Poor: area reclaim.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: area reclaim, small stones.
Shelton	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
28 Kitsap	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
29 Kitsap	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
30 Kitsap	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
31 Kitsap	Poor: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
32 McKenna	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, wetness.
33 Mukilteo	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
34, 35 Neilton	Good	Probable	Probable	Poor: small stones, area reclaim.
36 Neilton	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
37 Norma	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
38* Pits.				

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
39, 40 Poulsbo	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
41 Poulsbo	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
42*:				
Poulsbo	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Ragnar	Good	Probable	Improbable: too sandy.	Fair: small stones, thin layer.
43*:				
Poulsbo	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Ragnar	Good	Probable	Improbable: too sandy.	Fair: small stones, thin layer, slope.
44 Ragnar	Good	Probable	Improbable: too sandy.	Fair: small stones, thin layer.
45 Ragnar	Good	Probable	Improbable: too sandy.	Fair: small stones, thin layer, slope.
46 Ragnar	Fair: slope.	Probable	Improbable: too sandy.	Poor: slope.
47*:				
Ragnar	Fair: slope.	Probable	Improbable: too sandy.	Poor: slope.
Poulsbo	Poor: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
48 Schneider	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope.
49 Semiahmoo	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
50 Shalcar	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess humus, wetness.
51, 52 Shelton	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
53 Shelton	Fair: wetness, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
54 Shelton	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
55, 56: Shelton	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
57: Shelton	Fair: wetness, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
58*:				
Shelton	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
McKenna	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, wetness.
59, 60: Sinclair	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
61: Sinclair	Fair: wetness, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
62: Tacoma	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
63*:				
Urban land.				
Alderwood	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions
1 Alderwood	Severe: seepage.	Severe: seepage.	Severe: no water.	Cemented pan	Wetness, droughty, cemented pan.	Cemented pan.
2, 3 Alderwood	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Cemented pan, slope.	Wetness, droughty, cemented pan.	Slope, cemented pan.
4* Beaches.						
5 Belfast	Moderate: seepage.	Severe: piping.	Severe: cutbanks cave.	Deep to water	Floods	Erodes easily, too sandy.
6 Bellingham	Slight	Severe: ponding.	Severe: slow refill.	Ponding, percs slowly.	Ponding, percs slowly.	Ponding, percs slowly.
7 Cathcart	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Erodes easily.
8, 9 Cathcart	Severe: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, erodes easily.	Slope, erodes easily.
10* Dystric Xerorthents.						
11 Grove	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water	Droughty	Too sandy.
12, 13 Grove	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Droughty, slope.	Slope, too sandy.
14 Harstine	Moderate: seepage, cemented pan.	Moderate: thin layer, seepage, wetness.	Severe: no water.	Cemented pan	Wetness, droughty, cemented pan.	Cemented pan, wetness.
15, 16, 17 Harstine	Severe: slope.	Moderate: thin layer, seepage, wetness.	Severe: no water.	Cemented pan, slope.	Wetness, droughty, cemented pan.	Slope, cemented pan, wetness.
18 Indianola	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, slope.	Erodes easily, too sandy.
19, 20 Indianola	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, slope.	Slope, erodes easily, too sandy.
21*:						
Indianola	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, slope.	Slope, erodes easily, too sandy.
Kitsap	Severe: slope.	Severe: piping, hard to pack.	Severe: no water.	Percs slowly, slope.	Wetness, percs slowly, slope.	Slope, erodes easily, wetness.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions
22----------------- Kapowsin	Moderate: seepage, cemented pan.	Severe: thin layer.	Severe: no water.	Cemented pan---	Wetness, cemented pan.	Cemented pan, erodes easily.
23----------------- Kapowsin	Moderate: seepage, cemented pan, slope.	Severe: thin layer.	Severe: no water.	Cemented pan, slope.	Wetness, cemented pan, slope.	Cemented pan, erodes easily.
24----------------- Kapowsin Variant	Moderate: cemented pan.	Severe: thin layer.	Severe: no water.	Cemented pan---	Wetness, cemented pan.	Cemented pan, wetness.
25, 26------------- Kilchis	Severe: depth to rock.	Severe: seepage, large stones.	Severe: no water.	Deep to water--	Large stones, droughty, depth to rock.	Large stones, depth to rock.
27*:						
Kilchis-----------	Severe: depth to rock.	Severe: seepage, large stones.	Severe: no water.	Deep to water--	Large stones, droughty, depth to rock.	Large stones, depth to rock.
Shelton-----------	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Cemented pan, slope.	Wetness, droughty, cemented pan.	Slope, cemented pan, wetness.
28----------------- Kitsap	Moderate: seepage, slope.	Severe: piping, hard to pack.	Severe: no water.	Percs slowly, slope.	Wetness, percs slowly, slope.	Erodes easily, wetness.
29, 30, 31--------- Kitsap	Severe: slope.	Severe: piping, hard to pack.	Severe: no water.	Percs slowly, slope.	Wetness, percs slowly, slope.	Slope, erodes easily, wetness.
32----------------- McKenna	Moderate: slope.	Severe: ponding.	Severe: no water.	Ponding, percs slowly, slope.	Ponding, percs slowly, slope.	Erodes easily, ponding, percs slowly.
