SOIL SURVEY OF

Benton County Area, Oregon

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Oregon Agricultural Experiment Station

Major fieldwork for this soil survey was done in 1969. Soil names and descriptions were approved in 1970. Unless otherwise indicated, statements in the publication refer to conditions in the Benton County Area in 1969. This survey was made cooperatively by the Soil Conservation Service and the Oregon Agricultural Experiment Station. It is part of the technical assistance furnished to the Benton Soil and Water Conservation District.

Copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of the Benton County Area are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit, woodland suitability group, and wildlife group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units and woodland groups.

Foresters and others can refer to the section "Woodland", where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, industrial buildings, and recreation areas in the section "Town and Country Planning."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in the Benton County Area may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "General Nature of the Area."

Cover: **Looking west toward the Coast Range. Veneta soils in foreground, and Marys Peak, elevation 4,097 feet, on right.**

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

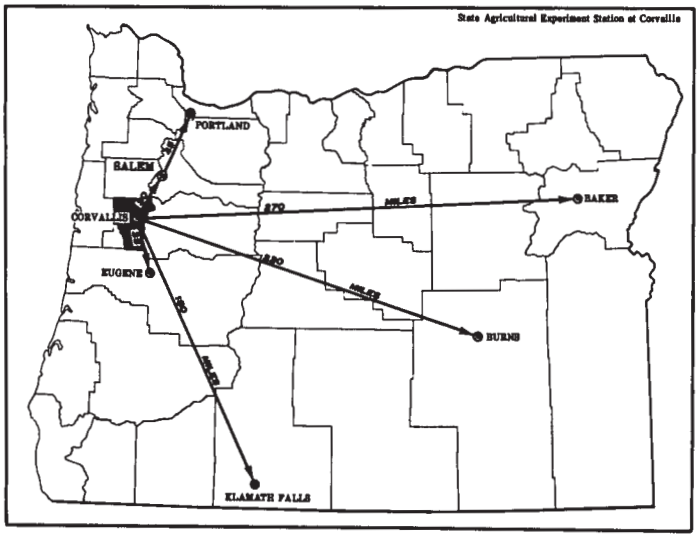

Figure 1.—Location of Benton County Area in Oregon.

BENTON COUNTY AREA is in northwestern Oregon (fig. 1). It consists of the eastern three-fourths of Benton County. The area is centrally located in the Willamette Valley and extends west from the Willamette River to the summit of the Coast Range.

The Benton County Area is located entirely within the Willamette River drainage basin. The part of the county not located in the survey area is in the Coast drainage basin, which drains into the Pacific Ocean. The Benton County Area is about 321,000 acres, or 501 square miles.

The Benton County Area has a well-developed drainage system. It is drained by three main stream systems—Marys River, Luckiamute River, and Muddy Creek. All the drainage water ultimately flows into the Willamette River, which flows north.

The eastern part of the Area is on the main valley floor and the alluvial flood plain. The low foothills rise to the west and merge into the mountainous, forested Coast Range in the western part of the Area. The mountainous area is mainly at elevations of about 1,200 feet. Elevations in the Benton County Area range from 190 feet on the flood plain along the Willamette River to 4,097 feet on Marys Peak in the Coast Range. The Area has a modified marine climate that varies considerably from east to west. Westward from the valley floor into the Coast Range, precipitation increases from 40 to 120 inches per year, temperature decreases, and the growing season shortens.

The main valley and the low foothills are mainly used for cultivated crops. The steeper uplands and the Coast Range are in timber. Farming in the Benton County Area began about 1845. The land use in recent years has been shifting from small grain and livestock to orchards, berries, vegetables, and specialty crops.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in the Benton County Area, where they are located, and how they can be used. The soil scientists went into the Area knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

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

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic

that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Bellpine silty clay loam, 3 to 12 percent slopes, is one of several phases within the Bellpine series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One such kind of mapping unit is shown on the soil map of the Benton County Area: the soil complex.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Price-Ritner complex, 20 to 30 percent slopes, is an example.

In most areas surveyed, there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names: Riverwash is a land type in this Survey Area.

While a soil survey is in progress, soil scientists take soil samples, as needed, for laboratory measurements and engineering tests. Laboratory data from the same kinds of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are then estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for the onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil and they relate this failure to the high shrink-swell potential of that soil. Thus, they use observation and knowledge of soil properties and available research data to predict limitations or suitability of soils for a present or potential use.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultations. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the Benton County Area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a survey area, who want to compare different parts of a survey area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in Benton County Area have been grouped into four general kinds of landscape for broad interpretive purposes. Each of the broad groups and the soil associations in each group are described in the following pages. The terms for texture used in the title for several of the associations apply to the texture of the surface layer. For example, in the title of association 2, the words "silty clay loams" refer to the texture of the surface layer.

Areas Dominated by Deep, Somewhat Excessively Drained to Poorly Drained Soils of the Bottom Lands

These soils are on bottom lands of the Willamette River and its tributaries. Slopes are mainly 0 to 7 percent. Nearly half of the acreage of these soils is well drained, and the rest is somewhat excessively drained to poorly drained. Flooding is a hazard in many places. Some of the soils have a seasonal high water table. Average annual precipitation ranges from 40 to 60 inches in most of the areas; however, in some places precipitation is as much as 90 inches.

Four soil associations are in this group. Most of the soils in these associations are farmed, and many different crops are grown on some of them.

1. Chehalis-Newburg-Cloquato association

Well-drained silty clay loams and silt loams and excessively drained loams and fine sandy loams

This association consists of silty clay loams, fine sandy loams, loams, and silt loams that formed in mixed alluvium on bottom lands of the major streams. Slopes are 0 to 3 percent. In areas that are not cultivated, the vegetation is

mainly Douglas-fir, cottonwood, maple, oak, ash, blackberry, and grasses. Average annual precipitation is about 40 to 45 inches, average annual air temperature is about 52° to 54° F., and the frost-free season is 165 to 210 days. Elevation ranges from 190 to 300 feet.

This association makes up about 8.5 percent of the survey area. Chehalis soils make up about 50 percent of the association, Newberg soils 20 percent, and Cloquato soils 15 percent. Camas, McBee, and Wapato soils, Mixed alluvial land, and Riverwash make up the remaining 15 percent.

The areas of Chehalis soils are a greater distance from the river than those of the other soils in this association. These soils are well drained. The surface layer and subsoil are dark-brown and very dark brown silty clay loam.

Newberg soils are immediately adjacent to the river channel. They are somewhat excessively drained. The surface layer is very dark grayish-brown sandy loam or loam. The underlying layers are dark-brown and brown fine sandy loam and loamy fine sand.

Cloquato soils are on the flood plain between Chehalis and Newberg soils. They are well drained. The surface layer is very dark grayish-brown and dark-brown silt loam. The subsoil is dark-brown silt loam.

The soils in this association are the most intensively farmed of all the soils in the Area. They are used mainly for orchard crops, small grain, and hay. The soils are also used for wildlife habitat and recreation. Vegetables, berries, specialty crops, and pasture are sprinkler irrigated. Irrigation water is available from streams and shallow wells. Small homesites are scattered throughout this association.

Soil compaction is a concern if the Chehalis soils are disturbed when wet. Flooding is a hazard in many places, and serious flooding from the major streams occurs in winter at least 1 year in 5. The soils are easy to work and are highly responsive to commercial fertilizer.

2. *McAlpin-Abiqua association*

Moderately well drained and well drained silty clay loams

This association consists of silty clay loams that formed in recent alluvium on bottom lands, terraces, and alluvial fans along tributaries of the Willamette River (fig. 2). Slopes are 0 to 5 percent. In areas that are not cultivated, the vegetation is mainly Douglas-fir, oak, maple, ash, blackberry, rose, hawthorn, and grasses. Average annual precipitation is 40 to 60 inches; average annual temperature is about 50° to 52° F., and the frost-free season is 165 to 210 days. Elevation ranges from 250 to 450 feet.

This association makes up 1.9 percent of the survey area. McAlpin soils make up about 50 percent of the association and Abiqua soils 35 percent. Briedwell, Waldo, and minor areas of Chehalis, Cloquato, and Newberg soils make up the remaining 15 percent.

McAlpin soils occupy the lower positions on the landscape, slightly below Abiqua soils. They are moderately well drained. The surface layer is dark-brown silty clay loam. The subsoil is very dark grayish-brown, dark-brown, and brown silty clay. Distinct mottles are below a depth of 24 inches.

Abiqua soils occupy the higher positions on the landscape. They are well drained. The surface layer is very dark brown silty clay loam. The subsoil is dark reddish-brown silty clay.

The soils in this association are used mainly for pasture, hay, grass seed, small grain, wildlife habitat, and recre-

Figure 2.—McAlpin and Abiqua soils on terrace in foreground; Dixonville soils on low foothills; and Price and Ritner soils on higher hills in background.

ation. Small areas are sprinkler irrigated and used for vegetables and specialty crops. Management is strongly influenced by irregular soil patterns. McAlpin soils have a seasonally high water table.

3. *Waldo-Bashaw association*

Poorly drained silty clay loams and clays

This association consists of silty clay loams and clays that formed in recent alluvium on bottom lands of tributaries to the Williamette River. Slopes are 0 to 3 percent. In areas that are not cultivated, the vegetation is ash, rose, hawthorn, sedge, rush, and grasses. Average annual precipitation is about 40 to 60 inches, average annual air temperature is about 50° to 54° F., and the frost-free season is 165 to 210 days. Elevation ranges from 200 to 450 feet.

This association makes up about 4.5 percent of the survey area. Waldo soils make up about 50 percent of the association and Bashaw soils 35 percent McAlpin, Briedwell, and Abiqua soils make up the remaining 15 percent.

Waldo soils are in low areas on the landscape. They are poorly drained. The surface layer is black silty clay loam and silty clay. The subsoil is dark-gray and gray clay.

Bashaw soils are poorly drained. The surface layer is black clay or heavy silty clay loam. The underlying layers are black, very dark gray, and dark-gray clay and silty clay. When wet, Bashaw soils are very sticky and very plastic. They crack deeply and become very hard when dry.

The soils in this association are used mainly for ryegrass seed, pasture, and wildlife habitat.

These soils are subject to frequent flooding. They are poorly suited to use as sites for roads, trails, and buildings. They have good response to commercial fertilizer.

4. *Winchuck variant-Nehalem association*

Well-drained silt loams

This association consists of silt loams that formed in alluvium on stream terraces, fans, and flood plains along streams in the Coast Range. Slopes are 0 to 7 percent. In areas that are not cultivated, the vegetation is Douglas-fir, western redcedar, alder, shrubs, and ferns. Average annual precipitation is 60 to 90 inches, average annual temperature is 48° to 50° F., and the frost-free season is 160 to 190 days. Elevation ranges from 400 to 700 feet.

This association makes up 1.7 percent of the survey area. Winchuck variant soils make up about 45 percent of the association and Nehalem soils about 45 percent. Brenner soils make up the remaining 10 percent.

Winchuck variant soils are well drained. The surface layer is dark-brown silt loam. The subsoil is dark-brown, dark yellowish-brown, and yellowish-brown silty clay loam, silt loam, and loam.

Nehalem soils are well drained. The surface layer is dark-brown silt loam and silty clay loam. The subsoil is dark-brown silty clay loam.

The soils in this association are used mainly for hay, pasture, wildlife habitat, and recreation. Small areas are sprinkler irrigated. Irrigation water generally is available from streams. Irregular soil patterns, excessive precipitation, and limited sunshine are some of the factors that influence use and management of these soils.

Areas Dominated by Deep, Well-Drained to Poorly Drained Soils of the Willamette Valley Terraces

These soils are on the terrace plain that forms the floor of the Willamette Valley. They are in areas between alluvial soils of the bottom lands and the foothills of the Coast Range. Elevation ranges from 190 to 300 feet. Slopes are mainly 0 to 3 percent, but in some places slopes are as much as 12 percent. About one-third of the acreage of these soils is well drained, and the rest is moderately well drained to poorly drained. Average annual precipitation ranges from 40 to 45 inches.

Three soil associations are in this group. Most of the soils in these associations are farmed, and many different crops are grown, especially on the well drained and moderately well drained soils.

5. *Woodburn-Willamette association*

Moderately well drained and well drained silt loams

This association consists of silt loams that formed in mixed alluvium on alluvial terraces of the Willamette Valley. Slopes are 0 to 12 percent. In areas that are not cultivated, the vegetation is Douglas-fir, oak, hazel brush, blackberry, poison-oak, and grasses. Average annual precipitation is about 40 to 45 inches, average annual air temperature is about 52° to 54° F., and the frost-free season is 165 to 210 days. Elevation ranges from 200 to 300 feet.

This association makes up about 5.3 percent of the survey area. Woodburn soils make up about 50 percent of the association and Willamette soils 35 percent. Dayton, Concord, Amity, and Malabon soils make up the remaining 15 percent.

Woodburn soils are slightly below Willamette soils on the landscape. They are moderately well drained. The surface layer is very dark grayish-brown and dark-brown silt loam. The subsoil is dark-brown silty clay loam and silt loam. Distinct mottles are below a depth of 20 to 30 inches.

Willamette soils occupy the higher positions on the landscape. These soils are well drained. The surface layer is very dark grayish-brown and dark-brown silt loam. The subsoil is dark-brown silty clay loam.

The soils in this association are used mainly for grass seed, hay, orchard crops, small grain, recreation, and wildlife habitat. Vegetables, hay, pasture, and mint are sprinkler irrigated. Small homesites are common in parts of this association. Irrigation water generally is available from wells. Woodburn soils respond to tile drainage. Drain outlets are not difficult to obtain. Willamette and Woodburn soils have good response to commercial fertilizer.

6. *Dayton-Amity association*

Poorly drained and somewhat poorly drained silt loams

This association consists of silt loams that formed in mixed alluvium on alluvial terraces of the Willamette Valley (fig. 3). Slopes are 0 to 2 percent. In areas that

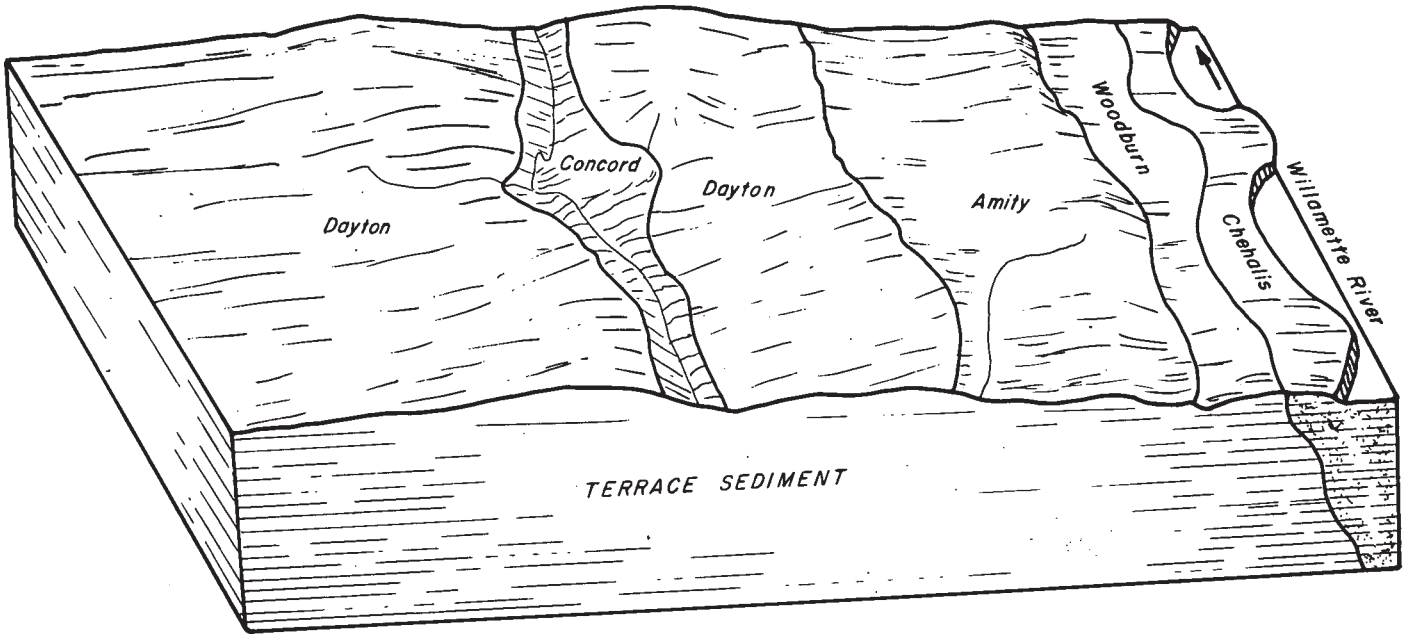

Figure 3.—**Cross section of part of Willamette Valley terraces, showing relationship of soils, relief, and parent materials in Dayton-Amity association**

are not cultivated, the vegetation is ash, oak, rose, blackberry, hawthorn, and grasses. Average annual precipitation is about 40 to 45 inches, average annual air temperature is about 52° to 54° F., and the frost-free season is 165 to 210 days. Elevation ranges from 200 to 300 feet.

This association makes up about 6.3 percent of the survey area. Dayton soils make up about 65 percent of the association and Amity soils 25 percent. Concord and Woodburn soils make up the remaining 10 percent.

Dayton soils are slightly below Amity soils on the landscape. They are poorly drained. The surface layer is dark grayish-brown silt loam, and the subsurface layer is gray silty clay loam. The subsoil is dark-gray and dark grayish-brown clay and silty clay.

Amity soils are on broad terraces. They are somewhat poorly drained, The surface layer is very dark grayish-brown silt loam, and the subsurface layer is very dark gray silt loam. The subsoil is dark-brown and dark grayish-brown silty clay loam. Distinct mottles are below a depth of 12 to 28 inches.

The soils in this association are used mainly for ryegrass seed, small grain, and wildlife habitat. Small homesites are common in some parts of this association. Irrigation water is not readily available. The response to tile drainage is good for Amity soils. Dayton soils are difficult to tile drain efficiently. Suitable outlets for drains are not always available in this association. Amity soils have a high water table, and Dayton soils pond during seasonal rains. The soils in this association have moderate response to commercial fertilizer.

7. *Malabon-Coburg association*

Well drained and moderately well drained silty clay loams

This association consists of silty clay loams that formed in mixed alluvium on terraces of the Williamette River. In areas that are not cultivated, the vegetation is ash, oak, rose, blackberry, hawthorn, and grasses. Average annual precipitation is about 40 to 45 inches, average annual air temperature is about 52° to 54° F., and the frost-free season is 165 to 210 days. Elevation ranges from 190 to 300 feet.

This association makes up about 7.5 percent of the survey area. Malabon soils (fig. 4) make up about 40 percent of the association and Coburg soils 35 percent. Dayton, Conser, and Salem soils make up the remaining 25 percent.

Malabon soils occupy high positions on the landscape. They are well drained. The surface layer is very dark grayish-brown silty clay loam, and the subsoil is very dark grayish-brown, very dark brown, and dark-brown silty clay and silty clay loam.

Coburg soils occupy the positions slightly below the Malabon soils. They are moderately well drained. The surface layer is very dark brown silty clay loam, and the subsoil is very dark brown and dark-brown silty clay loam and silty clay. Distinct mottles are below a depth of 20 to 34 inches.

The soils in this association are used mainly for small grain, grass seed, hay, pasture, recreation, and wildlife habitat. Vegetables, mint, hay, and pasture are sprinkler irrigated. Irrigation water is generally available from wells. Coburg soils respond to tile drainage. Drain outlets

Figure 4.—**Irrigated bush beans on Malabon silty clay loam. Slopes are 0 to 3 percent.**

are not difficult to obtain. Soil compaction is a concern if these soils are disturbed when wet. Malabon and Coburg soils have good response to commercial fertilizer.

Areas Dominated by Shallow to Deep, Well-Drained to Somewhat Poorly Drained Soils of the Foothills

These soils occur as isolated hills and as foothills of the Coast Range. Most of the soils are well drained. Slopes are mainly 2 to 75 percent, but about one-third of the acreage has slopes of more than 30 percent. Elevation ranges from 300 to 1,800 feet. Average annual precipitation is 40 to 60 inches.

Four associations are in this group. These soils are used for farming and timber production. Douglas-fir and Oregon white oak are the dominant trees.

8. Dixonville-Philomath association

Moderately deep, well-drained silty clay loams and shallow, well-drained silty clays

This association consists of silty clay loams and silty clays that formed in colluvium from igneous rocks in the foothills along the margins of the Willamette Valley. Slopes are 3 to 50 percent. In areas that are not cultivated, the vegetation is Douglas-fir, oak, Pacific madrone, blackberry, poison-oak, other shrubs, and grasses (fig. 5). Average annual precipitation is 40 to 60 inches, average annual air temperature is about 50° to 54° F., and the frost-free season is 165 to 210 days. Elevation ranges from 350 to 1,000 feet.

This association makes up 7.3 percent of the survey area. Dixonville soils make up about 70 percent of the association and Philomath soils 15 percent. Abiqua, Witzel, Hazelair, McAlpin, Witham, Bashaw, and Waldo soils make up the remaining 15 percent.

Dixonville soils are moderately deep and well drained. The surface layer is very dark brown and very dark grayish-brown silty clay loam. The subsoil is very dark brown and dark-brown clay and silty clay. The content of coarse fragments throughout ranges from 0 to 15 percent gravel and 0 to 20 percent cobblestones. The depth to bedrock ranges from 20 to 40 inches.

Philomath soils are on ridgetops and sides of hills. These soils are well drained. The surface layer is very dark brown silty clay and clay. The content of coarse fragments of basalt ranges from a trace to as much as 20 percent. The depth to bedrock is less than 20 inches.

The soils in this association are used mainly for pasture, hay, grass seed, small grain, recreation, wildlife habitat, timber, and watershed. Small homesites are important in parts of this association. Water supplies of acceptable quality and quantity for domestic use are limited in most areas. Use and management of this association are limited by a lack of irrigation water and a complex pattern of shallow soils. Erosion is a hazard on some of the clayey soils in this association.

9. Price-Ritner association

Deep, well-drained silty clay loams and moderately deep, well-drained gravelly silty clay loams

This association consists of silty clay loams and gravelly silty clay loams that formed in colluvium and residuum from igneous rocks on the foothills and uplands above the margins of the Willamette Valley (fig. 6). Slopes range from about 3 to 75 percent. In areas that are not cultivated, the native vegetation is mainly Oregon white oak at the lower elevations and Douglas-fir at the higher elevations.

Figure 5.—Characteristic oak and grass vegetation on Dixonville and Philomath soils. Price soils are on higher ridges in background.

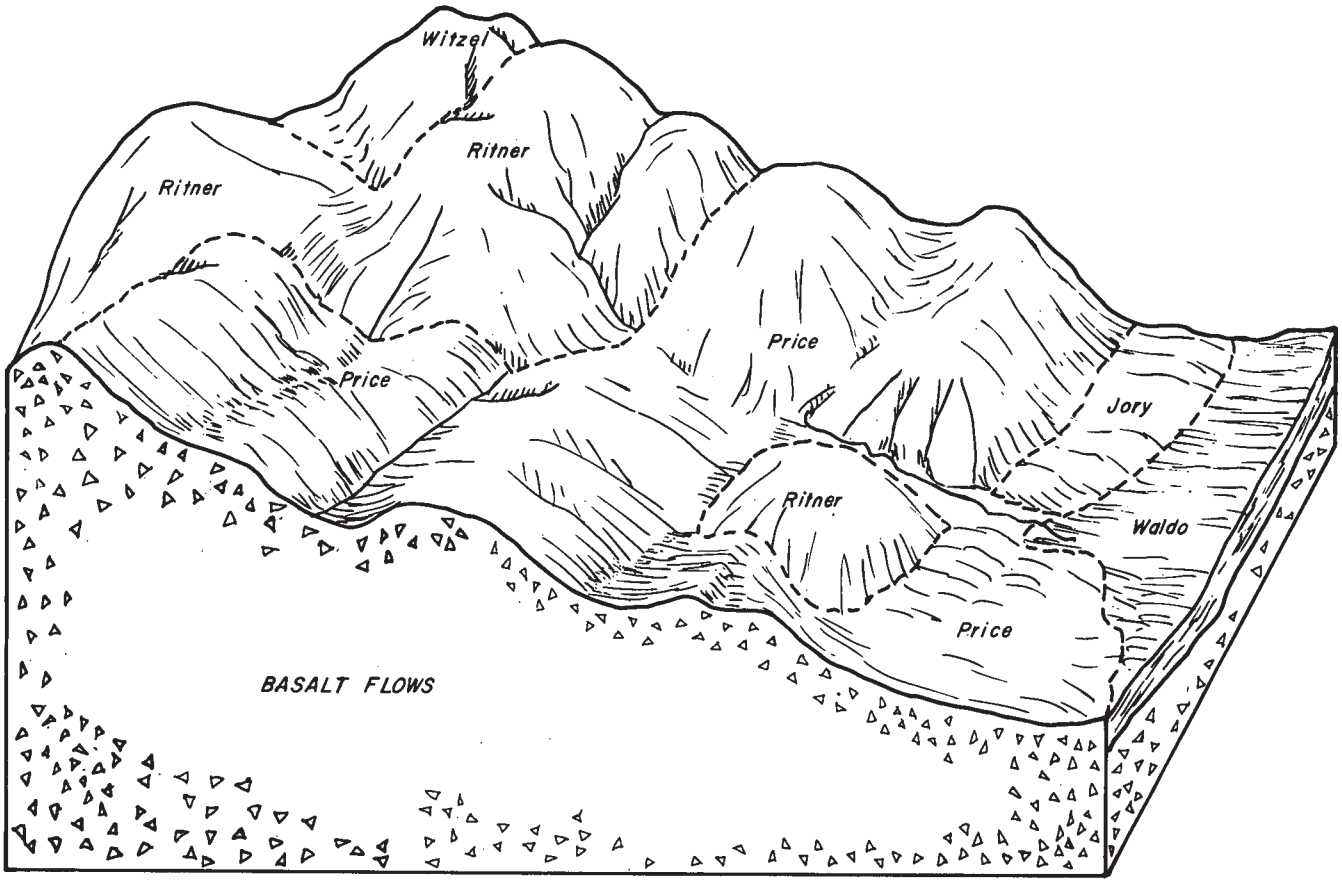

Figure 6.—Cross section of part of foothills of the Coast Range, showing relationship of soils, relief, and parent materials in Price-Ritner association.

Pacific madrone and bigleaf maple are scattered throughout, and poison-oak, hazelnut, brackenfern, and trailing blackberry are the main understory species. Average annual precipitation is 40 to 60 inches, the average annual air temperature is 49° to 54° F., and the frost-free season is 165 to 200 days. Elevation ranges from 400 to 1,800 feet.

This association makes up about 13.6 percent of the survey area. Price soils make up about 50 percent of the association and Ritner soils about 30 percent. Witham, Bashaw, Abiqua, McAlpin, and Waldo soils in drainageways and Philomath, Witzel, and Jory soils on uplands make up the remaining 20 percent.

Price soils are deep and well drained. The surface layer is dark reddish-brown silty clay loam. The subsoil is dark reddish-brown silty clay and gravelly clay. The content of coarse fragments ranges from about 5 to 35 percent. The depth to bedrock ranges from 40 to 60 inches.

Ritner soils commonly are on ridges and sides of ridges. These soils are moderately deep and well drained. The surface layer is dark reddish-brown gravelly silty clay loam. The subsoil is dark reddish-brown gravelly and very cobbly silty clay loam and silty clay. The content of coarse fragments is more than 35 percent. Depth to bedrock ranges from 30 to 40 inches.

The soils in this association are used mainly for timber, water supply, and wildlife habitat. Some areas are used for pasture, grass seed, and small grain. The major limitations are steepness and the hazard of erosion. Supplies of water of suitable quality and quantity for domestic use are limited in much of the association.

10. Jory-Bellpine association

Deep and moderately deep, well-drained silty clay loams

This association consists of silty clay loams that formed in colluvium from mixed igneous and sedimentary rocks. The association is on broad ridgetops and relatively stable landscapes on uplands (fig. 7). Slopes are 2 to 50 percent. In areas that are not cultivated, the native vegetation is mainly Oregon white oak at lower elevations and well-stocked stands of Douglas-fir at higher elevations. Poison-oak, hazelnut, snowberry, and brackenfern are the main understory species. Average annual precipitation is 40 to 60 inches, average annual air temperature is 52° to 54° F., and the frost-free season ranges from 165 to 200 days. Elevation ranges from 300 to 1,200 feet.

This association makes up about 12.5 percent of the survey area. Jory soils make up about 45 percent of the association and Bellpine soils about 35 percent. Price, Veneta, Hazelair, and Dupee soils make up the remaining 20 percent.

Jory soils are commonly more than 60 inches deep. The surface layer is dark reddish-brown silty clay loam. The subsoil is dark reddish-brown and dark-red silty clay and clay. The content of coarse fragments ranges from 0 to 15 percent.

Bellpine soils are generally 20 to 40 inches deep over bedrock. The surface layer is dark reddish-brown silty clay

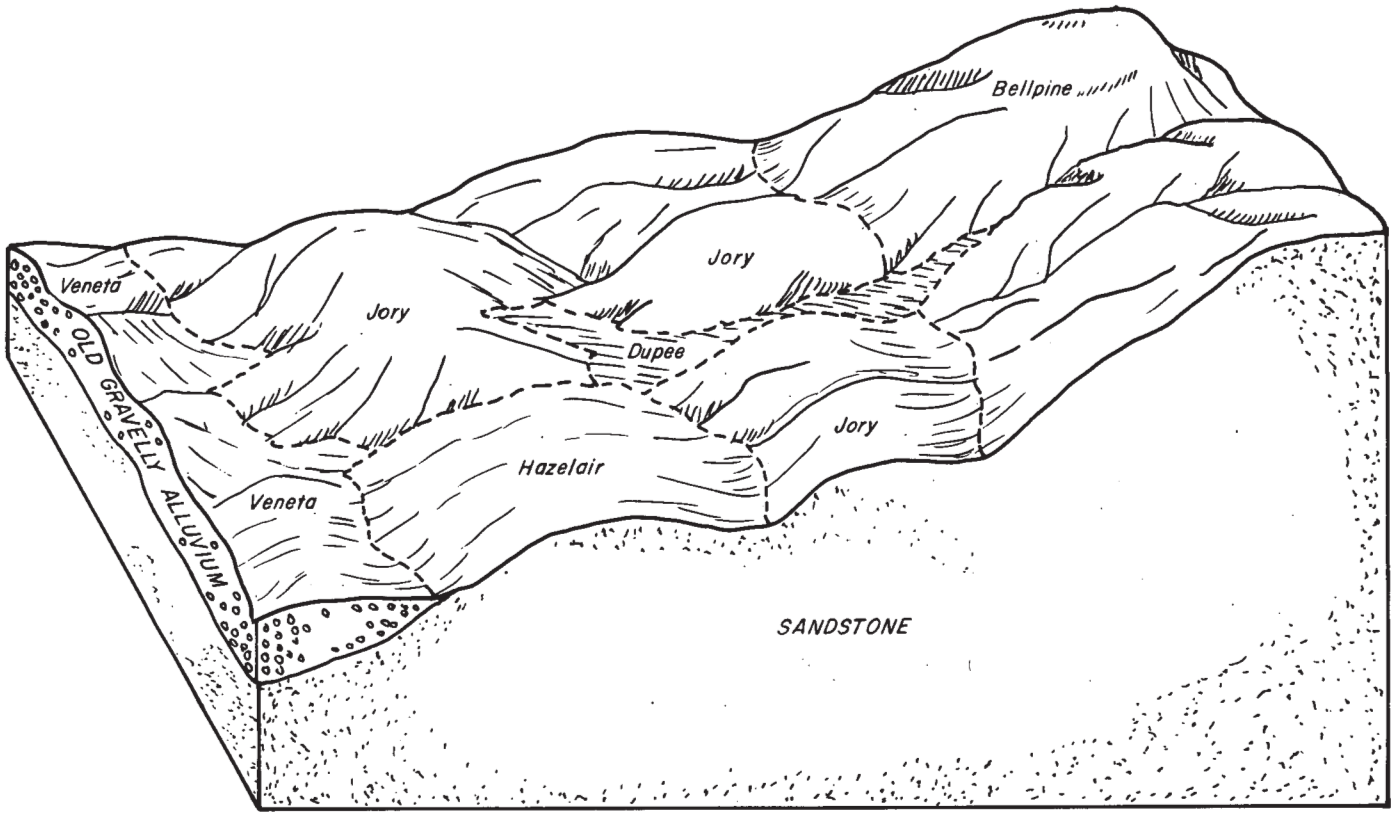

Figure 7.—**Cross section of part of foothills of the Coast Range, showing relationship of soils, relief, and parent materials in Jory-Bellpine association.**

loam. The subsoil is dark reddish-brown and dark-red clay, silty clay, and silty clay loam.

The soils in this association are used mainly for small grain, grass seed, orchards, hay, pasture, wildlife habitat, recreation, and timber. The steeper areas are used for timber. Small homesites are an important part of this association. The clayey soils of this association have severe trafficability restrictions, or equipment limitations, during wet seasons.

11. Hazelair-Veneta association

Moderately deep, moderately well drained to somewhat poorly drained silt loams and deep, moderately well drained to well drained silt loams

This association consists of silt loams or silty clay loams that formed in colluvium from sedimentary rock and old gravelly materials. The association is on foothills and terraces along the margins of the Willamette Valley. Slopes are mainly 3 to 12 percent, but some are as much as 20 percent. In areas that are not cultivated, the vegetation is Douglas-fir, Oregon white oak, poison-oak, wild rose, blackberry, and grasses. Average annual precipitation is 40 to 45 inches, average annual temperature is about 52° to 54° F., and the frost-free season is 165 to 210 days. Elevation ranges from 300 to 500 feet.

This association makes up about 4 percent of the survey area. Hazelair soils make up about 55 percent of the association and Veneta soils 20 percent. Veneta variant, Bellpine, and Dupee soils make up the remaining 25 percent.

Hazelair soils are generally 20 to 40 inches deep over sedimentary bedrock. The surface layer is dark-brown silt loam and silty clay loam. The subsoil is dark yellowish-brown silty clay loam.

Veneta soils are 40 to more than 60 inches deep over bedrock. The surface layer is dark-brown and dark yellowish-brown silt loam and silty clay loam. The subsoil is dark-brown silty clay loam, silty clay, and clay.

The soils in this association are used mainly for small grain, grass seed, hay, pasture, recreation, and wildlife habitat. Small homesites are an important part of this association. Only a few small patches of Douglas-fir remain in this association.

Areas Dominated by Deep and Moderately Deep, Well-Drained Soils of the Deeply Dissected Coast Range

These soils are in the western part of Benton County. This area mainly consists of broad ridges and long slopes dissected by numerous streams. On more than half of the acreage, slope is more than 25 percent. Elevation ranges from 750 to 3,500 feet. Average annual precipitation is 60 to 120 inches. Erosion is a major hazard.

Two soil associations are in this group. The soils are mainly used for timber, and Douglas-fir is the principal tree species. Because of high precipitation, the soils are a major source of water supply.

12. Klickitat-Marty association

Deep, well-drained gravelly clay loams and gravelly loams

This association consists of gravelly clay loams and gravelly loams that formed in colluvium weathered from mixed igneous rocks. The association is on broad ridges and dissected mountainsides in the Coast Range (fig. 8).

Figure 8.—Looking south from Franklin Ridge toward Flat Mountain. Klickitat and Marty soils in background on the higher dissected uplands, and Blachly and Honeygrove soils in foreground.

Slopes range from about 3 to 75 percent. The major tree species are Douglas-fir and hemlock, and noble fir is at higher elevations. Vine maple, salal, swordfern, and trailing blackberry are the main understory species. Average annual precipitation is 60 to 120 inches, average annual air temperature is 45° to 50° F., and the frost-free season is 120 to 190 days. Elevation ranges from 800 to 3,500 feet.

This association makes up about 5.6 percent of the survey area. Klickitat soils make up about 45 percent of the association and Marty soils 35 percent. Kilchis, Mulkey, Bohannon, Blachly, Slickrock, and Honeygrove soils make up the remaining 20 percent.

Klickitat soils are 40 to 50 inches deep over fractured rock. The surface layer is dark reddish-brown gravelly clay loam. The subsoil is reddish-brown and dark reddish-brown gravelly clay loam. The content of coarse fragments is more than 35 percent.