33----------------- Mukilteo	Moderate: seepage.	Severe: excess humus, ponding.	Moderate: slow refill.	Ponding, subsides.	Ponding---------	Ponding.
34----------------- Neilton	Severe: seepage.	Severe: seepage.	Severe: no water.	Deep to water--	Droughty, fast intake.	Too sandy.
35, 36------------- Neilton	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water--	Droughty, fast intake, slope.	Slope, too sandy.
37----------------- Norma	Severe: seepage.	Severe: piping, ponding.	Severe: cutbanks cave.	Ponding, cutbanks cave.	Ponding---------	Ponding, too sandy.
38* Pits.						
39----------------- Poulsbo	Severe: seepage.	Severe: seepage.	Severe: no water.	Cemented pan---	Wetness, droughty, cemented pan.	Cemented pan, wetness.
40, 41------------- Poulsbo	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Cemented pan, slope.	Wetness, droughty, cemented pan.	Slope, cemented pan, wetness.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions
42*:						
Poulsbo----------	Severe: seepage.	Severe: seepage.	Severe: no water.	Cemented pan---	Wetness, droughty, cemented pan.	Cemented pan, wetness.
Ragnar-----------	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Favorable------	Too sandy.
43*:						
Poulsbo----------	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Cemented pan, slope.	Wetness, droughty, cemented pan.	Slope, cemented pan, wetness.
Ragnar-----------	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Slope----------	Slope, too sandy.
44---------------- Ragnar	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Favorable------	Too sandy.
45, 46------------ Ragnar	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Slope----------	Slope, too sandy.
47*:						
Ragnar-----------	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water--	Slope----------	Slope, too sandy.
Poulsbo----------	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Cemented pan, slope.	Wetness, droughty, cemented pan.	Slope, cemented pan, wetness.
48---------------- Schneider	Severe: slope.	Severe: seepage.	Severe: no water.	Deep to water--	Large stones, droughty, slope.	Slope, large stones.
49---------------- Semiahmoo	Slight---------	Severe: excess humus, ponding.	Severe: slow refill, cutbanks cave.	Ponding, subsides.	Ponding--------	Ponding.
50---------------- Shalcar	Slight---------	Severe: piping, excess humus, ponding.	Severe: slow refill.	Ponding, subsides.	Ponding--------	Ponding.
51---------------- Shelton	Severe: seepage.	Severe: seepage.	Severe: no water.	Cemented pan---	Wetness, droughty, cemented pan.	Cemented pan, wetness.
52, 53, 54-------- Shelton	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Cemented pan, slope.	Wetness, droughty, cemented pan.	Slope, cemented pan, wetness.
55---------------- Shelton	Severe: seepage.	Severe: seepage.	Severe: no water.	Cemented pan---	Wetness, droughty, cemented pan.	Cemented pan, wetness.
56, 57------------ Shelton	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Cemented pan, slope.	Wetness, droughty, cemented pan.	Slope, cemented pan, wetness.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions
58*:						
Shelton----------	Severe: seepage.	Severe: seepage.	Severe: no water.	Cemented pan, slope.	Wetness, droughty,	Cemented pan, wetness.
McKenna----------	Moderate: slope.	Severe: ponding.	Severe: no water.	Ponding, percs slowly, slope.	Ponding, percs slowly, slope.	Erodes easily, ponding, percs slowly.
59---------------- Sinclair	Severe: seepage.	Severe: seepage.	Severe: no water.	Cemented pan, slope.	Wetness, droughty, cemented pan.	Cemented pan, wetness.
60, 61------------ Sinclair	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Cemented pan, slope.	Wetness, droughty, cemented pan.	Slope, cemented pan, wetness.
62---------------- Tacoma	Slight---------	Severe: piping, wetness.	Severe: slow refill, cutbanks cave.	Floods---------	Wetness, erodes easily, floods.	Erodes easily, wetness.
63*: Urban land.						
Alderwood--------	Severe: seepage.	Severe: seepage.	Severe: no water.	Cemented pan, slope.	Wetness, droughty, cemented pan.	Cemented pan.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1, 2, 3---------- Alderwood	0-1	Very gravelly sandy loam.	GM	A-1	0-5	45-60	35-50	25-35	15-25	20-30	NP-5
	1-22	Very gravelly loam, very gravelly sandy loam, very gravelly fine sandy loam.	GM	A-1, A-2	0-10	35-55	35-50	25-45	10-30	20-30	NP-5
	22-60	Cemented---------	---	---	---	---	---	---	---	---	---
4* Beaches.											