Marty soils are more than 60 inches deep over bedrock. The surface layer is dark reddish-brown gravelly loam. The subsoil is dark reddish-brown, reddish-brown, and yellowish-red loam and clay loam.

The soils in this association are used mainly for timber, recreation, and water supply. The principal limitations are steepness and the hazard of erosion.

13. Apt-Honeygrove-Bohannon association

Deep, well-drained silty clay loams and moderately deep, well-drained gravelly loams

This association consists of silty clay loams and gravelly loams that formed in colluvium weathered from mixed sedimentary and igneous rocks. This association is on broad uplands and mountainsides (fig. 9). Slopes range from about 3 to 75 percent. The native vegetation is Douglas-fir, alder, and bigleaf maple and an understory of salal, vine maple, oceanspray, hazelnut, fern, and huckleberry. Average annual precipitation is 60 to 120 inches, average annual air temperature is 46° to 50° F., and the frost-free season is 145 to 190 days. Elevation ranges from 750 to 3,500 feet.

This association makes up about 21.3 percent of the survey area. Apt soils make up about 40 percent of the association, Honeygrove soils about 25 percent, and Bohannon soils about 15 percent. Peavine, Blachly, Winchuck variant, and Slickrock soils make up the remaining 20 percent.

Apt soils are more than 60 inches deep over bedrock. The surface layer is very dark brown and very dark grayish-brown silty clay loam. The subsoil is brown, dark yellowish-brown, and strong-brown clay.

Honeygrove soils are more than 60 inches deep over bedrock. The surface layer is dark reddish-brown silty clay

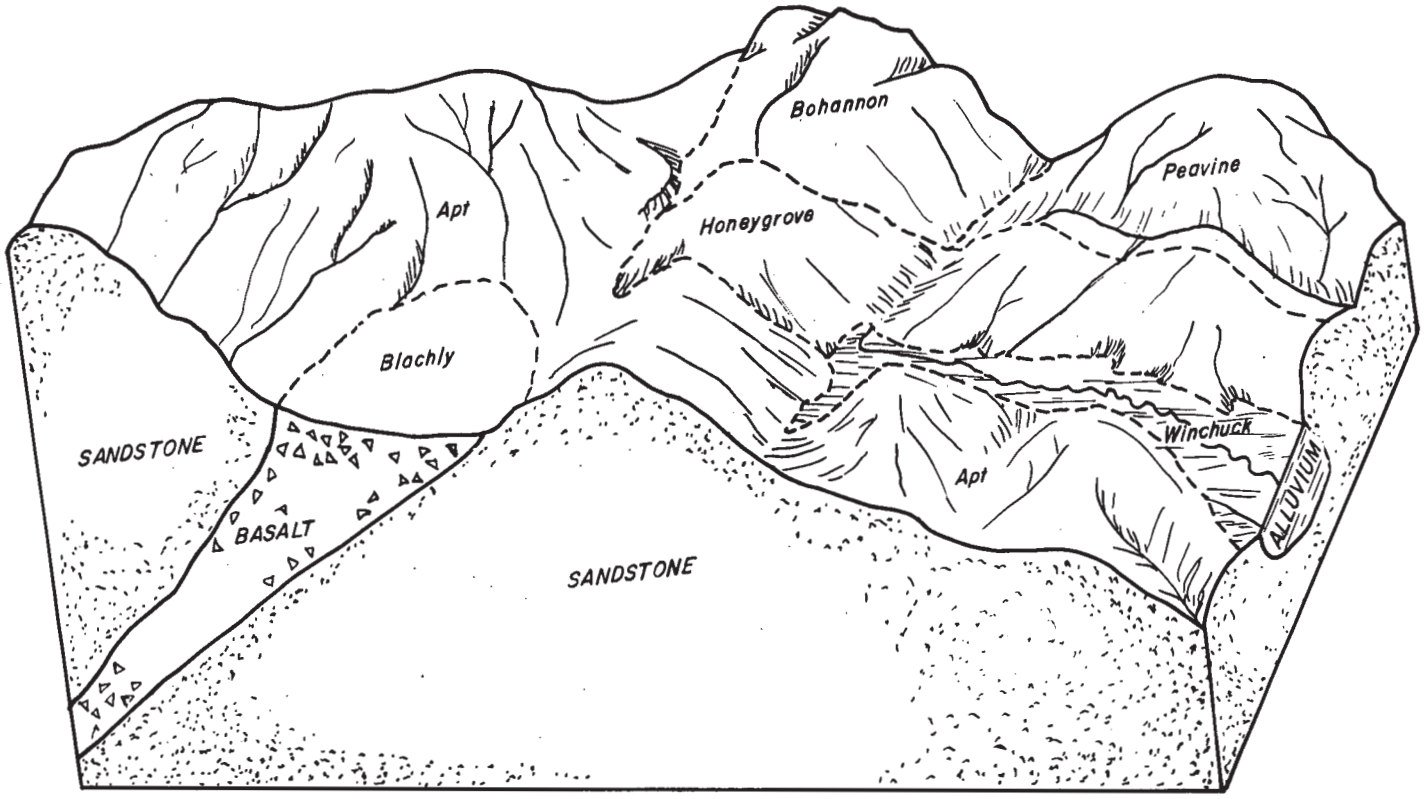

Figure 9.—**Cross section of part of the deeply dissected Coast Range, showing relationship of soils, relief, and parent materials in Apt-Honeygrove-Bohannon association.**

loam. The subsoil is dark reddish-brown and dark-red silty clay and clay.

Bohannon soils are 20 to 40 inches deep over bedrock. The surface layer is very dark brown and dark-brown gravelly loam. The subsoil is dark-brown gravelly loam. The content of coarse fragments in the subsoil ranges from 20 to 35 percent.

The soils in this association are used mainly for timber, water supply, and recreation. The major limitations are steepness and severe trafficability restrictions during wet seasons.

Descriptions of the Soils

This section describes the soil series and mapping units of the Benton County Area in alphabetic order. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

A representative profile of each series is described in detail in the first mapping unit. This profile is for use by scientists, engineers, and others who need to make highly technical soil interpretations. The layers, or horizons, are designated by symbols such as A1, B21, and C1. These symbols have special meaning for soil scientists. Many readers, however, need only remember that symbols beginning with "A" are for surface soil; those with "B" are for subsoil; and those with "C" are for substratum, or parent material. Color terms are for moist soil unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Riverwash, for example, does not belong to a soil series, but nevertheless is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit, woodland suitability group, and wildlife group in which the mapping unit has been placed. The page for the description of each capability unit, woodland suitability group, or wildlife group can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

Soils in the Benton County Area were mapped at two levels of intensity. Soils in areas used mainly for farming were mapped at a high level of intensity, and they are composed of uppercase and lowercase letters. The remaining soils, in the western part of the Survey Area, were mapped at a medium level of intensity; they are identified by map symbols composed only of uppercase letters.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary. More detailed information about the terminology and methods of soil mapping, if desired, can be obtained from the Soil Survey Manual (*20*).[1]

[1] Italic numbers in parentheses refer to Literature Cited, p. 117.

Abiqua Series

The Abiqua series consists of deep, well-drained soils. These soils formed in fine-textured, mixed alluvium on alluvial fans, terraces, and bottom lands along tributary streams and drainageways. Slopes are 0 to 5 percent.

Where these soils are not cultivated, the vegetation is Douglas-fir, oak, shrubs, and grasses. Elevation ranges from 250 to 450 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is 50° to 52° F., and the frost-free season is 165 to 210 days.

In a representative profile the surface layer is very dark brown silty clay loam about 17 inches thick. The subsoil is dark reddish-brown silty clay about 13 inches thick. The substratum is brown clay that extends to a depth of 60 inches or more.

Most areas of Abiqua soils have been cleared and are used for small grain, grass seed, pasture, and hay. They are also used for woodland, wildlife habitat, and recreation.

Abiqua silty clay loam, 0 to 3 percent slopes (AbA).—This soil is on alluvial terraces and fans.

Representative profile 8½ miles north of Corvallis, in the SW¼SW¼ sec. 14, T. 10 S., R. 5 W.:

A1—0 to 7 inches, very dark brown (7.5YR 2/3) silty clay loam, brown (7.5YR 5/3) dry; strong, fine, granular structure; hard, friable, sticky and plastic; many very fine roots; many fine interstitial pores; 1 to 2 percent fine fragments of partly weathered rock; medium acid; clear, smooth boundary. 5 to 7 inches thick.

A3—7 to 17 inches, very dark brown (7.5YR 2/3) heavy silty clay loam, brown (7.5YR 5/3) dry; weak, fine, subangular blocky structure and moderate, fine, granular structure; hard, friable, sticky and plastic; common very fine roots; many fine interstitial pores; 1 to 2 percent fine fragments of partly weathered rock; medium acid; clear, smooth boundary. 10 to 17 inches thick.

B21—17 to 25 inches, dark reddish-brown (5YR 3/3) silty clay, reddish brown (5YR 4/3) dry; moderate, fine and very fine, subangular blocky structure; very hard, firm, very sticky and very plastic; common roots; many very fine pores; 1 to 2 percent fine fragments of partly weathered rock; medium acid; gradual, smooth boundary. 8 to 20 inches thick.

B22—25 to 30 inches, dark reddish-brown (5YR 3/3) silty clay, reddish-brown (5YR 4/3) dry; moderate, fine and medium, subangular blocky structure; very hard, firm, sticky and plastic; common very fine roots; many very fine pores; common, thin, dark reddish-brown coatings on peds; 5 percent fine fragments of partly weathered rock; medium acid; clear, smooth boundary. 5 to 23 inches thick.

IIC—30 to 60 inches, brown (7.5YR 4/4) clay, brown (7.5YR 5/4) dry; common, medium, black stains and strong-brown (7.5YR 5/8) variegations; massive; very hard, very firm, very sticky and very plastic; common very fine pores; 10 percent fragments of fine partly weathered rock; medium acid.

Depth to bedrock ranges from 40 to 60 inches or more. The content of gravel ranges from 0 to 15 percent. The A horizon is 10 YR or 7.5YR in hue, and the B horizon is 7.5YR or 5YR The B horizon ranges from heavy silty clay loam to silty clay or clay in texture. A few cobblestones are in the B and C horizons in some places. In places at a depth of 40 inches or more are gray mottles or a C horizon that is gravelly.

Included with this soil in mapping was about 5 percent McAlpin and Waldo soils. Also included was about 5 percent Abiqua silty clay loam, 3 to 5 percent slopes.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acreage	Percent	Soil	Acreage	Percent
Abiqua silty clay loam, 0 to 3 percent slopes	771	0. 2	Kilchis very cobbly loam, 50 to 100 percent slopes	504	0. 2
Abiqua silty clay loam, 3 to 5 percent slopes	1,158	. 3	Klickitat gravelly clay loam, 30 to 50 percent slopes	2, 254	. 7
Amity silt loam	6,100	1. 9	Klickitat gravelly clay loam, 50 to 75 percent slopes	6, 753	2. 0
Apt silty clay loam, 3 to 12 percent slopes	2,845	. 9	Malabon silty clay loam	8, 265	2. 6
Apt silty clay loam, 5 to 25 percent slopes	6,182	1. 9	Marty gravelly loam, 3 to 25 percent slopes	5, 777	1. 8
Apt silty clay loam, 25 to 50 percent slopes	12,761	4. 0	Marty gravelly loam, 25 to 60 percent slopes	1, 819	. 6
Apt silty clay loam, uneven, 5 to 25 percent slopes	5,481	1. 7	McAlpin silty clay loam	2, 963	. 9
Bashaw clay	2,087	. 6	McBee silty clay loam	2, 050	. 6
Bashaw silty clay loam	4,008	1. 2	Mixed alluvial land	835	. 3
Bellpine silty clay loam, 3 to 12 percent slopes	1,684	. 5	Mulkey loam, 5 to 25 percent slopes	118	. 1
Bellpine silty clay loam, 12 to 20 percent slopes	3,632	1. 1	Nehalem silt loam	1, 767	. 8
Bellpine silty clay loam, 20 to 30 percent slopes	8,014	2. 5	Newberg fine sandy loam	1, 338	. 4
Bellpine silty clay loam, 30 to 50 percent slopes	4,247	1. 3	Newberg loam	4, 433	1. 4
Blachly silty clay loam, 3 to 30 percent slopes	1,759	. 5	Peavine silty clay loam, 3 to 30 percent slopes	1, 208	. 4
Blachly silty clay loam, 30 to 50 percent slopes	1,668	. 5	Peavine silty clay loam, 30 to 60 percent slopes	6, 293	2. 1
Bohannon gravelly loam, 25 to 50 percent slopes	4,735	1. 5	Philomath silty clay, 3 to 12 percent slopes	868	. 3
Bohannon gravelly loam, 50 to 75 percent slopes	3,226	1. 0	Philomath silty clay, 12 to 45 percent slopes	1, 760	. 5
Brenner silt loam	803	. 2	Pilchuck fine sandy loam	677	. 2
Briedwell gravelly loam, 0 to 7 percent slopes	924	. 3	Price silty clay loam, 3 to 12 percent slopes	1, 194	. 4
Briedwell gravelly loam, 7 to 20 percent slopes	188	. 1	Price silty clay loam, 12 to 20 percent slopes	3, 618	1. 1
Camas gravelly sandy loam	1,934	. 6	Price-Ritner complex, 20 to 30 percent slopes	8, 132	2. 5
Chehalis silty clay loam	10,365	3. 2	Price-Ritner complex, 30 to 60 percent slopes	13, 127	4. 1
Cloquato silt loam	4,806	1. 5	Ritner-Price complex, 12 to 30 percent slopes	1, 462	. 5
Coburg silty clay loam	7,233	2. 3	Ritner-Price complex, 30 to 75 percent slopes	12, 820	3. 9
Concord silt loam	1,198	. 4	Riverwash	328	. 1
Conser silty clay loam	2,704	. 8	Salem gravelly loam	587	. 2
Dayton silt loam	15,362	4. 7	Slickrock gravelly loam, 3 to 25 percent slopes	3,081	1. 0
Dixonville silty clay loam, 3 to 12 percent slopes	3,012	. 9	Slickrock gravelly loam, 25 to 50 percent slopes	2,911	. 9
Dixonville silty clay loam, 12 to 20 percent slopes	4,076	1. 3	Veneta loam, loamy subsoil variant, 2 to 7 percent slopes	322	. 1
Dixonville silty clay loam, 20 to 30 percent slopes	5,272	1. 6	Veneta loam, loamy subsoil variant, 7 to 20 percent slopes	1,612	. 5
Dixonville silty clay loam, 30 to 50 percent slopes	3,796	1. 2	Veneta loam, loamy subsoil variant, 20 to 30 percent slopes	228	. 1
Dupee silt loam, 3 to 12 percent slopes	3,248	1. 0	Veneta silt loam, 2 to 7 percent slopes	2,529	. 8
Hazelair silt loam, 3 to 12 percent slopes	1,151	. 4	Veneta silt loam, 7 to 20 percent slopes	2,915	. 9
Hazelair complex, 3 to 12 percent slopes	2,614	. 8	Waldo silty clay loam	8,406	2. 6
Hazelair complex, 12 to 20 percent slopes	2,122	. 6	Wapato silty clay loam	1,217	. 4
Honeygrove silty clay loam, 3 to 12 percent slopes	1,776	. 8	Willamette silt loam, 0 to 3 percent slopes	2,428	. 8
Honeygrove silty clay loam, 3 to 25 percent slopes	9,877	3. 0	Willamette silt loam, 3 to 12 percent slopes	4,597	1. 4
Honeygrove silty clay loam, 25 to 50 percent slopes	5,013	1. 6	Winchuck silt loam, silty subsoil variant, 2 to 7 percent slopes	1,779	. 6
Honeygrove silty clay loam, uneven, 5 to 25 percent slopes	675	. 2	Witham silty clay loam, 2 to 7 percent slopes	2,901	. 9
Jory silty clay loam, 2 to 12 percent slopes	2,852	. 9	Witzel very cobbly loam, 30 to 75 percent slopes	2,322	. 7
Jory silty clay loam, 12 to 20 percent slopes	6,561	1. 9	Woodburn silt loam, 0 to 3 percent slopes	8,339	2. 6
Jory silty clay loam, 20 to 30 percent slopes	3,315	1. 0	Woodburn silt loam, 3 to 12 percent slopes	1,809	. 6
Jory silty clay loam, 2 to 30 percent slopes	6,883	2. 1	Water	1,513	. 5
Jory silty clay loam, 30 to 50 percent slopes	3,023	. 9	Total	321,000	100. 0

Runoff is very slow to slow on this Abiqua soil, and the hazard of erosion is none to slight. Rooting depth is 40 inches or more. Permeability is moderately slow. Available water capacity is 7.5 to 11 inches. Workability is good.

Most of this soil is used for cereal grain and for hay and pasture, but small areas are wooded. It is well suited to the crops grown on it. Capability unit I–1; wildlife group 1.

Abiqua silty clay loam, 3 to 5 percent slopes (AbB).—This soil is similar to Abiqua silty clay loam, 0 to 3 percent slopes.

Runoff is slow on this Abiqua soil, and the hazard of erosion is slight.

This soil is used mostly for cereal grain and for hay and pasture. Small areas are wooded. This soil has slight limitations. Capability unit IIe–1; wildlife group 1.

Amity Series

The Amity series consists of deep, somewhat poorly drained soils. These soils formed in mixed alluvium on the Willamette Valley terraces. Slopes are 0 to 2 percent.

Where these soils are not cultivated, the vegetation is annual and perennial grasses, shrubs, and widely spaced oak trees. Elevation ranges from 200 to 300 feet. Average annual precipitation is 40 to 45 inches, average annual air

temperature is 52° to 54° F., and the frost-free season is 165 to 210 days.

In a representative profile the surface layer is very dark grayish-brown silt loam about 16 inches thick. The subsurface layer is very dark gray silt loam about 6 inches thick. The subsoil is dark-brown and dark grayish-brown, mottled silty clay loam about 22 inches thick. The substratum is dark-brown, mottled silty clay loam that extends to a depth of 60 inches or more.

Amity soils are used for small grain, hay, pasture, and grass seed; and where drained and irrigated, they are used for vegetable crops. The areas are also used for wildlife habitat and recreation.