5---------------- Belfast	0-5	Loam-------------	ML	A-4	0	100	100	80-90	70-80	30-40	5-10
	5-22	Silt loam, loam, fine sandy loam.	ML	A-4	0	100	100	75-85	65-75	30-40	5-10
	22-60	Stratified silt loam to loamy sand.	ML	A-4	0-5	90-100	85-100	70-80	50-60	25-35	NP-10
6---------------- Bellingham	0-8	Silty clay loam	OL, OH, ML, MH	A-7	0	100	100	95-100	85-100	40-55	15-25
	8-60	Silty clay, clay	CL, CH	A-7	0	100	100	95-100	85-100	45-65	20-40
7, 8, 9---------- Cathcart	0-9	Silt loam--------	ML	A-4, A-5	0	90-95	85-95	70-80	60-70	35-45	5-10
	9-38	Loam, sandy loam, silt loam.	ML, SM	A-4, A-5	0	80-95	80-90	70-85	45-65	35-45	5-10
	38-60	Loam, clay loam	ML, SM	A-4	0	80-90	75-85	65-75	40-60	30-40	5-10
10* Dystric Xerorthents.											
11, 12, 13------- Grove	0-17	Very gravelly sandy loam.	GM	A-1	0-5	25-35	20-30	10-25	5-15	20-25	NP-5
	17-30	Very gravelly coarse sand, extremely gravelly loamy sand.	GP-GM	A-1	0-5	25-35	15-30	10-15	5-10	---	NP
	30-60	Very gravelly sand, very gravelly coarse sand.	GP	A-1	0-5	35-50	15-30	5-15	0-5	---	NP
14, 15, 16, 17--- Harstine	0-32	Gravelly sandy loam.	SM	A-2, A-1	0-5	65-85	50-75	40-55	20-35	---	NP
	32-60	Cemented---------	---	---	---	---	---	---	---	---	---
18, 19, 20------- Indianola	0-7	Loamy sand-------	SM	A-2	0	80-100	75-100	50-75	20-35	---	NP
	7-29	Loamy fine sand, loamy sand, sand.	SM	A-2	0	80-100	75-100	50-75	20-35	---	NP
	29-60	Sand, loamy fine sand, fine sand.	SM, SP-SM, SP	A-2, A-3, A-1	0	80-100	75-100	40-75	0-30	---	NP
21*: Indianola-------	0-7	Loamy sand-------	SM	A-2	0	80-100	75-100	50-75	20-35	---	NP
	7-29	Loamy fine sand, loamy sand, sand.	SM	A-2	0	80-100	75-100	50-75	20-35	---	NP
	29-60	Sand, loamy fine sand, fine sand.	SM, SP-SM, SP	A-2, A-3, A-1	0	80-100	75-100	40-75	0-30	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
21*:											
Kitsap	0-13	Silt loam	ML	A-4	0	100	100	90-100	80-90	25-40	NP-10
	13-35	Silt loam, silty clay loam.	ML, MH	A-4, A-5, A-7	0	95-100	90-100	90-100	85-100	35-55	5-20
	35-60	Stratified silt to silty clay loam.	ML, MH	A-4, A-5, A-7	0	95-100	90-100	90-100	85-100	35-55	5-20
22, 23 Kapowsin	0-5	Gravelly loam	SM, ML	A-4	0-5	70-80	55-65	50-65	35-55	20-40	NP-10
	5-23	Gravelly loam, gravelly sandy loam, loam.	SM	A-4	0-10	70-80	65-80	45-60	35-45	20-35	NP-10
	23	Cemented	---	---	---	---	---	---	---	---	---
24 Kapowsin Variant	0-7	Gravelly clay loam.	CL	A-6	0	65-75	60-70	60-70	50-60	30-40	15-20
	7-20	Silty clay loam, gravelly silty clay loam, loam.	CL	A-6	0	70-85	65-80	65-75	55-75	30-40	15-20
	20-60	Cemented	---	---	---	---	---	---	---	---	---
25, 26 Kilchis	0-5	Very gravelly sandy loam.	GM	A-1	15-30	40-60	35-55	20-40	10-25	---	NP
	5-19	Very gravelly silt loam, very gravelly loam, very cobbly loam.	GM	A-1, A-2, A-4	25-55	30-60	25-50	20-45	15-40	20-30	NP-5
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
27*:											
Kilchis	0-5	Very gravelly sandy loam.	GM	A-1	15-30	40-60	35-55	20-40	10-25	---	NP
	5-19	Very gravelly silt loam, very gravelly loam, very cobbly loam.	GM	A-1, A-2, A-4	25-55	30-60	25-50	20-45	15-40	20-30	NP-5
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Shelton	0-3	Very gravelly sandy loam.	GM	A-1	0-5	30-60	25-50	20-40	10-25	---	NP
	3-25	Very gravelly sandy loam, very gravelly loam.	GM	A-1	0-10	25-45	20-40	20-30	10-20	20-25	NP-5
	25-60	Cemented	---	---	---	---	---	---	---	---	---
28, 29, 30, 31 Kitsap	0-13	Silt loam	ML	A-4	0	100	100	90-100	80-90	25-40	NP-10
	13-35	Silt loam, silty clay loam.	ML, MH	A-4, A-5, A-7	0	95-100	90-100	90-100	85-100	35-55	5-20
	35-60	Stratified silt to silty clay loam.	ML, MH	A-4, A-5, A-7	0	95-100	90-100	90-100	85-100	35-55	5-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
32-------------- McKenna	0-6	Gravelly loam----	ML, GM	A-4	0-5	60-80	55-75	55-65	40-60	20-40	NP-10
	6-28	Very gravelly silt loam, very gravelly clay loam, very gravelly loam.	GM-GC, GC	A-2, A-4, A-6	0-5	30-60	25-50	20-50	20-45	25-40	5-15
	28-37	Very gravelly sandy loam, very gravelly silty clay loam, very gravelly loam.	GM-GC, GC	A-2, A-4, A-6, A-7	0-5	30-60	25-50	20-50	20-45	20-45	5-20
	37-60	Gravelly silty clay.	GC, GM-GC	A-2, A-5, A-6, A-4	0-5	60-80	50-75	40-60	35-50	20-45	5-20
33-------------- Mukilteo	0-6	Sapric material	Pt	A-8	0	---	---	---	---	---	---
	6-60	Hemic material---	Pt	A-8	0	---	---	---	---	---	---
34, 35, 36------- Neilton	0-4	Gravelly loamy sand.	GM	A-2	0-10	60-70	55-65	35-55	20-35	---	NP
	4-19	Very gravelly loamy sand.	GP-GM	A-1	0-15	40-50	30-45	10-20	5-10	---	NP
	19-60	Very gravelly sand, extremely gravelly sand.	GP	A-1	5-15	35-45	20-35	5-15	0-5	---	NP
37-------------- Norma	0-8	Fine sandy loam	SM	A-2, A-1	0	100	100	70-90	20-35	15-20	NP-5
	8-22	Sandy loam, fine sandy loam, silt loam.	SM	A-2, A-4	0	95-100	75-100	50-85	25-45	15-20	NP-5
	22-60	Stratified loamy sand to silty clay loam.	SM, SM-SC	A-2, A-4	0	95-100	75-100	50-70	30-45	15-30	NP-10
38* Pits.											
39, 40, 41------- Poulsbo	0-2	Gravelly sandy loam.	SM	A-2, A-1	0-5	65-75	50-70	35-50	20-30	---	NP
	2-24	Gravelly sandy loam, gravelly loam.	SM	A-1, A-2	0-10	60-70	55-65	30-40	15-35	---	NP
	24-60	Cemented---------	---	---	---	---	---	---	---	---	---
42*, 43*:											
Poulsbo---------	0-2	Gravelly sandy loam.	SM	A-2, A-1	0-5	65-75	50-70	35-50	20-30	---	NP
	2-24	Gravelly sandy loam, gravelly loam.	SM	A-1, A-2	0-10	60-70	55-65	30-40	15-35	---	NP
	24-60	Cemented---------	---	---	---	---	---	---	---	---	---
Ragnar----------	0-4	Fine sandy loam	SM	A-4	0	95-100	85-100	60-85	35-50	---	---
	4-23	Fine sandy loam, sandy loam.	SM	A-4	0	95-100	75-100	60-85	35-50	20-40	NP-10
	23-60	Loamy sand, sand	SM, SP, SP-SM	A-2, A-1, A-3	0	95-100	85-95	45-70	0-20	---	NP
44, 45, 46------- Ragnar	0-4	Fine sandy loam	SM	A-4	0	95-100	85-100	60-85	35-50	---	---
	4-23	Fine sandy loam, sandy loam.	SM	A-4	0	95-100	75-100	60-85	35-50	20-40	NP-10
	23-60	Loamy sand, sand	SM, SP, SP-SM	A-2, A-1, A-3	0	95-100	85-95	45-70	0-20	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
47*:											
Ragnar----------	0-4	Fine sandy loam	SM	A-4	0	95-100	85-100	60-85	35-50	---	---
	4-23	Fine sandy loam, sandy loam.	SM	A-4	0	95-100	75-100	60-85	35-50	20-40	NP-10
	23-60	Loamy sand, sand	SM, SP, SP-SM	A-2, A-1, A-3	0	95-100	85-95	45-70	0-20	---	NP
Poulsbo---------	0-2	Gravelly sandy loam.	SM	A-2, A-1	0-5	65-75	50-70	35-50	20-30	---	NP
	2-24	Gravelly sandy loam, gravelly loam.	SM	A-1, A-2	0-10	60-70	55-65	30-40	15-35	---	NP
	24-60	Cemented---------	---	---	---	---	---	---	---	---	---
48--------------- Schneider	0-6	Very gravelly loam.	GM	A-1, A-2	5-20	25-60	20-50	20-40	15-30	25-35	NP-10
	6-23	Very gravelly loam, very gravelly silt loam, extremely gravelly loam.	GM	A-1, A-2	5-30	30-50	20-40	20-35	15-30	30-40	5-10
	23-48	Very gravelly loam, very gravelly silt loam, extremely gravelly silt loam.	GM	A-1, A-2	5-30	30-50	20-40	20-35	15-30	30-40	5-10