Amity silt loam (Am).—This soil occupies broad terraces in the Willamette Valley. Slopes are 0 to 2 percent.

Representative profile, one-half mile north of the Fir Grove School and 5 miles northeast of Corvallis, in the NW¼NW¼ sec. 23, T. 10 S., R. 4 W.:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/3) silt loam, grayish brown (10YR 5/2) dry; moderate, fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; few fine concretions; many fine interstitial pores; slightly acid; abrupt, smooth boundary. 6 to 9 inches thick.

A12—7 to 16 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak, medium, prismatic structure parting to moderate, medium, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many roots; few fine concretions; many very fine and few fine and medium pores; medium acid; clear, smooth boundary. 8 to 12 inches thick.

A2—16 to 22 inches, very dark gray (10YR 3/1) silt loam, gray (N 6/0) dry; common faint mottles; weak, medium, prismatic structure parting to moderate, coarse, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; many very fine and few fine and medium pores; common, fine, reddish-brown concretions; medium acid; clear, smooth boundary. 5 to 8 inches thick.

B2t—22 to 34 inches, dark-brown (10YR 4/3) silty clay loam, light brownish gray (10YR 6/2) dry; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; common roots; many very fine and few fine and medium tubular pores; gray (10YR 6/1) fine sand and silt coatings on ped surfaces; moderately thick, continuous (10YR 3/2) clay films on ped faces and in pores; medium acid; gradual, wavy boundary. 9 to 15 inches thick.

B3t—34 to 44 inches, dark-brown (10YR 4/3) and dark grayish-brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; many, medium, distinct, strong-brown (7.5YR 5/6) and reddish-brown (5YR 4/4) mottles; weak, medium, subangular blocky structure; hard, firm, sticky and plastic; few roots; many fine and medium tubular pores; common moderately thick clay films on some ped faces and in pores; slightly acid; gradual, wavy boundary. 8 to 12 inches thick.

C—44 to 60 inches, dark-brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; many, distinct, dark-brown (7.5YR 4/4) and strong-brown (7.5YR 4/6) mottles; massive; hard, friable, slightly sticky and plastic; many very fine and few fine and medium tubular pores; moderately thick clay films in larger pores; slightly acid.

The A horizon has a dry value of 4 or 5 and a moist chroma and value of 2 or 3. The A2 horizon has a moist value of 3 or 4, a dry value of 5 or 6, and a chroma of 1 or 2 moist and 0 to 2 dry. Depth to distinct mottles ranges from 12 to 28 inches. The B horizon ranges from 10YR to 2.5Y in hue. It has a moist value of 4 or 5, a dry value of 5 or 6, and a chroma of 2 or 3, moist and dry.

Included with this soil in mapping were about 2 percent Woodburn soils and 5 percent Concord and Dayton soils.

Runoff is slow and the hazard of erosion is slight. Rooting depth is moderately restricted because of an annual fluctuating high water table. This water table is from 12 to 24 inches deep in winter and in spring. Workability is fair. Permeability is moderately slow. Available water capacity is 9 to 12 inches.

This soil is used for small grain, hay, pasture, and grass seed. If it is drained, it is suitable for a wider range of crops. It is used for pole beans, corn, and other row crops where irrigation has been installed. A small acreage has been used for residential development. Capability unit IIw–1; wildlife group 2.

Apt Series

The Apt series consists of deep, well-drained soils that formed in colluvium weathered from sedimentary rock. These soils are on hilly uplands. Slopes are 3 to 50 percent.

The vegetation is Douglas-fir, alder, and maple and an understory of vine maple, salal, hazel nut, oceanspray, and brackenfern. Elevation ranges from 750 to 1,000 feet. Average annual precipitation is 60 to 90 inches, average annual air temperature is about 48° to 50° F., and the average frost-free season is 160 to 190 days.

In a representative profile the surface layer is very dark brown and very dark grayish-brown silty clay loam about 10 inches thick. The subsoil is dark-brown, dark yellowish-brown, and strong-brown silty clay and clay that extends to a depth of about 60 inches.

Apt soils are used mainly for woodland, water supply, and wildlife habitat. Some small areas are used for grain, hay, and pasture.

Apt silty clay loam, 5 to 25 percent slopes (ASD).—This soil is on broad ridges and side slopes.

Representative profile, 3 miles west of Kings Valley, in the SW¼SW¼ sec. 23, T. 10 S., R. 7 W.:

A1—0 to 5 inches, very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; strong, fine, granular structure; slightly hard, friable, sticky and plastic; many very fine roots; many very fine interstitial pores; very strongly acid; clear, smooth boundary. 2 to 5 inches thick.

A3—5 to 10 inches, very dark grayish-brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate, fine, subangular blocky structure; hard, friable, sticky and plastic; many roots; many very fine tubular pores; very dark brown (10YR 2/2) ped coatings; very strongly acid; clear, smooth boundary. 5 to 7 inches thick.

B1t—10 to 17 inches, dark-brown (10YR 3/3) silty clay, brown (10YR 5/3) dry; moderate, medium, subangular blocky structure; hard, friable, sticky and very plastic; many very fine to medium roots; many very fine and fine tubular pores; few moderately thick clay films in pores; very strongly acid; abrupt, smooth boundary. 7 to 12 inches thick.

B21—17 to 26 inches, dark yellowish-brown (10YR 3/4) silty clay, light yellowish brown (10YR 6/4) dry; moderate, fine, subangular blocky structure; hard, firm, sticky and very plastic; common roots; common very fine tubular pores; few thin and moderately thick clay films on peds and in pores; very strongly acid; clear, smooth boundary. 4 to 9 inches thick.

B22t—26 to 36 inches, strong-brown (7.5YR 4/6) clay, light brown (7.5YR 6/4) dry; moderate, fine and very fine, subangular blocky structure; very hard, firm, sticky and very plastic; few fine and medium roots; many

very fine tubular pores; common moderately thick clay films; very strongly acid; clear, smooth boundary. 10 to 15 inches thick.

B23t—36 to 50 inches, strong-brown (7.5YR 5/6) clay, reddish yellow (7.5YR 6/6) dry; weak, fine and medium, subangular blocky structure; very hard, firm, sticky and very plastic; many very fine tubular pores; common moderately thick clay films on peds and in pores; very strongly acid; clear, smooth boundary. 10 to 15 inches thick.

B3t—50 to 60 inches, strong-brown (7.5YR 5/6) clay, reddish yellow (7.5YR 7/6) dry; weak, fine to coarse, subangular blocky structure; very hard, firm, sticky and very plastic; few very fine roots; many very fine pores; few thin clay films; very strongly acid.

The A horizon has a value of 4 or 5 (dry) and 2 or 3 (moist) and a chroma of 2 or 3. It is 10YR or 7.5YR in hue. The B2t horizon has a dry value of 6 or 7, a moist value of 3 or 6, and chromas of 3 to 6. It is 10YR or 7.5YR in hue. Depth to the underlying sedimentary bedrock is 5 feet or more.

This soil is mapped in wooded areas, but not with the detailed intensity of the cultivated areas.

Included with this soil in mapping were about 5 percent Honeygrove soils and 10 percent Peavine soils. Where dikes of basic igneous rock intrude, 3 percent Blachly soils and 2 percent Klickitat soils were included in some areas. Also included were a few small areas of Apt soils that have slopes of 3 percent.

Runoff is medium to rapid on this Apt soil. The hazard of erosion is moderate to high. Rooting depth is 60 inches or more. Permeability is moderately slow. Available water capacity is 7.5 to 10 inches.

This soil is used mainly for timber production and water supply. About 10 percent of the acreage of this soil is used for natural and cultivated pasture. Capability unit IVe–3; woodland suitability group 2c1; wildlife group 4.

Apt silty clay loam, 3 to 12 percent slopes (ApC).—This soil is similar to Apt silty clay loam, 5 to 25 percent slopes. It was mapped near farmsteads at a more detailed intensity than the other Apt soils.

Runoff is medium. The hazard of erosion is moderate.

About 50 percent of the acreage of this soil is cultivated to hay, improved pasture, and cereal grain. The remaining acreage is in unimproved pasture and woodland. Capability unit IIIe–4; woodland suitability group 2c1; wildlife group 4.

Apt silty clay loam, 25 to 50 percent slopes (ASF).—This soil has slopes that average about 35 percent.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production, water supply, and wildlife habitat. Capability unit VIe–1; woodland suitability group 2c3; wildlife group 4.

Apt silty clay loam, uneven, 5 to 25 percent slopes (ATD).—This soil has slopes that average about 15 percent. The uneven slopes are small steplike benches that are at right angles to the direction of the slope. In a gross cross section, the downward slope generally is interrupted and irregular like stairsteps. Uneven slopes are caused by sliding and slumping.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. The hazard of sliding is severe.

About 10 percent of the acreage of these soils is cultivated to hay and improved pasture. The remaining acreage is used for unimproved pasture, woodland, water supply, and wildlife habitat. Capability unit IVe–4; woodland suitability group 2c2; wildlife group 4.

Bashaw Series

The Bashaw series consists of deep, poorly drained soils that formed in recent alluvium. These soils are level to depressional and are on alluvial bottom lands. Some areas of this soil are subject to overflow every 2 or 3 years. Slopes are 0 to 3 percent.

Where these soils are not cultivated, vegetation is ash, Oregon white oak, wild rose, poison-oak, rushes, sedges, and grass. Elevation ranges from 200 to 300 feet. The average annual precipitation is 40 to 60 inches, the average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 210 days.

In a representative profile the surface layer is black clay about 11 inches thick. The underlying material is also black clay about 21 inches thick. The substratum is very dark gray clay to a depth of about 46 inches. Below this, to a depth of 60 inches, is dark-gray, mottled silty clay.

Bashaw soils are used for spring grain, hay, pasture, and wildlife habitat.

Bashaw clay (Bc).—This soil occupies small areas in narrow bands along small drainageways in foothills and on terraces. Slopes are 0 to 3 percent.

Representative profile, 5 miles northeast of Corvallis, in the SW¼SE¼ sec. 7, T. 11 S., R. 4 W.:

Ap—0 to 5 inches, black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; strong, fine, subangular blocky structure; very hard, firm, very sticky and very plastic; many very fine roots; many fine interstitial pores; medium acid; clear, smooth boundary. 3 to 6 inches thick.

A12—5 to 11 inches, black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; moderate, fine and medium, angular blocky structure; very hard, very firm, very sticky and very plastic; common very fine roots; common very fine pores; slightly acid; clear, smooth boundary. 6 to 15 inches thick.

AC1—11 to 29 inches, black (10YR 2/1) clay, very dark gray (10YR 3/1) dry; massive with many wedge-shaped aggregates and intersecting slickensides; very hard, very firm, very sticky and very plastic; few roots; many very fine pores; slightly acid; clear, smooth boundary. 14 to 20 inches thick.

AC2—29 to 40 inches, black (10YR 2/1) clay, dark gray (10YR 4/1) dry; massive with many wedge-shaped aggregates and intersecting slickensides; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine pores; many slickensides; neutral; clear, wavy boundary. 10 to 20 inches thick.

C1—40 to 46 inches, very dark gray (10YR 3/1) clay, dark gray (10YR 4/1) dry; massive with many, fine, wedge-shaped aggregates and many intersecting slickensides; very hard, firm, very sticky and very plastic; no roots; few very fine pores; neutral; clear, smooth boundary. 5 to 20 inches thick.

C2—46 to 60 inches, dark-gray (5Y 4/1) silty clay, gray (10YR 5/1) dry; common, medium, distinct, dark-brown (7.5 YR 4/4) mottles; massive with many, fine, wedge-shaped aggregates and many intersecting slickensides; very hard, firm, very sticky and very plastic; no roots; few very fine pores; neutral.

The A horizon has a moist color value of 2 or 3 and a chroma of 1 or less. The dry value is 3 or 4, and the chroma is 1 or 2. The structure in the top few inches of the A horizon ranges from weak to strong, granular or fine, subangular blocky. The AC horizon is massive or has weak, coarse, primsatic structure. The AC horizon is 10YR or 2.5Y in hue and has a moist value of 2 or 3. The C horizon is 10YR, 2.5Y, or 5Y in hue. It is massive or has weak structure.

Included with this soil in mapping was a Waldo soil that makes up about 10 percent of the areas mapped.

Runoff is very slow or ponded. The hazard of erosion is slight. Permeability is very slow on this Bashow soil. Rooting depth is restricted by a high water table and a very firm clay substratum. Available water capacity is 8 to 10 inches. Workability is poor. This soil is subject to stream overflow in some areas.

This soil is used for pasture. It is used for spring grain, grass seed, and hay where drainage has been installed. Capability unit IVw–4; wildlife group 2.

Bashaw silty clay loam (Ba).—This soil is similar to Bashaw clay, but the surface layer is heavy silty clay loam. Slopes are 0 to 3 percent. Depth to clay generally ranges from 10 to 18 inches. A silty clay layer is above the clay in some places.

Permeability is moderate above the clay and very slow in the clay. This soil is subject to stream overflow.

This soil is used for pasture. It is used for spring grain, grass seed, and hay where it is drained. Many areas are in dense stands of hardwoods and shrubs. Because of its silty clay loam surface layer, this soil has a somewhat better response to surface and subsurface drainage where outlets are available. Capability unit IVw–5; wildlife group 2.

Bellpine Series

The Bellpine series consists of moderately deep, well-drained soils that formed in colluvium weathered from sedimentary rocks. These soils are on the low foothills and the higher, rolling uplands. Slopes are 3 to 50 percent.

Where these soils are not cultivated, the vegetation is Douglas-fir and oak and an understory of snowberry, trailing blackberry, poison-oak, and brackenfern. Elevation ranges from about 300 to 800 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is about 52° to 54° F., and the average frost-free season is 165 to 200 days.

In a representative profile the surface layer is dark reddish-brown silty clay loam about 6 inches thick. The subsoil is dark-red and dark reddish-brown silty clay loam, silty clay, and clay about 20 inches thick. It is underlain by fragmented, partly weathered sandstone.

Bellpine soils are used for cereal grain, orchards, hay, pasture, water supply, timber, wildlife habitat, and recreation.

Bellpine silty clay loam, 12 to 20 percent slopes (BeD).—This soil is on low foothills. Slopes are long and smooth and average about 18 percent.

Representative profile, in the SE¼SE¼ sec. 34, T. 12 S., R. 6 W.:

Ap—0 to 6 inches, dark reddish-brown (5YR 3/3) silty clay loam, reddish brown (5YR 5/4) dry; moderate, very fine to medium, granular structure; hard, friable, sticky and plastic; many very fine roots; many very fine interstitial pores; medium acid; clear, smooth boundary. 3 to 6 inches thick.

B1—6 to 10 inches, dark reddish-brown (5YR 3/4) heavy silty clay loam, reddish brown (5YR 4/4) dry; moderate, very fine and fine, subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine and fine tubular pores; few, unweathered, basalt pebbles and cobblestones at lower boundary; medium acid; abrupt, wavy boundary. 3 to 10 inches thick.

IIB21t—10 to 20 inches, dark-red (2.5YR 3/6) silty clay, red (2.5YR 4/6) dry; moderate, fine and medium, subangular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine roots; many very fine and fine tubular pores; common moderately thick clay films on peds and in pores; few, fine, weathered, sandstone pebbles; strongly acid; gradual, wavy boundary. 8 to 16 inches thick.

IIB22t—20 to 26 inches, dark-red (2.5YR 3/6) clay, red (2.5YR 4/6) dry; moderate, medium, subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; many very fine tubular pores; common moderately thick clay films; 20 percent yellowish-brown weathered pebbles; strongly acid; abrupt, irregular boundary. 4 to 10 inches thick.

IIIC—26 to 36 inches, pinkish-gray (7.5YR 7/2) and reddish-brown (5YR 5/4) partly weathered sandstone; many, thick, reddish-brown (5YR 4/4) and dark-red (2.5YR 3/6) clay films on fragments; thin tongues of the B22t horizon extend into the C horizon.

The A horizon has a dry value of 4 or 5. It has a chroma of 3 or 4. The B horizon has a moist value of 3 or 4 and a chroma from 3 to 6. It is 5YR or 2.5YR in hue. The content of coarse fragments of sedimentary rock in the lower part of the B horizon ranges from 10 to 30 percent. Depth to the underlying, partly weathered bedrock ranges from 20 to 40 inches.

Included with this soil in mapping were about 10 percent Jory soils and 5 percent Dupee, Hazelair, and Veneta soils.

Runoff is medium, and the hazard of erosion is moderate. Root penetration is restricted by the underlying bedrock. Permeability is slow. Available water capacity is 3.5 to 7 inches.

This soil is used for cereal grain, hay, pasture, water supply, and wildlife habitat. Capability unit IIIe–1; woodland suitability group 2c4; wildlife group 4.

Bellpine silty clay loam, 3 to 12 percent slopes (BeC).—This soil is similar to Bellpine silty clay loam, 12 to 20 percent slopes.

The hazard of erosion is slight, and runoff is slow to medium.

This soil is used for cereal grain, hay and pasture, orchards, water supply, and wildlife habitat. Capability unit IIe–2; woodland suitability group 2c4; wildlife group 4.

Bellpine silty clay loam, 20 to 30 percent slopes (BeE).—This soil is similar to Bellpine silty clay loam, 12 to 20 percent slopes.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for woodland, pasture, water supply, and wildlife habitat. Capability unit IVe–1; woodland suitability group 2c4; wildlife group 4.

Bellpine silty clay loam, 30 to 50 percent slopes (BeF).—This soil is similar to Bellpine silty clay loam, 12 to 20 percent slopes. Included in mapping was a soil that is similar to this Bellpine soil, except that depth to underlying bedrock is less than 20 inches. This soil makes up as much as 15 percent of this mapping unit in some places.

Runoff is very rapid, and the hazard of erosion is high.

This soil is used for timber production, pasture, water supply, and wildlife habitat. Capability unit VIe–2; woodland suitability group 2c5; wildlife group 4.

Blachly Series

The Blachly series consists of deep, well-drained soils that formed in colluvium over basalt or sedimentary rock. These soils are on the mountainous uplands in the Coast Range. Slopes are 3 to 50 percent.