	48	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
49--------------- Semiahmoo	0-66	Muck-------------	Pt	A-8	0	---	---	---	---	---	---
50--------------- Shalcar	0-32	Muck-------------	Pt	A-8	---	---	---	---	---	---	---
	32-60	Stratified sapric material to silty clay.	SM, ML, OL, CL	A-2, A-4, A-6	0	100	100	70-85	30-70	20-35	NP-15
51, 52, 53, 54--- Shelton	0-3	Very gravelly sandy loam.	GM	A-1	0-5	30-60	25-50	20-40	10-25	---	NP
	3-25	Very gravelly sandy loam, very gravelly loam.	GM	A-1	0-10	25-45	20-40	20-30	10-20	20-25	NP-5
	25	Cemented---------	---	---	---	---	---	---	---	---	---
55, 56, 57------- Shelton	0-11	Extremely gravelly sandy loam.	GM, GP-GM	A-1	0-5	20-30	15-25	10-20	5-15	---	NP
	11-22	Extremely gravelly sandy loam, very gravelly loam.	GM	A-1	0-10	25-45	20-40	20-30	10-20	20-25	NP-5
	22	Cemented---------	---	---	---	---	---	---	---	---	---
58*:											
Shelton---------	0-11	Extremely gravelly sandy loam.	GM, GP-GM	A-1	0-5	20-30	15-25	10-20	5-15	---	NP
	11-22	Extremely gravelly sandy loam, very gravelly loam.	GM	A-1	0-10	25-45	20-40	20-30	10-20	20-25	NP-5
	22	Cemented---------	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
58*:											
McKenna----------	0-6	Gravelly loam----	ML, GM	A-4	0-5	60-80	55-75	55-65	40-60	20-40	NP-10
	6-28	Very gravelly silt loam, very gravelly clay loam, very gravelly loam.	GM-GC, GC	A-2, A-4, A-6	0-5	30-60	25-50	20-50	20-45	25-40	5-15
	28-37	Very gravelly sandy loam, very gravelly silty clay loam, very gravelly loam.	GM-GC, GC	A-2, A-4, A-6, A-7	0-5	30-60	25-50	20-50	20-45	20-45	5-20
	37-60	Gravelly silty clay.	GC, GM-GC	A-2, A-5, A-6, A-4	0-5	60-80	50-75	40-60	35-50	20-45	5-20
59, 60, 61-------- Sinclair	0-8	Very gravelly sandy loam.	GM	A-1	0-5	40-60	35-50	25-35	10-20	20-30	NP-5
	8-25	Very gravelly sandy loam, very gravelly loam.	GM	A-1	0-5	45-55	35-50	25-30	10-20	20-30	NP-5
	25-60	Cemented---------	---	---	---	---	---	---	---	---	---
62--------------- Tacoma	0-6	Silt loam--------	ML	A-4	0	100	100	90-100	70-90	15-25	NP-5
	6-36	Silt loam, silty clay loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	85-95	20-40	NP-15
	36-60	Stratified very gravelly sand to clay.	ML, CL, GM, CL-ML	A-6, A-7, A-4, A-5	0	60-95	50-90	45-85	40-80	20-40	5-15
63*: Urban land.											
Alderwood--------	0-1	Very gravelly sandy loam.	GM	A-1	0-5	45-60	35-50	25-35	15-25	20-30	NP-5
	1-22	Very gravelly loam, very gravelly sandy loam, very gravelly fine sandy loam.	GM	A-1, A-2	0-10	35-55	35-50	25-45	10-30	20-30	NP-5
	22-60	Cemented---------	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; the symbol > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	In/hr	In/in	pH				Pct
1, 2, 3---------- Alderwood	0-1	0.6-2.0	0.07-0.12	5.1-6.0	Low------------	0.17	2	5-10
	1-22	2.0-6.0	0.07-0.13	5.1-6.0	Low------------	0.20		
	22-60	---	---	---	---------------	----		
4* Beaches.								
5---------------- Belfast	0-5	0.6-2.0	0.22-0.24	5.6-6.5	Low------------	0.32	5	5-10
	5-22	0.6-2.0	0.19-0.21	5.6-6.5	Low------------	0.37		
	22-60	0.6-2.0	0.18-0.20	5.6-6.5	Low------------	0.43		
6---------------- Bellingham	0-8	0.06-0.2	0.20-0.24	5.6-6.5	High-----------	0.32	5	10-15
	8-60	0.06-0.2	0.20-0.24	6.1-7.3	High-----------	0.24		
7, 8, 9---------- Cathcart	0-9	0.6-2.0	0.18-0.21	4.5-6.0	Low------------	0.37	3	5-10
	9-38	0.6-2.0	0.15-0.17	4.5-6.5	Low------------	0.43		
	38-60	0.6-2.0	0.14-0.17	4.5-6.5	Low------------	0.37		
10* Dystric Xerorthents.								