The vegetation is Douglas-fir and alder and some hemlock at higher elevations. The understory is vine maple, salal, oceanspray, swordfern, and brackenfern. Elevation ranges from 900 to 2,200 feet. Average annual precipitation is 60 to 120 inches, the average annual air temperature is about 48° to 50° F., and the average frost-free season is about 150 to 190 days.

In a representative profile, the surface layer is dark reddish-brown silty clay loam about 6 inches thick. The subsoil is dark-red and yellowish-red silty clay and silty clay loam about 54 inches thick.

Blachly soils are used for timber production, water supply, and wildlife habitat. None of these soils are now cultivated.

Blachly silty clay loam, 3 to 30 percent slopes (BLE).—This soil is on benched sides of mountains. The uneven slopes are small steplike benches that are at right angles to the direction of the slope. In a gross cross section the downward slope is generally interrupted and irregular like a stairstep. These uneven slopes are caused by sliding and slumping. Slopes average about 20 percent.

Representative profile, 5 miles southeast of the summit of Marys Peak, in the SE¼NW¼ sec. 2, T. 13 S., R. 7 W.:

A1—0 to 6 inches, dark reddish-brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) dry; strong, fine, granular structure; slightly hard, friable, sticky and slightly plastic; many very fine to medium roots; many very fine interstitial pores; very strongly acid; clear, smooth boundary. 5 to 9 inches thick.

B1—6 to 25 inches, dark-red (2.5YR 3/6) silty clay, red (2.5YR 4/6) dry; moderate, very fine, subangular blocky structure and fine, granular structure; slightly hard, friable, slightly sticky and plastic; many very fine to coarse roots; many very fine tubular pores; very acid; clear, smooth boundary. 14 to 22 inches thick.

IIB21—25 to 41 inches, yellowish-red (5YR 4/6) silty clay, yellowish red (5YR 5/6) dry; moderate, very fine and fine, subangular blocky structure; hard, firm, sticky and plastic; few very fine and fine roots; many very fine tubular pores; few diorite pebbles; very strongly acid; gradual, smooth boundary, 9 to 20 inches thick,

IIB22—41 to 51 inches, yellowish-red (5YR 4/6) silty clay, yellowish red (5YR 5/6) dry; moderate, fine and medium, subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; common very fine tubular pores; few diorite pebbles; very strongly acid; gradual, smooth boundary. 8 to 14 inches thick.

IIB3—51 to 60 inches, yellowish-red (5YR 5/6) heavy silty clay loam, yellowish red (5YR 5/8) dry; weak, medium, subangular blocky structure; common very fine tubular pores; no roots; few partly weathered pebbles; very strong acid.

The A horizon has a moist chroma and value of 3 or 4. It is 7.5YR or 5YR in hue. The B2 horizon has a moist value of 3 or 4 and a dry value from 4 to 6. It has a chroma of 4 or 6. It is 5YR or 2.5YR in hue. Content of coarse fragments ranges from few to 15 percent in the B horizon. Depth to bedrock is 5 feet or more.

Included with this soil in mapping were about 10 percent Marty soils, 5 percent Klickitet soils, and 5 percent Bohannon and Slickrock soils.

Runoff is medium on this Blachy soil. The hazard of erosion is moderate, and the hazard of sliding is severe. Root penetration is to a depth of 40 inches or more. Permeability is moderately slow. Available water capacity is 7 to 9 inches.

This soil is used for timber production, water supply, and wildlife habitat. Small acreages are sometimes pastured. Capability unit IVe–4; woodland suitability group 2c2; wildlife group 5.

Blachly silty clay loam, 30 to 50 percent slopes (BLF).—This soil is on sides of mountains. Slopes average 40 percent.

As much as 15 percent Klickitat soils were included in mapping in some areas.

Runoff is rapid on this Blachly soil, and the hazard of erosion is high.

This soil is used for woodland, water supply, and wildlife habitat. Capability unit VIe–1; woodland suitability group 2c3; wildlife group 5.

Bohannon Series

The Bohannon series consists of well-drained, moderately deep soils that formed in colluvial materials weathered from sandstone. Slopes are 25 to 75 percent. These soils are on mountainous uplands in the Coast Range.

The vegetation is Douglas-fir, bigleaf maple, alder, vine maple, salal, swordfern, and brackenfern. Elevation ranges from 1,000 to 3,500 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is about 46° to 50° F., and the average frost-free season is about 145 to 190 days.

In a representative profile the surface layer is very dark brown and dark-brown gravelly loam about 18 inches thick. The subsoil is dark-brown gravelly loam about 17 inches thick. It is underlain by sandstone bedrock at a depth of about 35 inches.

Bohannon soils are used for timber production, water supply, and wildlife habitat. None of these soils are now cultivated.

Bohannon gravelly loam, 25 to 50 percent slopes (BOF).—This soil is on mountains and on narrow ridges. Slopes average about 40 percent.

Representative profile, 7½ miles west of Kings Valley, in the SW¼SW¼ sec. 15, T. 10 S., R. 7 W.:

A11—0 to 5 inches, very dark brown (7.5YR 2/2) gravelly loam, dark brown (10YR 4/3) dry; strong, very fine and fine, granular structure; soft, very friable, nonsticky and nonplastic; many roots; many interstitial pores; 20 percent pebbles; very strongly acid; gradual, smooth boundary. 3 to 5 inches thick.

A12—5 to 10 inches, very dark brown (7.5YR 2/2) gravelly loam, dark brown (7.5YR 4/2) dry; moderate, very fine and fine, granular structure; soft, very friable, slightly sticky and slightly plastic; many roots; many interstitial pores; 15 percent pebbles; very strongly acid; clear, smooth boundary. 4 to 7 inches thick.

A3—10 to 18 inches, dark-brown (7.5YR 3/3) gravelly loam, dark grayish brown (7.5YR 4/2) dry; moderate, fine, granular structure and fine, subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many roots; many very fine interstitial pores; 20 percent pebbles; very strongly acid; clear, smooth boundary. 0 to 8 inches thick.

B21—18 to 26 inches, dark-brown (7.5YR 4/4) gravelly loam, brown (7.5YR 5/4) dry; weak, very fine, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common roots; many very fine and fine tubular pores; 20 percent pebbles and 10 percent cobblestones; very strongly acid; clear, smooth boundary. 6 to 10 inches thick.

B22—26 to 35 inches, dark-brown (7.5YR 4/4) gravelly loam, strong brown (7.5YR 5/6) dry; weak, fine, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common roots; common very fine tubular pores; 25 percent pebbles and 15 percent cobblestones; very strongly acid; abrupt, wavy boundary. 0 to 12 inches thick.

IIR—35 inches, partly weathered, very firm, fractured Tyee Sandstone.

The A horizon has a moist value and chroma of 2 or 3 and a dry value of 3 to 5. It is 10YR to 7.5YR in hue. The content of coarse fragments ranges from few to 25 percent. The B horizon has a dry value of 5 or 6. It has a chroma of 3 or 4 and is 10YR and 7.5YR in hue. The content of coarse fragments ranges from 20 to 35 percent. Depth to bedrock ranges from 20 to 40 inches.

Included with this soil in mapping were about 10 percent Slickrock soils and 5 percent Peavine and Blachly soils.

Runoff is rapid on this Bohannon soil. The hazard of erosion is high. Root penetration ranges from 20 to 40 inches. Permeability is moderately rapid. The available water capacity is 3 to 6 inches.

This soil is used for woodland, water supply, and wildlife habitat. Because of steepness, it has severe limitations to use and is unsuitable for cultivated crops. Capability unit VIe–1; woodland suitability group 3r1; wildlife group 5.

Bohannon gravelly loam, 50 to 75 percent slopes (BOG).—This soil is on mountains. Slopes average about 65 percent. Included in mapping was about 10 to 15 percent of a soil that is very gravelly loam throughout and about 15 to 20 inches deep over bedrock.

Runoff is very rapid, and the hazard of erosion is high.

This soil is used for woodland, water supply, and wildlife habitat. Because it is very steep, it has very severe limitations to use and is unsuitable for cultivation. Capability unit VIIe–1; woodland suitability group 3r2; wildlife group 5.

Brenner Series

The Brenner series consists of poorly drained, deep soils that formed in mixed alluvium from basic igneous and sedimentary rocks. Slopes are 0 to 2 percent.

Where these soils are not cultivated, the vegetation is western redcedar and alder and a dense understory of water-tolerant shrubs. They occupy the lower positions on flood plains along rivers and streams in the Coast Range. Most areas have been cleared for pasture. Elevation ranges from 400 to 700 feet. The average annual precipitation is 60 to 90 inches, the average annual air temperature is about 48° to 50° F., and the average frost-free season is about 160 to 190 days.

In a representative profile the surface layer is very dark grayish-brown silt loam and silty clay loam about 17 inches thick. The subsoil is dark-gray and grayish-brown silty clay about 18 inches thick and has prominent yellowish-red mottles. The substratum is gray heavy silty clay loam that has prominent mottles of yellowish red and yellowish brown. It extends to a depth of 60 inches or more.

Brenner soils are used for hay, pasture, and wildlife habitat.

Brenner silt loam (Bp).—This soil is on flood plains in the tributary valleys of the Coast Range. Slopes are 0 to 2 percent.

Representative profile, 3½ miles north of Summit, in the NE¼SE¼ sec. 20, T. 10 S., R. 7 W.:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; common, fine, distinct, reddish-brown (5YR 4/4) mottles; moderate, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; strongly acid; abrupt, smooth boundary, 6 to 10 inches thick.

A12—9 to 17 inches, very dark grayish-brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; common, fine, prominent, yellowish-red (5YR 5/6) mottles; moderate, fine, granular structure and medium, fine, subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine interstitial and tubular pores; very strongly acid; clear, smooth boundary, 5 to 9 inches thick.

B2g—17 to 29 inches, dark-gray (10YR 4/1) silty clay, light brownish gray (10YR 6/2) dry; many, medium and large, prominent, yellowish-red (5YR 5/6) mottles; moderate, fine and medium, subangular blocky structure; hard, firm, very sticky and very plastic; common very fine roots; many very fine tubular pores; very strongly acid; clear, smooth boundary. 10 to 14 inches thick.

B3g—29 to 35 inches, grayish-brown (2.5Y 5/2) silty clay, light gray (2.5Y 7/2) dry; many, medium and large, prominent, yellowish-red (5YR 5/6) mottles; weak, medium and coarse, subangular blocky structure; hard, firm, very sticky and very plastic; few very fine roots; many very fine tubular pores; very strongly acid; clear, smooth boundary. 6 to 12 inches thick.

Cg—35 to 60 inches, gray (10YR 5/1) heavy silty clay loam, light gray (10YR 7/1) dry; common, medium and large, prominent, yellowish-red (5YR 5/6) and yellowish-brown (10YR 5/8) mottles; massive; hard, firm, sticky and plastic; few very fine tubular pores; very strongly acid.

The A horizon has a moist value of 2 or 3 and a dry value of 4 or 5. It ranges from silt loam to silty clay loam in texture. Depth to mottling ranges from 0 to 10 inches. The texture of the B horizon ranges from silty clay loam to silty clay. In some profiles the C horizon has stratifications of sandy loam or loamy sand.

Included with this soil in mapping was about 5 percent of another poorly drained soil that has a silty clay surface layer and a clay subsoil.

Runoff is very slow or ponded, and the hazard of erosion is slight. Root penetration is limited by a high water table in fall, in winter, and early in spring. This soil is subject to occasional flooding. Permeability is slow. Available water capacity is 9 to 11.5 inches.

This soil is used for hay, pasture, and wildlife habitat. Small areas are still in native vegetation. Capability unit IIIw–1; wildlife group 2.

Briedwell Series

The Briedwell series consists of deep, well-drained soils on gravelly terraces. Slopes are 0 to 20 percent.

Where these soils are not cultivated, the vegetation is Douglas-fir, Oregon white oak, poison-oak, snowberry, wild rose, and grass. Elevation ranges from 350 to 650 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is 50° to 52° F., and the average frost-free season is 165 to 210 days.

In a representative profile the surface layer is dark-brown gravelly loam about 7 inches thick. The subsoil is dark reddish-brown gravelly silty clay loam about 10 inches thick. The substratum is dark-brown gravelly clay loam and variegated very gravelly clay loam that extends to a depth of 48 inches or more.

Briedwell soils are used for hay, pasture, cereal grain, Christmas trees, and wildlife habitat.

Briedwell gravelly loam, 0 to 7 percent slopes (BrB).—This soil occupies gravelly terraces. Slopes average about 4 percent.

Representative profile, 1½ miles south of the community of Kings Valley, in the SE¼SE¼ sec. 16, T. 10 S., R. 6 W.:

Ap—0 to 7 inches, dark-brown (7.5YR 3/3) gravelly loam, brown (10YR 5/3) dry; moderate, fine, granular structure and very fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; 25 percent pebbles; strongly acid; abrupt, smooth boundary. 6 to 9 inches thick.

B2—7 to 17 inches, dark reddish-brown (5YR 3/3) gravelly silty clay loam, dark brown (7.5YR 4/4) dry; moderate, very fine and fine, subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine tubular pores; 25 percent pebbles; medium acid; clear, wavy boundary. 8 to 14 inches thick.

IIC1—17 to 30 inches, dark-brown (7.5YR 4/4) gravelly clay loam, strong brown (7.5YR 5/6) dry; yellowish-red (5YR 4/6) and light yellowish-brown (10YR 6/4) variegations; massive; very hard, firm, sticky and plastic; few very fine roots; common pores; 45 percent partly weathered pebbles; medium acid; abrupt, smooth boundary. 9 to 15 inches thick.

IIC2—30 to 60 inches, variegated yellowish-brown (10YR 5/6 and 5/4), grayish-brown (10YR 5/2), and reddish-brown (5YR 4/4) very gravelly clay loam; massive; very hard, firm, sticky and plastic; few very fine and fine pores; clay coatings on pebble surfaces; 60 percent partly weathered pebbles; medium acid.

The A horizon ranges from gravelly loam to gravelly clay loam in texture. The content of gravel ranges from 20 percent to 35 percent. The B horizon ranges from gravelly clay loam to gravelly silty clay loam in texture. The C horizon is 35 to 65 percent gravel. Depth to underlying weathered sedimentary bedrock ranges from 40 to 60 inches or more.

Included with this soil in mapping was about 10 percent Abiqua and McAlpin soils.

Runoff is slow on this Briedwell soil. The hazard of erosion is slight to moderate. Rooting depth is restricted by the gravelly substratum. Permeability is moderate. Available water capacity is 4 to 8 inches.

This soil is used for hay, pasture, cereal grain, Christmas trees, and wildlife habitat. It is suitable for a wider range of crops when irrigated. Capability unit IIIe–3; wildlife group 3.

Briedwell gravelly loam, 7 to 20 percent slopes (BrD).—This soil is similar to Briedwell gravelly loam, 0 to 7 percent slopes. A soil similar to Briedwell gravelly loam, 0 to 7 percent slopes, except that it is 15 to 40 inches deep over siltstone, was included in mapping. It makes up as much as 10 percent of the mapped areas.

Runoff is medium, and the hazard of erosion is moderate.

Most of the acreage has been cleared and is now in natural and improved pasture. A small acreage of coniferous trees is used for Christmas tree production. Capability unit IVe–2; wildlife group 3.

Camas Series

The Camas series consists of deep, excessively drained soils that formed in mixed, gravelly or cobbly, recent alluvium. These soils are on alluvial bottom lands along the Williamette River. They are subject to overflow once every 2 to 6 years. Slopes are 0 to 3 percent.

Where these soils are not cultivated, the vegetation is ash, cottonwood, Douglas-fir, blackberry, annual weeds, and grass. Elevation ranges from 190 to 300 feet. Average annual precipitation is 40 to 45 inches, average air temperature is 52° to 54° F., and the average frost-free season is 165 to 210 days.

In a representative profile (fig. 10), the surface layer is dark-brown gravelly sandy loam about 7 inches thick. The substratum is variegated dark-brown, very dark grayish-brown, dark grayish-brown, and dark-gray very gravelly sand that extends to a depth of 60 inches or more.

Camas soils are used for cereal grain, pasture, hay, vegetables, orchards, and wildlife habitat.

Figure 10.—**Profile of Camas gravelly sandy loam.**

Camas gravelly sandy loam (Ca).—This soil occupies flood plains in small, oval or narrow areas. Slopes are 0 to 3 percent.

Representative profile, 2 miles north of Oliver Butte, in the NE¼SW¼ sec. 12, T. 14 S., R. 5 W.:

Ap—0 to 7 inches, dark-brown (10YR 3/3) gravelly sandy loam, brown (10YR 5/3) dry; weak, fine, granular structure and very fine, subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many fine interstitial pores; 30 percent pebbles: medium acid; abrupt, wavy boundary. 7 to 11 inches thick.

IIC—7 to 60 inches, variegated dark-brown (10YR 4/3), very dark grayish-brown (10YR 3/2), dark grayish-brown (10YR 4/2), and dark-gray (10YR 3/1) very gravelly sand; massive parting to single grain; loose, nonsticky and nonplastic; common very fine roots to a depth of 14 inches; about 45 percent pebbles and 15 percent cobblestones; medium acid.

The A horizon has a moist value and chroma of 2 or 3. The content of gravel ranges from 25 to 40 percent. The A horizon ranges from gravelly loam to gravelly sandy loam in texture. In the C horizon the volume of gravel and cobblestones is more than 50 percent.

Included with this soil in mapping was about 10 percent Plichuck and Newberg soils.

Runoff is slow, and the hazard of erosion is moderate. Permeability is very rapid on this Camas soil. The very gravelly and cobbly sandy substratum restricts rooting depth. Available water capacity is 1.5 to 3 inches. Workability is poor. This soil is subject to overflow about once in every 2 to 6 years.

This soil is used for cereal grain, pasture, hay, and orchards. It is used for vegetable and specialty crops when irrigated. It is poorly suited to root crops. Capability unit IVw–2; wildlife group 1.

Chehalis Series

The Chehalis series consists of deep, well-drained soils that formed in mixed, recent alluvium on alluvial bottom lands. Slopes are 0 to 3 percent. In most areas these soils are subject to overflow about once in 3 to 5 years.

Where these soils are not cultivated, the vegetation is Douglas-fir, ponderosa pine, ash, bigleaf maple, and oak and an understory of vines and shrubs. Elevation ranges from 190 to 300 feet. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the average frost-free season is 165 to 210 days.

In a representative profile the surface layer is dark-brown and very dark brown silty clay loam about 11 inches thick. The subsoil is very dark brown and dark-brown silty clay loam about 34 inches thick. The substratum is dark yellowish-brown silty clay loam that extends to a depth of 60 inches or more.

Chehalis soils are used for cereal grain, pasture, hay, vegetable and specialty crops, wildlife habitat, and recreation.

Chehalis silty clay loam (Ch).—This soil occupies large areas on alluvial bottom lands along the major streams and rivers. Slopes are 0 to 3 percent.

Representative profile, 2 miles northeast of Oliver Butte, in the NW¼SE¼ sec. 11, T. 14 S., R. 5 W.:

Ap1—0 to 6 inches, dark-brown (10YR 3/3) light silty clay loam, dark brown (10YR 4/3) dry; moderate, very fine and fine, granular structure and weak, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; common worm casts; very dark grayish-brown (10YR 3/2) and very dark brown (10YR 2/2) coatings; neutral; clear, smooth boundary. 5 to 9 inches thick.

Ap2—6 to 11 inches, very dark brown (10YR 2/3; 10YR 2/2, uncrushed) silty clay loam, dark brown (10YR 4/3) dry; moderate, fine granular structure and weak, medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial and tubular pores; neutral; gradual, smooth boundary. 0 to 7 inches thick.

B21—11 to 20 inches, very dark brown (10YR 2/3; 10YR 2/2, uncrushed) silty clay loam, dark brown (10YR 4/3) dry; strong, fine granular structure and very fine, subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine and few fine tubular pores; neutral; gradual, smooth boundary. 6 to 10 inches thick.

B22—20 to 35 inches, very dark brown (10YR 2/3; 10YR 2/2, uncrushed) silty clay loam, brown (10YR 5/3) dry; moderate, very fine and fine, subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine and fine tubular pores; neutral; clear, smooth boundary. 12 to 16 inches thick.

B3—35 to 45 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate, fine and medium, subangular blocky structure; hard, friable, sticky and plastic; many very fine tubular pores; few very fine roots; neutral; clear, smooth boundary. 6 to 12 inches thick.

C—45 to 60 inches, dark yellowish-brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) dry; few, medium, faint, very dark grayish-brown (10YR 3/2) mottles; massive; hard, friable, sticky and plastic; many very fine pores; no roots; neutral.

The A and B horizons have a moist value and chroma of 2 or 3. Some faint mottling occurs below a depth of 40 inches in some places. Depth to underlying strata of sand and gravel ranges from 5 feet to many feet.

Included with this soil in mapping were about 10 percent Cloquato or Newberg soils and 5 percent McBee and Wapato soils.

Runoff is slow on this Chehalis soil, and the hazard of erosion is slight to moderate. Rooting depth is 60 inches or more. Permeability is moderate. Available water capacity is 11 to 13 inches. Workability is good.

This soil is used for cereal grain, hay, pasture, and orchards. It is used for pole and bush beans, sweet corn, mint, berries, and other row crops when irrigated. Capability unit IIw–2; wildlife group 1.

Cloquato Series

The Cloquato series consists of deep, well-drained soils that formed in mixed recent alluvium. These soils are on alluvial bottoms and are subject to overflow several times in some years, but the average is once in 2 to 4 years. These soils are traversed by overflow channels and sloughs. Slopes are 0 to 3 percent.

Where these soils are not cultivated, the vegetation is Douglas-fir, cottonwood, bigleaf maple, Oregon white oak, and ash and an understory of vine maple, wild blackberry, vines, shrubs, and grass. Elevation ranges from 190 to 300 feet. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the average frost-free season 165 to 210 days.

In a representative profile the surface layer is very dark grayish-brown and dark-brown silt loam about 13 inches thick. The subsoil is dark-brown silt loam about 28 inches thick. The substratum is dark-brown silt loam that extends to a depth of 60 inches or more.

Cloquato soils are used for cereal grain, pasture, hay, vegetables, orchards (fig. 11), and specialty crops. They are also used for wildlife habitat, recreation, and woodland.

Cloquato silt loam (Cm).—This soil is in large areas on flood plains parallel to the main streams and rivers.

Representative profile, 2 miles northeast of Oliver Butte, in the NW¼SE¼ sec. 12, T. 14 S., R. 5 W.:

Ap1—0 to 6 inches, very dark grayish-brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate, fine, granular structure and weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many fine interstitial pores; slightly acid; clear, smooth boundary. 5 to 10 inches thick.

Ap2—6 to 13 inches, dark-brown (10YR 3/3; 10YR 3/2, uncrushed) silt loam, brown (10YR 5/3) dry; weak, medium, subangular blocky structure and fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine tubular pores; common very fine roots; slightly acid; clear, smooth boundary. 0 to 7 inches thick.

B21—13 to 29 inches, dark-brown (10YR 3/3; 10YR 3/2, uncrushed) silt loam, brown (10YR 5/3) dry; strong, very fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine tubular pores; common very fine roots; slightly acid; gradual, wavy boundary. 12 to 19 inches thick.

B22—29 to 41 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate, very fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine tubular pores; common very fine roots; slightly acid; gradual, wavy boundary. 8 to 16 inches thick.

C—41 to 70 inches, dark-brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; common, medium, faint, dark grayish-brown (10YR 4/2) and distinct, yellowish-brown (10YR 5/6) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine interstitial pores; no roots; slightly acid.

Figure 11.—Filbert orchard on Cloquato silt loam. Slopes are 0 to 3 percent.

The A and B horizons have a moist color value and chroma of 2 or 3. In some places stratified layers of sand are below a depth of 40 inches.

Included with this soil in mapping were about 5 percent Newberg and Camas soils and 5 percent Chehalis soils.

Runoff is slow on this Cloquato soil, and the hazard of erosion is slight to moderate. Rooting depth is 60 inches or more. Permeability is moderate. Available water capacity is 12 to 14 inches. Workability is excellent.

This soil is used for cereal grain, hay, pasture, and orchards. It is used for beans, corn, mint, berries, and other row crops when irrigated. Capability unit IIw–2; wildlife group 1.

Coburg Series

The Coburg series consists of deep, moderately well drained soils that formed in mixed alluvium. These soils occupy broad terraces that parallel the Willamette River alluvial flood plains. Slopes are 0 to 3 percent.

Where these soils are not cultivated, the vegetation is grass and scattered stands of Douglas-fir and oak. Elevation ranges from 190 to 300 feet. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 210 days.

In a representative profile the surface layer is very dark brown silty clay loam about 11 inches thick. The subsoil is very dark brown and dark-brown silty clay loam and silty clay about 32 inches thick. The substratum is dark-brown clay loam and sandy clay loam that extends to a depth of 60 inches or more.

Coburg soils are used for cereal grain, grass seed, pasture, and hay (fig. 12). In places, small areas are used for irrigated vegetable crops and for recreation, woodland, and wildlife habitat.

Coburg silty clay loam (Cn).—This soil occupies medium-size areas parallel to the Willamette River flood plains.

Representative profile, 2 miles southeast of Monroe, in the SW¼NW¼ sec. 2, T. 15 S., R. 5 W.:

Ap1—0 to 7 inches, very dark brown (10YR 2/3) silty clay loam, dark brown (10YR 4/3) dry; moderate, fine, granular structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; medium acid; abrupt, smooth boundary. 5 to 9 inches thick.

Ap2—7 to 11 inches, very dark brown (10YR 2/3) silty clay loam, dark grayish brown (10YR 4/2) dry; weak, fine, granular structure and medium, subangular blocky structure; hard, firm, sticky and plastic; many very fine roots; many very fine interstitial pores; medium acid; abrupt, smooth boundary. 0 to 5 inches thick.

B1—11 to 26 inches, very dark brown (10YR 2/3) silty clay loam, dark grayish brown (10YR 4/2) dry; few, fine, faint, dark-brown (7.5YR 4/4) mottles; moderate, very fine and medium, subangular blocky structure; hard, firm, sticky and plastic; common roots; common very fine and fine tubular pores; common very fine roots; few fine concretions; slightly acid; clear, smooth boundary. 0 to 17 inches thick.

B21t—26 to 34 inches, dark-brown (10YR 3/3) light silty clay, dark grayish brown (10YR 4/2) dry; common, fine and medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine and medium, subangular blocky structure; hard, firm, very sticky and plastic; many very fine tubular pores; common, thin and few, moderately thick, very dark grayish-brown clay

Figure 12.—Ladino clover and orchardgrass pasture on Coburg silty clay loam. Slopes are 0 to 3 percent.

films; common, fine, black concretions; slightly acid; clear, smooth boundary. 14 to 22 inches thick.

B22t—34 to 43 inches, dark-brown (10YR 3/3) heavy silty clay loam, brown (10YR 4/3) dry; many, medium and large, distinct, dark-gray (10YR 4/1), dark grayish-brown (10YR 4/2), and strong-brown (7.5YR 5/6) mottles; weak, fine and medium, subangular blocky structure; very hard, firm, sticky and plastic; few roots; common fine and medium tubular pores; common, moderately thick (10YR 3/4) clay films on peds and in pores; common, fine, black concretions; slightly acid; abrupt, smooth boundary. 7 to 12 inches thick.

IIC1—43 to 51 inches, dark-brown (10YR 3/3) clay loam, dark brown (10YR 4/3) dry; many, fine and medium, distinct, dark-brown (7.5YR 4/4) mottles; massive; slightly hard and brittle, friable, slightly sticky and plastic; common very fine and fine pores; common, moderately thick, brown (7.5YR 4/2) clay films in pores; slightly acid; abrupt, smooth boundary, 6 to 11 inches thick.

IIC2—51 to 62 inches, dark-brown (10YR 3/3) sandy clay loam, brown (10YR 5/3) dry; many, large, distinct, yellowish-red (5YR 5/6) mottles; massive; slightly hard and brittle, friable, slightly sticky and slightly plastic; common very fine and fine pores; dark grayish-brown (10YR 4/2) clay films in pores; neutral.

The A horizon has a moist color value and chroma of 2 or 3. It has a dry value of 3 or 4. It is silty clay loam or silt loam in texture. The B2t horizon has a moist value of 3 or 4 and chroma of 2 or 3. Depth to distinct mottling ranges from about 20 to 34 inches. The B horizon ranges from silty clay loam to clay in texture. The C horizon has a moist color value and chroma of 3 or 4. Stratified sand or gravel is in the C horizon in some places.

Included with this soil in mapping were about 5 percent Woodburn and Malabon soils and 2 percent Conser soils.

Runoff is slow on this Coburg soil, and the hazard of erosion is slight. Rooting depth is restricted by a seasonal water table below a depth of 20 inches. Permeability is moderately slow. Available water capacity is 9 to 13 inches. Workability is good. Occasionally this soil is flooded along tributary streams.

This soil is used for cereal grain, grass seed, pasture, and hay. It is used for vegetable crops and berries when irrigated. Capability unit IIw-3; wildlife group 1.

Concord Series

The Concord series consists of deep, poorly drained soils that formed in silty alluvium. These soils are on broad Willamette Valley terraces. Slopes are 0 to 2 percent.

Where these soils are not cultivated, the vegetation is rushes, sedges, wild blackberry, hazelnut, annual grasses, and Oregon white oak. Elevation ranges from 200 to 300 feet. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 210 days.

In a representative profile the surface layer is dark grayish-brown silt loam about 6 inches thick. The subsurface layer is dark grayish-brown and grayish-brown silt loam about 20 inches thick. The subsoil is grayish-brown silty clay loam about 12 inches thick. The substratum is grayish-brown silt loam that extends to a depth of 60 inches or more.

Concord soils are used for grass seed, spring grain, pasture and hay, and wildlife habitat.

Concord silt loam (Co).—This soil occupies narrow bands in drainageways and depressions on broad valley terraces. Slopes are 0 to 2 percent.

Representative profile, 3 miles south of Corvallis Airport, in the SW¼NE¼ sec. 10, T. 13 S., R. 5 W.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silt loam, grayish brown (10YR 5/2) dry; common, fine, distinct, dark-brown (7.5YR 4/4) mottles; moderate, fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots;

many interstitial pores; medium acid; abrupt, smooth boundary. 5 to 7 inches thick.

A21—6 to 16 inches, dark grayish-brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; common, fine and medium, distinct, dark-brown (7.5YR 3/4) mottles; weak, medium and moderate, very fine, subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine tubular pores; medium acid; clear, smooth boundary. 2 to 10 inches thick.

A22—16 to 26 inches, grayish-brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; many, fine, distinct, dark-brown (7.5YR 4/4) mottles; moderate, very fine, subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; many very fine tubular pores; medium acid; clear, smooth boundary. 6 to 12 inches thick.

IIB2t—26 to 31 inches, grayish-brown (2.5YR 5/2) heavy silty clay loam, light gray (10YR 7/2) dry; many fine, distinct, yellowish-brown (7.5YR 5/6) mottles; weak, fine, prismatic structure and moderate, very fine, subangular blocky structure; firm, hard, sticky and plastic; few fine roots; many very fine and fine tubular pores; common moderately thick clay films in pores and thin films on peds; common, fine, black stains on peds; slightly acid; abrupt, smooth boundary. 5 to 10 inches thick.

IIIB3t—31 to 38 inches, grayish-brown (10YR 4/2) silty clay loam, light gray (10YR 7/2) dry; many, fine, distinct, dark-brown (7.5YR 4/4) mottles; moderate, fine and medium, subangular blocky structure; hard, firm, sticky and plastic; no roots; many very fine tubular pores; common moderately thick clay films in pores and few thin film on peds; few, fine, black concretions; slightly acid; clear, wavy boundary. 6 to 9 inches thick.

IIIC—38 to 60 inches, grayish-brown (10YR 5/2) silt loam, light gray (2.5YR 7/2) dry; few, fine, distinct, dark-brown (7.5YR 4/4) mottles; massive; hard, friable, sticky and plastic; no roots; common very fine pores; few, thick, reddish-brown clay films in pores; slightly acid.

The A horizon has a moist value of 3 to 5 and chroma of 1 to 2. It is 10YR in hue. The B horizon ranges from silty clay loam to silty clay in texture. It has a moist chroma of 1 or 2 and is 10YR to 2.5Y in hue. The C horizon ranges from silt loam to silty clay loam in texture and has a moist value of 4 or 5.

Included with this soil in mapping were about 5 percent Dayton soils and 3 percent Amity soils.

Runoff is very slow on this Concord soil, and the hazard of erosion is none to slight. Rooting depth is restricted by a seasonal high water table. Permeability is slow. Available water capacity is 9 to 12 inches. Workability is good.

This soil is used for grass seed, spring grain, pasture, and hay. Capability unit IIIw–1; wildlife group 2.

Conser Series

The Conser series consists of deep, poorly drained soils that formed in mixed alluvium. These soils are in slightly depressional areas in drainageways on the main valley terraces. Slopes are 0 to 3 percent.

Where these soils are not cultivated, the vegetation is Oregon white oak, ash, hawthorn, rose, sedges, rushes, and grass. Elevation ranges from 190 to 300 feet. Average annual precipitation is about 40 to 45 inches, average annual air temperature is about 52° to 54° F., and the frost-free season is 165 to 210 days.

In a representative profile the surface layer is very dark grayish-brown silty clay loam about 9 inches thick. The subsoil, to a depth of about 17 inches, is very dark gray heavy clay loam. Below is very dark grayish-brown, dark-gray, and grayish-brown clay that extends to a depth of 60 inches or more.

Conser soils are used mainly for grass seed, hay, pasture, and wildlife habitat.

Conser silty clay loam (Cs).—This soil occupies drainageways on the main valley terrace.

Representative profile, three-fourths of a mile east of Winkle Butte, in the SW¼SW¼ sec. 13, T. 13 S., R. 5 W.:

A11—0 to 3 inches, very dark grayish-brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate, fine, granular structure; hard, friable, sticky and plastic; many very fine and few fine to coarse roots; many very fine interstitial pores; slightly acid; clear, smooth boundary. 3 to 6 inches thick.

A12—3 to 9 inches, very dark grayish-brown (10YR 3/2) heavy silty clay loam, dark grayish brown (10YR 4/2) dry; common, fine, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; many very fine tubular pores; many very fine and few fine to coarse roots; slightly acid; clear, smooth boundary. 4 to 8 inches thick.

IIB1g—9 to 17 inches, very dark gray (10YR 3/1) heavy clay loam, grayish brown (10YR 5/2) dry; common, fine, distinct, strong-brown (7.5YR 5/6) and dark-brown (7.5YR 4/4) mottles; moderate, medium, subangular blocky structure; very hard, firm, very sticky and plastic; many very fine tubular pores; many very fine and few fine to coarse roots; few, moderately thick and common, thin, dark-gray (10YR 4/1) coatings; few fine pebbles; slightly acid; clear, smooth boundary. 6 to 10 inches thick.

IIIB21tg—17 to 31 inches, very dark grayish-brown (10YR 3/2) clay, grayish brown (10YR 5/2) dry; common, fine and medium, distinct, dark-brown (7.5YR 4/4 and 10YR 4/3) and strong-brown (7.5YR 5/6) mottles; weak, medium, prismatic structure parting to strong, fine, subangular blocky structure; very hard, firm, very sticky and very plastic; many very fine tubular pores; common very fine and few fine and medium roots; common moderately thick clay films on ped surfaces; medium acid; gradual, wavy boundary. 12 to 18 inches thick.

IIIB22tg—31 to 51 inches, dark-gray (10YR 4/1) clay, grayish brown (10YR 5/2) dry; common, medium, distinct, strong-brown (7.5YR 4/6 and 7.5YR 5/6) mottles; moderate, fine and medium, subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine and few fine and medium roots; many very fine pores; common moderately thick clay films; slightly acid; gradual, wavy boundary. 17 to 24 inches thick.

IIIB3g—51 to 60 inches, grayish-brown (10YR 5/2) clay, pale brown (10YR 6/3) dry; moderate, fine and medium, subangular blocky structure; common, coarse, prominant, strong-brown (7.5YR 5/6) and yellowish-red (5YR 5/6) mottles; firm, very hard, very sticky and very plastic; common very fine pores; common, moderate, thick, dark-gray (10YR 4/1) clay films in pores; slightly acid.