11, 12, 13------- Grove	0-17	2.0-6.0	0.05-0.08	5.1-6.0	Low------------	0.10	2	2-10
	17-30	6.0-20	0.03-0.05	5.1-6.0	Low------------	0.10		
	30-60	6.0-20	0.02-0.05	5.1-6.0	Low------------	0.05		
14, 15, 16, 17--- Harstine	0-32	0.6-2.0	0.07-0.09	4.5-6.0	Low------------	0.20	2	5-10
	32-60	---	---	---	---------------	----		
18, 19, 20------- Indianola	0-7	2.0-6.0	0.08-0.11	5.1-7.3	Low------------	0.37	5	1-5
	7-29	6.0-20	0.07-0.10	5.1-7.3	Low------------	0.24		
	29-60	6.0-20	0.04-0.07	5.1-7.3	Low------------	0.20		
21*:								
Indianola-------	0-7	2.0-6.0	0.08-0.11	5.1-7.3	Low------------	0.37	5	1-5
	7-29	6.0-20	0.07-0.10	5.1-7.3	Low------------	0.24		
	29-60	6.0-20	0.04-0.07	5.1-7.3	Low------------	0.20		
Kitsap----------	0-13	0.6-2.0	0.19-0.21	5.6-7.3	Low------------	0.32	5	3-10
	13-35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate-------	0.37		
	35-60	0.06-0.2	0.17-0.20	5.6-7.3	Moderate-------	0.37		
22, 23----------- Kapowsin	0-5	0.6-2.0	0.12-0.14	5.6-6.5	Low------------	0.28	2	5-10
	5-23	0.6-2.0	0.12-0.14	5.1-6.5	Low------------	0.43		
	23	---	---	---	---------------	----		
24--------------- Kapowsin Variant	0-7	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-------	0.24	2	6-10
	7-20	0.2-0.6	0.17-0.19	5.1-6.0	Moderate-------	0.28		
	20-60	---	---	---	---------------	----		
25, 26----------- Kilchis	0-5	2.0-6.0	0.04-0.07	4.5-5.5	Low------------	0.10	1	4-8
	5-19	2.0-6.0	0.06-0.09	4.5-5.5	Low------------	0.10		
	19	---	---	---	---------------	----		
27*:								
Kilchis----------	0-5	2.0-6.0	0.04-0.07	4.5-5.5	Low------------	0.10	1	4-8
	5-19	2.0-6.0	0.06-0.09	4.5-5.5	Low------------	0.10		
	19	---	---	---	---------------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	In/hr	In/in	pH				Pct
27*:								
Shelton	0-3	6.0-20	0.07-0.13	5.1-5.5	Low	0.20	2	5-10
	3-25	6.0-20	0.07-0.13	5.1-5.5	Low	0.20		
	25-60	---	---	---	---	----		
28, 29, 30, 31 Kitsap	0-13	0.6-2.0	0.19-0.21	5.6-7.3	Low	0.32	5	3-10
	13-35	0.6-2.0	0.18-0.20	5.6-7.3	Moderate	0.37		
	35-60	0.06-0.2	0.17-0.20	5.6-7.3	Moderate	0.37		
32 McKenna	0-6	0.6-2.0	0.16-0.19	4.5-6.0	Low	0.37	3	3-15
	6-28	0.06-0.2	0.13-0.18	5.1-6.0	Moderate	0.32		
	28-37	<0.06	0.08-0.10	5.6-6.5	Moderate	0.32		
	37-60	<0.06	0.08-0.10	5.6-6.5	Moderate	0.32		
33 Mukilteo	0-6	0.6-2.0	0.30-0.40	4.5-5.0	Low	----	---	---
	6-60	0.6-2.0	0.30-0.40	4.5-5.5	Low	----		
34, 35, 36 Neilton	0-4	6.0-20	0.05-0.07	5.1-6.0	Low	0.17	2	---
	4-19	6.0-20	0.03-0.05	5.1-6.0	Low	0.15		
	19-60	>20	0.02-0.04	5.6-7.3	Low	0.10		
37 Norma	0-8	2.0-6.0	0.12-0.15	4.5-6.5	Low	0.28	5	---
	8-22	2.0-6.0	0.12-0.15	5.6-6.5	Low	----		
	22-60	0.6-2.0	0.12-0.15	5.6-7.3	Low	----		
38* Pits.								