To a depth of 9 to 12 inches the moist color value is 2 or 3 and the dry value is 3 or 4. The A horizon ranges from silt loam to heavy silty clay loam in texture. Faint to distinct, strong-brown mottles are in the A horizon in some places. The Bt horizon is silty clay or clay in texture. Lenses of coarse sand and gravel are below a depth of 40 inches in places.

Included with this soil in mapping was about 5 to 10 percent Coburg and Dayton soils.

Runoff is slow to ponded on this Conser soil. The hazard of erosion is slight. Rooting depth is limited by a seasonal high water table. Permeability is slow. Available water capacity is 7.5 to 9.5 inches. Workability is good. This soil is subject to occasional flooding.

This soil is used mainly for grass seed, hay, and pasture crops. Limited acreages of hay and pasture are sprinkler irrigated. Capability unit IIIw–1; wildlife group 2.

Dayton Series

The Dayton series consists of deep, poorly drained soils. These soils formed in water-deposited silt underlain by older materials. They are in the Willamette Valley on terraces that parallel the flood plain along the Willamette River. Slopes are 0 to 2 percent.

Where these soils are not cultivated, the vegetation is Oregon white oak, shrubs, and grasses. Elevation ranges from 200 to 300 feet. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the average frost-free season is 165 to 210 days.

In a representative profile the surface layer is dark grayish-brown silt loam about 8 inches thick. The subsurface layer is gray silty clay loam about 7 inches thick. The subsoil is dark-gray and dark grayish-brown clay and silty clay about 30 inches thick. The substratum is brown silty clay loam that extends to a depth of 60 inches.

Dayton soils are used for hay, pasture, grass seed, and spring grain crops and for wildlife habitat.

Dayton silt loam (Da).—This soil occupies terraces in the Willamette Valley.

Representative profile, 3 miles south of the Corvallis Airport, in the NW¼SE¼ sec. 10, T. 13 S., R. 5 W.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam gray (10YR 6/1) dry; common, fine, distinct, yellowish-red (5YR 6/1) dry; common, fine, distinct, yellow-structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; medium acid; abrupt, smooth boundary. 5 to 9 inches thick.

A2—8 to 15 inches, gray (10YR 5/1) silty clay loam, light gray (10YR 7/1) dry; common, fine, distinct, dark-brown (7.5YR 4/4) mottles; weak, coarse, prismatic structure and moderate, very fine, subangular blocky structure; very hard, firm, sticky and plastic; many very fine roots; many very fine tubular pores; medium acid; abrupt, smooth boundary. 4 to 12 inches thick.

IIB2t—15 to 33 inches, dark-gray (2.5Y 4/1) clay, gray (N 5/0) dry; weak, coarse, prismatic structure; extremely hard, very firm, very sticky and very plastic; few very fine tubular pores; few coarse slickensides; few roots along ped faces; thin, continuous, thick clay films; medium acid; clear, smooth boundary. 10 to 20 inches thick.

IIB3t—33 to 45 inches, dark grayish-brown (10YR 4/2) silty clay, light brownish gray (10YR 6/2) dry; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, coarse, subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine tubular pores; common moderately thick clay films in pores and few films on peds; few black concretions and stains; medium acid; clear, smooth boundary. 5 to 14 inches thick.

IIIC—45 to 60 inches, brown (10YR 5/3) silty clay loam, light gray (10YR 7/2) dry; common, medium, distinct, dark yellowish-brown (10YR 4/6 and 4/4), yellowish-brown (10YR 5/6), and grayish-brown (10YR 5/2) mottles; massive; firm, very hard, sticky and slightly plastic; few very fine pores; few, moderately thick, dark, reddish-brown (5YR 3/4) clay films pores; slightly acid.

The combined thickness of the A and B horizons ranges from 30 to 48 inches. The Ap horizon is very dark grayish brown or dark grayish brown when moist. The A2 horizon is silt loam or silty clay loam. Depth to the IIB2t horizon is 12 to 18 inches. The C horizon ranges from silty clay loam to silty clay or clay in texture.

Included with this soil in mapping was about 5 percent Amity and Concord soils.

Runoff is slow to ponded on this Dayton soil. The hazard of erosion is slight. Available water capacity above the clayey subsoil is 3.75 to 4.5 inches, and it is 7 to 9 inches to a depth of 5 feet. Permeability is very slow. Rooting depth is restricted by a fluctuating high water table and a clay or silty clay subsoil. This soil is subject to occasional flooding in areas that are along tributary streams.

This soil is used for grass seed, hay, pasture, and some spring grain crops. It is used for a wider range of crops where subsurface drainage is installed. Capability unit IVw–1; wildlife group 2.

Dixonville Series

The Dixonville series consists of well-drained, moderately deep soils that formed in colluvium weathered from basic igneous rocks. These soils occupy low foothills and steep uplands. Slopes are 3 to 50 percent.

Where these soils are not cultivated, the vegetation is mainly annual grasses, weeds, scattered poison-oak, Oregon white oak, and wild rose. Douglas-fir is on some of the steeper slopes and at higher elevations. Elevation ranges from 350 to 1,000 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 200 days.

In a representative profile, the surface layer is very dark brown and very dark grayish-brown silty clay loam and silty clay about 13 inches thick. The subsoil is very dark brown and dark-brown silty clay and clay about 24 inches thick. Weathered basalt bedrock underlies the subsoil at a depth of about 37 inches.

Dixonville soils are used for pasture, cereal grain, homesites, recreation, water supply, woodland, and wildlife habitat.

Dixonville silty clay loam, 20 to 30 percent slopes (DnE).—This soil occupies long foot slopes on uplands. Slopes average about 25 percent.

Representative profile, 2 miles northeast of Philomath, in the NE¼SW¼ sec. 31, T. 11 S., R. 5 W.:

A1—0 to 5 inches, very dark brown (10YR 2/2) silty clay loam, dark grayish brown (10YR 4/2) dry; strong, fine, granular structure; hard, friable, sticky and plastic; many very fine roots; many, very fine interstitial pores; slightly acid; clear, smooth boundary. 4 to 6 inches thick.

A3—5 to 13 inches, very dark grayish-brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; moderate, fine, subangular blocky structure; hard, friable, very sticky and very plastic; many very fine roots; many very fine tubular pores; medium acid; clear, smooth boundary. 6 to 10 inches thick.

B2t—13 to 27 inches, very dark brown (7.5YR 2/2) clay, dark brown (7.5YR 4/2) dry; moderate, fine and medium, subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine roots; many very fine tubular pores; few moderately thick clay films on peds; medium acid; clear, wavy boundary. 4 to 13 inches thick.

B3t—27 to 37 inches, dark-brown (7.5YR 4/4) silty clay, brown (7.5YR 5/4) dry; weak, medium, subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; many very fine tubular pores; common moderately thick (7.5YR 3/2) clay films; medium acid; clear, smooth boundary. 6 to 17 inches thick.

C1—37 to 50 inches, variegated, light brownish-gray (10YR 6/2), dark yellowish-brown (10YR 4/4), and yellow-

ish-brown (10YR 5/6) saprolite; massive; very hard, very firm, sticky and plastic; few, moderately thick, dark reddish-brown clay films on fractures.

The A horizon ranges from 7.5YR to 10YR in hue. The content of coarse fragments is 0 to 10 percent pebbles and 0 to 5 percent cobblestones. The B horizon ranges from 7.5YR to 5YR in hue. Coarse fragments are 0 to 15 percent pebbles and 0 to 20 percent cobblestones. The depth to the underlying weathered basalt substratum or saprolite ranges from 20 to 40 inches.

Included with this soil in mapping were about 5 percent Philomath soils and 10 percent Ritner and Price soils.

Runoff is rapid on this Dixonville soil, and the hazard of erosion is high. Rooting depth ranges from 20 to 40 inches. Permeability is slow. Available water capacity is 3 to 7.5 inches.

This soil is used for unimproved pasture, woodland, water supply, and wildlife habitat. Capabiltiy unit IVe–1; woodland suitability group 4c1; wildlife group 4.

Dixonville silty clay loam, 3 to 12 percent slopes (DnC).—This soil is similar to Dixonville silty clay loam, 20 to 30 percent slopes.

Runoff is medium on this Dixonville soil, and the hazard of erosion is slight.

This soil is used for unimproved pasture, improved pasture, cereal grain, woodland, water supply, and wildlife habitat. Capability unit IIe–2; woodland suitability group 4c1; wildlife group 3.

Dixonville silty clay loam, 12 to 20 percent slopes (DnD).—This soil is similar to Dixonville silty clay loam, 20 to 30 percent slopes.

Runoff is medium on this Dixonville soil, and the hazard of erosion is moderate.

This soil is used for unimproved pasture, cereal grain, hay and improved pasture, water supply, and wildlife habitat. Capability unit IIIe–1; woodland suitability group 4c1; wildlife group 3.

Dixonville silty clay loam, 30 to 50 percent slopes (DnF).—This soil is similar to Dixonville silty clay loam, 20 to 30 percent slopes.

Runoff is very rapid on this Dixonville soil, and the hazard of erosion is high.

This soil is used for unimproved pasture, woodland, watershed, and wildlife habitat. Capability unit VIe–2; woodland suitability group 4c1; wildlife group 4.

Dupee Series

The Dupee series consists of deep, moderately well drained to somewhat poorly drained soils that formed in mixed colluvium underlain by sedimentary bedrock. These soils are in swales and depressions and on foot slopes on uplands. Slopes are 3 to 12 percent.

Where these soils are not cultivated, vegetation is Douglas-fir, oak, poison-oak, blackberry, and fern. Elevation ranges from 300 to 600 feet. Average annual precipitation ranges from 40 to 60 inches, average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 200 days.

In a representative profile the surface layer is dark-brown silt loam about 14 inches thick. The subsoil is dark-brown heavy silty clay loam and clay about 38 inches thick. The substratum is dark-brown clay loam that extends to a depth of 60 inches or more.

Dupee soils are used for cereal grain, grass seed, hay, pasture, and wildlife habitat.

Dupee silt loam, 3 to 12 percent slopes (DuC).—This soil is in swales and depressions on uplands. Slopes average about 7 percent.

Representative profile, 2 miles south of Inavale School, in the NW¼SW¼ sec. 20, T. 13 S., R. 5 W.:

Ap—0 to 6 inches, dark-brown (7.5YR 3/2) silt loam, dark brown (7.5YR 4/2) dry; moderate, fine, granular structure; slightly hard, friable, slightly sticky and plastic; many very fine roots; many very fine interstitial pores; medium acid; clear, smooth boundary. 6 to 9 inches thick.

A3—6 to 14 inches, dark-brown (7.5YR 3/4) silt loam, brown (7.5YR 5/4) dry; moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many very fine roots; many very fine pores; strongly acid; clear, smooth boundary. 0 to 8 inches thick.

B1—14 to 24 inches, dark-brown (7.5YR 4/4) heavy silty clay loam, brown (7.5YR 5/4) dry; common, fine, yellowish-red (5YR 5/6) variegations and dark-brown (7.5YR 3/4) ped coatings; weak, medium, prismatic structure and moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; many very fine pores; few thin clay films in pores; strongly acid; clear, smooth boundary. 4 to 12 inches thick.

B21t—24 to 33 inches, dark-brown (7.5YR 4/4) clay, brown (7.5YR 5/4) dry; common, fine, distinct, yellowish-red (5YR 5/6) and dark grayish-brown (10YR 4/2) mottles; moderate, medium, prismatic structure; very hard, firm, sticky and plastic; few very fine roots; common very fine pores; common thin clay films on ped surfaces and in pores; few black coatings and common black and reddish-brown concretions; common, yellowish-brown, weathered particles 1 to 2 millimeters in size; strongly acid; gradual, wavy boundary. 6 to 10 inches thick.

B22t—33 to 52 inches, dark-brown (7.5YR 4/4) clay, light brown (7.5YR 6/4) dry; many, fine and medium, distinct, yellowish-brown (5YR 5/6) and dark grayish-brown (10YR 4/2) mottles; few, medium, black stains; moderate, medium, prismatic structure; very hard, firm, sticky and plastic; many fine and very fine pores; few very fine and fine roots; common thin and few moderately thick clay films on peds; common gray silt coatings on ped surfaces; very strongly acid; clear, wavy boundary. 10 to 22 inches thick.

C—52 to 60 inches, dark-brown (7.5YR 4/4) heavy clay loam, light brown (7.5YR 6/4) dry; many, medium, distinct, brownish-yellow (10YR 5/6) and dark grayish-brown (10YR 4/2) mottles; many, medium, black stains; massive; very hard, very firm, sticky and plastic; few very fine pores; few clay films in pores; very strongly acid.

The A horizon ranges from 7.5YR to 10YR in hue. It has a moist value of 2 or 3. The B horizon ranges from 7.5YR to 10YR in hue and has a moist value of 4 to 6. It ranges from silty clay loam to clay in texture. Thickness of the solum ranges from 30 to 60 inches, depth to distinct mottling ranges from 20 to 30 inches, and depth to underlying bedrock ranges from 40 inches to 60 inches or more.

Included with this soil in mapping was about 5 percent Hazelair soils.

Runoff is moderately slow to medium on this Dupee soil, and the hazard of erosion is moderate. Root penetration is deep, although it is slightly restricted by a fluctuating seasonal high water table. Permeability is moderately slow. Available water capacity is 8 to 14 inches.

This soil is used for grain, grass seed, hay and pasture, and wildlife habitat. Small areas are in woodland and unimproved pasture. Capability unit IIIe–2; wildlife group 3.

Hazelair Series

The Hazelair series consists of moderately deep, moderately well drained to somewhat poorly drained soils that formed in colluvium weathered from sedimentary bedrock. They are on low, rolling foothills (fig. 13). Slopes are 3 to 12 percent.

Where these soils are not cultivated, the vegetation is Oregon white oak, grass, poison-oak, and wild rose. Elevation ranges from 300 to 500 feet. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 210 days.

In a representative profile, the surface layer is dark-brown silt loam and silty clay loam about 15 inches thick. The subsoil is dark yellowish-brown heavy silty clay loam about 8 inches thick. The substratum is grayish-brown clay about 10 inches thick. It is underlain by weathered, fragmented siltstone.

Hazelair soils are used for cereal grain, grass seed, hay, pasture, and wildlife habitat and for recreation. A few areas in oak-grass are used for pasture.

Hazelair silt loam, 3 to 12 percent slopes (HaC).—These soils are on low foothills. Average slopes are about 7 percent.

Representative profile, 3 miles southeast of the Inavale School, in NE¼NW¼ sec. 29, T. 13 S., R. 5 W.:

Ap—0 to 7 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate, fine, granular structure and moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; medium acid; abrupt, smooth boundary. 6 to 10 inches thick.

A12—7 to 15 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate, fine, subangular blocky structure; hard, friable, slightly sticky and plastic; many very fine roots; many very fine interstitial pores; medium acid; clear, smooth boundary. 0 to 9 inches thick.

B2—15 to 23 inches, dark yellowish-brown (10YR 4/4) heavy; silty clay loam, brown (10YR 5/3) dry; weak, fine, prismatic structure and moderate, fine, subangular blocky structure; hard, firm, sticky, and plastic; common very fine roots; many very fine pores; thin, pale-brown, silt coatings on peds; medium acid; abrupt, smooth boundary. 3 to 10 inches thick.

IIC1—23 to 33 inches, grayish-brown (10YR 5/2) clay, pale brown (10YR 6/3) dry; many, fine and medium, reddish-brown (5YR 4/4) and yellowish-red (5YR 5/6) mottles; massive; vertical fracture 6 inches apart; extremely hard, very firm, very sticky and very plastic; common very fine pores; common very fine roots; few large slickensides; medium acid; clear, wavy boundary. 6 to 12 inches thick.

IIIC2—33 to 41 inches, mottled, dark-gray (10YR 4/1), brown (10YR 5/3), reddish-brown (5YR 4/4), and black, weathered, clayey fragmented siltstone; thick brown and grayish-brown clay films in pores and fractures.

The Ap horizon has a moist chroma and value of 2 or 3. Mottles in the B2 and C horizons have a chroma from 2 to 6. Depth to the clay C1 horizon ranges for 12 to 24 inches. Underlying the clay C1 horizon between depths of 20 and 40 inches is weathered sedimentary rock or saprolite and some small areas of basalt bedrock.

Included with this soil in mapping was about 5 to 10 percent of Dupee and Veneta soils.

Permeability is very slow on this Hazelair soil, runoff is medium, and the erosion hazard is slight. Available water capacity is 3.5 to 7 inches. Root penetration is limited by a clayey substratum and a seasonal water table.

Most areas of this soil are used for small grain, grass seed, hay, pasture, and wildlife habitat and for recreation. Some oak-grass areas are in pasture. Capability unit IIIe–2; wildlife group 3.

Hazelair complex, 3 to 12 percent slopes (HeC).—Areas of the Hazelair and Hazelair soils, well-drained variant, are so intermingled that they cannot be mapped separately, and therefore are mapped as a complex. This complex is about 55 percent Hazelair soils, 30 percent Hazelair soils, well-drained variant, and 15 percent included areas of Bellpine and Dupee soils and other soils that have a silt loam horizon and are less than 20 inches deep to sedimentary bedrock. Also included in mapping was a soil that has a silt loam surface layer and a silty clay loam subsoil and is 20 to 30 inches deep to sedimentary bedrock.

The soils of this complex are used mainly for cereal grain, hay, pasture, and wildlife habitat and for recreation. Capability unit IIIe–2; wildlife group 3.

Hazelair complex, 12 to 20 percent slopes (HeD).—The soils in this mapping unit are similar to those in the Hazelair complex, 3 to 12 percent slopes, but the surface layer is thinner because of erosion. This complex is about

Figure 13.—**Typical area of Hazelair soils on low foothills northeast of Lewisburg.**

45 percent Hazelair soils, 40 percent Hazelair soils, well-drained variant, and 15 percent included soils. Included in mapping were Bellpine soils and other soils that have silt loam horizons and are less than 20 inches to sedimentary bedrock. Also included was a soil that has a silt loam surface layer and a silty clay loam subsoil that is 20 to 30 inches deep.

Runoff is medium. The hazard of erosion is high.

The soils in this complex are used for cereal grain, hay, pasture, and wildlife habitat and for recreation. Capability unit IIIe-1; wildlife group 3.