39, 40, 41 Poulsbo	0-2	2.0-6.0	0.08-0.10	5.1-6.0	Low	0.20	2	5-10
	2-24	2.0-6.0	0.07-0.09	4.5-5.0	Low	0.24		
	24-60	---	---	---	---	----		
42*, 43*:								
Poulsbo	0-2	2.0-6.0	0.08-0.10	5.1-6.0	Low	0.20	2	5-10
	2-24	2.0-6.0	0.07-0.09	4.5-5.0	Low	0.24		
	24-60	---	---	---	---	----		
Ragnar	0-4	2.0-6.0	0.13-0.15	5.6-6.5	Low	0.32	5	2-10
	4-23	2.0-6.0	0.13-0.15	5.6-6.5	Low	0.32		
	23-60	6.0-20	0.07-0.09	5.6-6.5	Low	0.24		
44, 45, 46 Ragnar	0-4	2.0-6.0	0.13-0.15	5.6-6.5	Low	0.32	5	2-10
	4-23	2.0-6.0	0.13-0.15	5.6-6.5	Low	0.32		
	23-60	6.0-20	0.07-0.09	5.6-6.5	Low	0.24		
47*:								
Ragnar	0-4	2.0-6.0	0.13-0.15	5.6-6.5	Low	0.32	5	2-10
	4-23	2.0-6.0	0.13-0.15	5.6-6.5	Low	0.32		
	23-60	6.0-20	0.07-0.09	5.6-6.5	Low	0.24		
Poulsbo	0-2	2.0-6.0	0.08-0.10	5.1-6.0	Low	0.20	2	5-10
	2-24	2.0-6.0	0.07-0.09	4.5-5.0	Low	0.24		
	24-60	---	---	---	---	----		
48 Schneider	0-6	0.6-2.0	0.08-0.13	5.1-6.5	Low	0.28	3	5-10
	6-23	0.6-2.0	0.07-0.12	5.1-6.5	Low	0.28		
	23-48	0.6-2.0	0.06-0.10	5.6-6.5	Low	0.32		
	48	---	---	---	---	----		
49 Semiahmoo	0-66	0.2-0.6	0.25-0.30	4.5-6.5	Low	----	---	---
50 Shalcar	0-32	0.2-0.6	0.30-0.40	4.5-6.0	Low	----	---	---
	32-60	0.2-0.6	0.08-0.10	3.6-6.0	Low	0.24		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	In/hr	In/in	pH				Pct
51, 52, 53, 54--- Shelton	0-3	6.0-20	0.10-0.13	5.1-5.5	Low------------	0.20	2	5-10
	3-25	6.0-20	0.10-0.13	5.1-5.5	Low------------	0.20		
	25	---	---	---	---------------	----		
55, 56, 57------- Shelton	0-11	6.0-20	0.07-0.10	5.1-5.5	Low------------	0.20	2	5-10
	11-22	6.0-20	0.07-0.10	5.1-5.5	Low------------	0.20		
	22	---	---	---	---------------	----		
58*:								
Shelton---------	0-11	6.0-20	0.07-0.13	5.1-5.5	Low------------	0.20	2	5-10
	11-22	6.0-20	0.07-0.13	5.1-5.5	Low------------	0.20		
	22	---	---	---	---------------	----		
McKenna---------	0-6	0.6-2.0	0.16-0.19	4.5-6.0	Low------------	0.37	3	3-15
	6-28	0.06-0.2	0.13-0.18	5.1-6.0	Moderate-------	0.32		
	28-37	<0.06	0.08-0.10	5.6-6.5	Moderate-------	0.32		
	37-60	<0.06	0.08-0.10	5.6-6.5	Moderate-------	0.32		
59, 60, 61------- Sinclair	0-8	2.0-6.0	0.07-0.10	4.5-6.0	Low------------	0.20	2	3-7
	8-25	2.0-6.0	0.07-0.10	4.5-6.0	Low------------	0.24		
	25-60	---	---	---	---------------	----		
62--------------- Tacoma	0-6	0.2-0.6	0.19-0.21	3.6-5.0	Low------------	0.37	5	10-20
	6-36	0.2-0.6	0.14-0.16	3.6-5.0	Low------------	0.49		
	36-60	0.2-0.6	0.14-0.16	3.6-5.0	Low------------	0.37		
63*: Urban land.								
Alderwood-------	0-1	0.6-2.0	0.07-0.12	5.1-6.0	Low------------	0.17	2	5-10
	1-22	2.0-6.0	0.07-0.13	5.1-6.0	Low------------	0.20		
	22-60	---	---	---	---------------	----		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[See text for definitions of terms such as "rare," "brief," "apparent," and "perched." The symbol > means more than, plus sign means ponding. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Cemented pan		Subsidence		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Initial	Total	Uncoated steel	Concrete
					Ft			In		In	In		
1, 2, 3----------- Alderwood	C	None--------	---	---	2.5-3.0	Perched	Jan-Mar	20-40	Thin	---	---	Moderate	Moderate
4* Beaches.													
5---------------- Belfast	B	Occasional	Very brief	Nov-Mar	3.5-6.0	Apparent	Nov-Mar	---	---	---	---	Moderate	Moderate.
6---------------- Bellingham	C	None--------	---	---	+1-1.0	Apparent	Nov-Jun	---	---	---	---	High-----	Moderate.
7, 8, 9----------- Cathcart	C	None--------	---	---	>6.0	---	---	---	---	---	---	High-----	Moderate.
10* Dystric Xerorthents.													
11, 12, 13-------- Grove	A	None--------	---	---	>6.0	---	---	---	---	---	---	Moderate	Moderate.
14, 15, 16, 17---- Harstine	C	None--------	---	---	2.0-3.5	Perched	Jan-Apr	25-40	Thin	---	---	Moderate	Moderate.
18, 19, 20-------- Indianola	A	None--------	---	---	>6.0	---	---	---	---	---	---	Moderate	High.
21*:													
Indianola---------	A	None--------	---	---	>6.0	---	---	---	---	---	---	Moderate	High.
Kitsap-----------	C	None--------	---	---	1.5-2.5	Perched	Dec-May	---	---	---	---	Moderate	Moderate.
22, 23------------ Kapowsin	C	None--------	---	---	1.0-2.0	Perched	Dec-Jun	20-32	Thin	---	---	Moderate	Moderate.
24---------------- Kapowsin Variant	C	None--------	---	---	1.5-2.0	Perched	Dec-Mar	20-35	Thin	---	---	Moderate	High.
25, 26------------ Kilchis	C	None--------	---	---	>6.0	---	---	---	---	---	---	High-----	High.
27*:													
Kilchis----------	C	None--------	---	---	>6.0	---	---	---	---	---	---	High-----	High.
Shelton----------	C	None--------	---	---	2.0-3.0	Perched	Dec-Mar	20-35	Thin	---	---	Moderate	Moderate.
28, 29, 30, 31---- Kitsap	C	None--------	---	---	1.5-2.5	Perched	Dec-May	---	---	---	---	Moderate	Moderate.
32---------------- McKenna	C/D	None--------	---	---	+1-0.5	Perched	Nov-Mar	---	---	---	---	High-----	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro- logic group	Flooding			High water table			Cemented pan		Subsidence		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Initial	Total	Uncoated steel	Concrete
					Ft			In		In	In		
33 Mukilteo	D	None	---	---	+1-0	Apparent	Oct-May	---	---	4-10	>60	High	High.
34, 35, 36 Neilton	A	None	---	---	>6.0	---	---	---	---	---	---	Moderate	Moderate.
37 Norma	B/D	None	---	---	+1-1.0	Apparent	Nov-Apr	---	---	---	---	High	Moderate.
38* Pits.													
39, 40, 41 Poulsbo	C	None	---	---	1.0-2.5	Perched	Dec-Mar	20-40	Thin	---	---	Moderate	Moderate.
42*, 43*:													
Poulsbo	C	None	---	---	1.0-2.5	Perched	Dec-Mar	20-40	Thin	---	---	Moderate	Moderate.
Ragnar	A	None	---	---	>6.0	---	---	---	---	---	---	Moderate	Moderate.
44, 45, 46 Ragnar	A	None	---	---	>6.0	---	---	---	---	---	---	Moderate	Moderate.
47*:													
Ragnar	A	None	---	---	>6.0	---	---	---	---	---	---	Moderate	Moderate.
Poulsbo	C	None	---	---	1.0-2.5	Perched	Dec-Mar	20-40	Thin	---	---	Moderate	Moderate.
48 Schneider	B	None	---	---	>6.0	---	---	---	---	---	---	Moderate	Moderate.
49 Semiahmoo	D	None	---	---	+1-0	Apparent	Nov-May	---	---	6-12	60-80	High	High.
50 Shalcar	D	None	---	---	+1-0	Apparent	Nov-May	---	---	6-8	16-28	High	High.
51, 52, 53, 54, 55, 56, 57 Shelton	C	None	---	---	2.0-3.0	Perched	Dec-Mar	20-35	Thin	---	---	Moderate	Moderate.
58*:													
Shelton	C	None	---	---	2.0-3.0	Perched	Dec-Mar	20-35	Thin	---	---	Moderate	Moderate.
McKenna	C/D	None	---	---	+1-0.5	Perched	Nov-Mar	---	---	---	---	High	Moderate.
59, 60, 61 Sinclair	C	None	---	---	1.5-2.5	Perched	Dec-Mar	20-30	Thin	---	---	Moderate	High.
62 Tacoma	D	Frequent	Brief to very long.	Jan-Dec	0-2.0	Apparent	Jan-Dec	---	---	---	---	High	High.
63*: Urban land.													
Alderwood	C	None	---	---	2.5-3.0	Perched	Jan-Mar	20-40	Thin	---	---	Moderate	Moderate.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Alderwood	Loamy-skeletal, mixed, mesic Dystric Entic Durochrepts
Belfast	Coarse-loamy, mixed, nonacid, mesic Typic Udifluvents
Bellingham	Fine, mixed, nonacid, mesic Mollic Haplaquepts
Cathcart	Medial, mesic Andic Xerochrepts
Grove	Sandy-skeletal, mixed, mesic Dystric Xerorthents
Harstine	Coarse-loamy, mixed, mesic Dystric Entic Durochrepts
Indianola	Mixed, mesic Dystric Xeropsamments
Kapowsin	Coarse-loamy, mixed, mesic Dystric Entic Durochrepts
Kapowsin Variant	Fine-loamy, mixed, mesic Dystric Entic Durochrepts
Kilchis	Loamy-skeletal, mixed, mesic Lithic Haplumbrepts
Kitsap	Fine-silty, mixed, mesic Aquic Xerochrepts
McKenna	Loamy-skeletal, mixed, nonacid, mesic Mollic Haplaquepts
Mukilteo	Dysic, mesic Typic Medihemists
Neilton	Sandy-skeletal, mixed, mesic Dystric Xerorthents
Norma	Coarse-loamy, mixed, nonacid, mesic Mollic Haplaquepts
Poulsbo	Coarse-loamy, mixed, mesic Dystric Entic Durochrepts
Ragnar	Sandy, mixed, mesic Dystric Xerochrepts
Schneider	Loamy-skeletal, mixed, mesic Typic Xerumbrepts
Semiahmoo	Euic, mesic Typic Medisaprists
Shalcar	Loamy, mixed, euic, mesic Terric Medisaprists
Shelton	Loamy-skeletal, mixed, mesic Dystric Entic Durochrepts
Sinclair	Loamy-skeletal, mixed, mesic Dystric Entic Durochrepts
Tacoma	Medial, acid, mesic Andaqueptic Fluvaquents

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