Hazelair Series, Well-Drained Variant

The Hazelair series, well-drained variant, consists of moderately deep, well-drained soils that formed in material weathered from sedimentary bedrock in the low foothills. The general topography rises above the valley terraces as smoothly sloping low foothills that have broad tops that break to narrow side slopes. Slopes are 3 to 20 percent.

Where these soils are not cultivated, the vegetation is grass, Oregon white oak, wild rose, poison-oak, and snowberry. Elevation ranges from 300 to 500 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 210 days.

In a representative profile the surface layer is dark-brown silty clay loam about 11 inches thick. The subsoil is dark-brown silty clay and dark yellowish-brown clay about 13 inches thick. It is underlain by weathered siltstone at a depth of about 24 inches.

Hazelair soils, well-drained variant, are used mainly for cereal grain, hay, and pasture. They are also used for recreation and wildlife habitat.

This soil is mapped only in complexes with normal Hazelair soils.

Representative profile of a Hazelair soil, well-drained variant, 3 miles southeast of Inavale School, in the NE¼ NW¼ sec. 29, T. 13 S., R. 5 W.:

Ap—0 to 5 inches, dark-brown (10YR 3/3) light silty clay loam, brown (10YR 5/3) dry; moderate, very fine and fine granular structure; hard, friable, sticky and plastic; many fine roots; many very fine interstitial pores; medium acid; clear, smooth boundary. 4 to 8 inches thick.

A3—5 to 11 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate, fine, granular structure and very fine and fine, subangular blocky structure; hard, friable, sticky and plastic; many roots; many very fine tubular pores; medium acid; clear, smooth boundary. 3 to 8 inches thick.

B21—11 to 19 inches, dark-brown (10YR 4/3) light silty clay, brown (10YR 5/3) dry; moderate, fine and medium, subangular blocky structure; hard, firm, sticky and plastic; common roots; common fine tubular pores; strongly acid; clear, smooth boundary. 6 to 12 inches thick.

IIB22—19 to 24 inches, dark yellowish-brown (10YR 4/4) clay, pale brown (10YR 6/3) dry; moderate, medium, subangular blocky structure; hard, firm, very sticky and very plastic; few fine roots; common fine tubular pores; strongly acid; abrupt, irregular boundary. 4 to 15 inches thick.

IIC—24 to 30 inches, fine, weathered siltstone that has dark-brown (7.5YR 4/4), yellowish-red (5YR 4/6), and black coatings; 5 to 10 percent dark yellowish-brown (10YR 4/4) tongues of clay from the IIB22 horizon.

The A horizon has a moist value and chroma of 2 or 3. It is silt loam to silty clay loam in texture. The B horizon ranges from 10YR to 7.5YR in hue. Depth to underlying weathered sedimentary bedrock ranges from 20 to 40 inches.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 3.5 to 7 inches. Permeability is slow. Root penetration is restricted by the underlying bedrock.

These soils are used mainly for cereal grain, hay, pasture, wildlife habitat, and recreation.

Honeygrove Series

The Honeygrove series consists of deep, well-drained soils that formed in colluvium weathered from sedimentary and basalt rocks in hilly to mountainous topography that has broad, rolling tops and steep side slopes. Slopes are 3 to 50 percent.

Where these soils are not cultivated, the vegetation is Douglas-fir, bigleaf maple, salal, oceanspray, hazelnut, and fern. Elevation ranges from 750 to 1,000 feet. Average annual precipitation is 60 to 90 inches, average annual air temperature is about 48° to 50° F., and the average frost-free season is 160 to 190 days.

In a representative profile the surface layer is dark reddish-brown silty clay loam about 8 inches thick. The subsoil is dark reddish-brown and dark-red silty clay and clay that extends to a depth of 60 inches or more.

Honeygrove soils are used for cereal grain, hay, pasture, timber, water supply, and wildlife habitat.

Honeygrove silty clay loam, 3 to 25 percent slopes (HND).—This soil occupies broad ridges and side slopes. Slopes average about 15 percent.

Representative profile, 7 miles west of Philomath on Old Peak Road, in the SE¼SE¼ sec. 11, T 12 S., R. 7 W.:

A1—0 to 8 inches, dark reddish-brown (5YR 3/3) silty clay loam, dark reddish brown (5YR 3/4) dry; strong, fine, granular structure; slightly hard, friable, sticky and plastic; many roots; many very fine interstitial pores; strongly acid; clear, smooth boundary. 4 to 8 inches thick.

B1—8 to 14 inches, dark reddish-brown (2.5YR 3/4) silty clay, reddish brown (2.5YR 4/4) dry; moderate, fine, granular structure; hard, firm, sticky and plastic; many roots; many very fine and fine interstitial pores; very strongly acid; abrupt, smooth boundary. 5 to 7 inches thick.

B21t—14 to 21 inches, dark reddish-brown (2.5YR 3/4) clay, red (2.5YR 4/6) dry; moderate, fine, subangular blocky structure; very hard, firm, sticky and plastic; many roots; many very fine tubular pores; common thick clay films; very strongly acid; clear, smooth boundary. 5 to 8 inches thick.

B22t—21 to 36 inches, dark-red (2.5YR 3/6) clay, red (2.5YR 4/6) dry; moderate, fine and medium, subangular blocky structure; very hard, firm, sticky and plastic; common roots; common very fine tubular pores; common thick clay films; very strongly acid; gradual, wavy boundary. 14 to 20 inches thick.

B23t—36 to 49 inches, dark-red (2.5YR 3/6) clay, red (2.5YR 4/6) dry; moderate, medium, subangular blocky structure; very hard, firm, sticky and plastic; few roots; common very fine tubular pores; common thick clay films on peds; few, gravel-size, coarse fragments; very strongly acid; gradual, wavy boundary. 10 to 16 inches thick.

B3t—49 to 60 inches, dark-red (2.5YR 3/6) clay, red (2.5YR 4/6) dry; weak, medium, subangular blocky structure; very hard, firm, sticky and plastic; common very fine tubular pores; common thick clay films on ped; few, gravel-size, coarse fragments; very strongly acid.

The A horizon has a moist value of 2 or 3 and a dry value of 3 or 4. It is 7.5YR or 5YR in hue. The B horizon is 5YR or 2.5YR in hue. Depth to underlying sedimentary bedrock ranges from about 5 to 10 feet. The lower part of the B horizon is as much as 15 percent coarse fragments in some places.

Included with this soil in mapping was about 5 to 10 percent Apt and Peavine soils. Also included, where dikes of igneous rock intrude, was about 5 percent Klickitat soils. Because this soil is mapped only in forested areas, it is not so intensively mapped as cultivated areas.

Runoff is medium, and the hazard of erosion is moderate. Available water capacity is 8 to 10 inches. Permeability is moderately slow. Rooting depth is unrestricted and is deep.

This soil is used mainly for timber production (fig. 14), water supply, and wildlife habitat. About 10 percent of this soil is used for natural and improved pasture and for cereal grain. Capability unit IVe–3; woodland suitability group 2c1; wildlife group 4.

Honeygrove silty clay loam, 3 to 12 percent slopes (HgC).—This soil has slopes that average about 9 percent.

Runoff is medium. The hazard of erosion is moderate.

About 25 percent of the acreage of this soil is cultivated to cereal grain, hay, and improved pasture. The remaining acreage is in unimproved pasture and woodland. This soil is also used for wildlife habitat and water supply. Capability unit IIIe–4; woodland suitability group 2c1; wildlife group 4.

Honeygrove silty clay loam, 25 to 50 percent slopes (HNF).—This soil has slopes that average about 35 percent.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production, water supply, and wildlife habitat. Because slopes are steep, this soil is not suited to cultivation. Capability unit VIe–1; woodland suitability group 2c3; wildlife group 4.

Honeygrove silty clay loam, uneven, 5 to 25 percent slopes (HOD).—This soil has slopes that average about 15 percent.

The uneven slopes are small steplike benches at right angles to the direction of the slope. In a gross cross section the downward slope is generally interrupted and irregular like stairsteps. Uneven slopes are caused by sliding and slumping.

Figure 14.—Cable logging Douglas-fir on Honeygrove silty clay loam, 3 to 25 percent slopes.

Runoff is medium, and the hazard of erosion is moderate. The slide and slump hazard is severe.

This soil is used mainly for timber production, water supply, and wildlife habitat. Small areas are in pasture. Capability unit IVe–4; woodland suitability group 2c2; wildlife group 4.

Jory Series

The Jory series consists of deep, well-drained soils that formed in colluvium weathered from sedimentary and basic igneous rocks. These soils are on the higher rolling uplands that border the steeper mountainous areas. Slopes are 2 to 50 percent.

The vegetation is Douglas-fir, grand fir, and Oregon white oak and an understory of poison-oak, snowberry, grass, and fern. Elevation ranges from 400 to 1,200 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 200 days.

In a representative profile, the surface layer is dark reddish-brown silty clay loam about 15 inches thick. The subsoil is dark-red and dark reddish-brown silty clay and clay that extends to a depth of 60 inches.

Jory soils are used for small grain, grass seed, hay, timber production, recreation, water supply, and wildlife habitat.

Jory silty clay loam, 2 to 12 percent slopes (JoC).—This soil occupies broad ridges and side slopes. Slopes average about 7 percent.

Representative profile, 2 miles south of Inavale School, in the SW¼NW¼ sec. 20, T. 13 S., R. 5 W.:

A1—0 to 7 inches, dark reddish-brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/3) dry; moderate, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine interstitial pores; few fine concretions; very strongly acid; clear, smooth boundary. 5 to 8 inches thick.

A3—7 to 15 inches, dark reddish-brown (5YR 3/4) silty clay loam, reddish brown (5YR 4/4) dry; moderate, fine, granular structure and moderate, very fine, subangular blocky structure; slightly hard, friable, sticky and plastic; common very fine and fine roots; common very fine interstitial and tubular pores; very strongly acid; clear, wavy boundary. 4 to 12 inches thick.

B1—15 to 23 inches, dark reddish-brown (2.5YR 3/4) silty clay, red (2.5YR 4/6) dry; moderate, fine and very fine, subangular blocky structure; hard, friable, sticky and plastic; common very fine and fine and few medium and coarse roots; many very fine tubular pores; few, fine, reddish-brown and black concretions; very strongly acid; abrupt, wavy boundary. 7 to 12 inches thick.

IIB21t—23 to 35 inches, dark-red (2.5YR 3/6) clay, red (2.5YR 4/6) dry; moderate, medium, subangular blocky structure; very hard, very firm, sticky and very plastic; common very fine tubular pores; few very fine pores; common moderately thick clay films; many, coarse, black stains; very strongly acid; gradual, wavy boundary. 9 to 16 inches thick.

IIB22t—35 to 51 inches, dark-red (2.5YR 3/6) clay, red (2.5YR 4/5) dry; moderate, medium, subangular blocky structure; very hard, very firm, sticky and very plastic; common very fine tubular pores; few very fine roots; many moderately thick clay films; strong-brown (7.5YR 5/8) weathered fragments 2 to 5 millimeters

in size; common, medium, black stains; very strongly acid; gradual, wavy boundary. 10 to 21 inches thick.

IIB23t—51 to 60 inches, dark-red (2.5YR 3/6) silty clay, red (2.5YR 4/6) dry; weak, medium and coarse, subangular blocky structure; very hard, firm, sticky and plastic; common very fine tubular pores; no roots; common moderately thick clay films; many, medium and coarse, strong-brown (7.5YR 5/6), weathered fragments; very strongly acid.

The A horizon is 7.5YR or 5YR in hue. The B horizon ranges from 5YR to 2.5YR in hue and has a moist value of 3 or 4. Depth to the underlying bedrock ranges from 40 inches to many feet. As much as 15 percent coarse fragments are in the lower part of the B horizon in some places. The underying bedrock may be basic igneous rock or sedimentary rock.

Included with this soil in mapping were about 5 to 10 percent Price and Ritner soils, 5 percent Bellpine soils, and 1 percent Dupee soils.

Runoff is medium on this Jory soil. The hazard of erosion is slight. Available water capacity is 7 to 11 inches. Permeability is moderately slow. Root penetration is deep.

This soil is used mainly for cereal grain, grass seed, orchards, hay, and pasture. Some areas are used for timber production, water supply, wildlife habitat, and recreation (fig. 15). Capability unit IIe–2; woodland suitability group 2c4; wildlife group 3.

Jory silty clay loam, 12 to 20 percent slopes (JoD).—This soil is similar to Jory silty clay loam, 2 to 12 percent slopes.

Runoff is medium on this Jory soil, and the hazard of erosion is moderate.

About 40 percent of the acreage of this soil is used for grain, hay, and pasture. The remaining acreage is in woodland or natural pasture. This soil is also used for water supply, wildlife habitat, and recreation. Capability unit IIIe–1; woodland suitability group 2c4; wildlife group 3.

Figure 15.—**Picnic area on Jory silty clay loam, 2 to 12 percent slopes. Tabletop is solid plank, 85 feet long, from a Douglas-fir grown in Benton County Area.**

Jory silty clay loam, 20 to 30 percent slopes (JoE).—This soil has slopes that average about 25 percent.

Runoff is medium, and the hazard of erosion is high.

About 15 percent of the acreage of this soil is used for cereal crops and pasture. This soil is used mainly for timber production, natural pasture, water supply, wildlife habitat, and recreation. Capability unit IVe–1; woodland suitability group 2c4; wildlife group 4.

Jory silty clay loam, 2 to 30 percent slopes (JRE).—This soil has slopes that average about 20 percent. Because this soil is mapped only in forested areas, it is not so intensively mapped as soils in cultivated areas.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used mainly for timber production, water supply, and wildlife habitat. A few areas are in natural pasture. Capability unit IVe–1; woodland suitability group 2c4; wildlife group 4.

Jory silty clay loam, 30 to 50 percent slopes (JRF).—This soil is similar to Jory silty clay loam, 2 to 12 percent slopes, except that it is somewhat shallower, 40 to 48 inches, to bedrock. This soil occupies steep uplands and has slopes that average about 35 percent.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production, unimproved pasture, water supply, and wildlife habitat. Because slopes are steep this soil is not suited to cultivation. Capability unit VIe–2; woodland suitability group 2c5; wildlife group 4.

Kilchis Series

The Kilchis series consists of shallow, well-drained or excessively drained soils that formed in colluvium weathered from basic igneous rocks. These soils are on mountainous topography in the Coast Range (fig. 16). Slopes are 50 to 100 percent.

The vegetation is Douglas-fir, hemlock, and noble fir and an understory of brackenfern, salal, and Oregongrape. Elevation ranges from 3,000 to 4,000 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is about 45° to 48° F., and the annual frost-free season is about 120 to 150 days.

In a representative profile the surface layer is dark reddish-brown very cobbly loam about 5 inches thick. The subsoil is a dark reddish-brown very cobbly loam about 14 inches thick. It is underlain by fractured diorite bedrock at a depth of about 19 inches.

This soil is used for timber production, water supply, wildlife habitat, and recreation.

Kilchis very cobbly loam, 50 to 100 percent slopes (KHG).—This soil has average slopes of about 65 percent.

Representative profile, 1 mile northwest of the summit of Marys Peak, in the SE¼SW¼ sec. 20, T. 12 S., R. 7 W.:

A1—0 to 5 inches, dark reddish-brown (5YR 3/2) very cobbly loam, dark brown (7.5YR 4/4) dry; moderate, very fine, granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many fine interstitial pores; 40 percent angular cobblestones and 15 percent pebbles; very strongly acid; clear, wavy boundary. 4 to 8 inches thick.

B1—5 to 13 inches, dark reddish-brown (5YR 3/2) very cobbly loam, dark brown (7.5YR 4/4) dry; moderate, very fine, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very

Figure 16.—Looking west toward Marys Peak in the Coast Range. Kilchis and Bohannon soils on side slopes of Marys Peak, and Klickitat soils in foreground.

fine roots; few very fine interstitial pores; 35 percent cobblestones and 20 percent pebbles; very strongly acid; clear, wavy boundary. 0 to 9 inches thick.

B2—13 to 19 inches, dark reddish-brown (5YR 2/3) very cobbly loam, dark reddish brown (5YR 3/4) dry; moderate, very fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common roots; few very fine interstitial pores; 35 percent cobblestones and 25 percent pebbles; very strongly acid; abrupt, irregular boundary. 4 to 8 inches thick.

IIR—19 inches, fractured diorite bedrock and a few thin tongues of the material from B2 horizon are in rock cleavages.

The amount of rock fragments in the profile ranges from 40 to 70 percent. Rock outcrops occur in some places. Depth to underlying bedrock ranges from 12 to 20 inches.

Included with this soil in mapping were about 10 percent Klickitat soils and 5 percent Mulkey soils.

Runoff is very rapid, and the hazard of erosion is high. Available water capacity is 1 to 3 inches. Permeability is moderately rapid. Root penetration is limited by the underlying bedrock.

This soil is suitable for wildlife habitat, water supply, and recreation. This shallow soil provides only a small volume of soil for tree roots, except in places where roots penetrate deep fractures in the bedrock. Tree survival is low, and the windthrow hazard is high. Capability unit VIIs–1; woodland suitability group 5d1; wildlife group 5.

Klickitat Series

The Klickitat series consists of deep, well-drained soils that formed in colluvium weathered from basalt and intrusive rocks. These soils are on steep mountainous uplands in the Coast Range. Slopes are 30 to 75 percent.

The vegetation is mainly Douglas-fir. Some hemlock grows at higher elevations. The understory is salal, vine maple, oceanspray, and swordfern. Elevation ranges from 900 to 3,500 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is about 45° to 50° F., and the average frost-free period is 120 to 150 days.

In a representative profile, the surface layer is dark reddish-brown gravelly clay loam about 8 inches thick. The subsoil is reddish-brown and dark reddish-brown clay loam and gravelly clay loam about 21 inches thick. The substratum is yellowish-red very cobbly clay loam about 19 inches thick. Fractured basalt bedrock is at a depth of about 48 inches.

Klickitat soils are used for timber production, water supply, and wildlife habitat.

Klickitat gravelly clay loam, 30 to 50 percent slopes (KKF).—This soil has average slopes of about 40 percent.

Representative profile, 6½ miles southwest of Philomath, in the NE¼NW¼ sec. 25, T. 12 S., R. 7 W.:

A1—0 to 8 inches, dark reddish-brown (5YR 3/2) gravelly clay loam, reddish brown (5YR 4/3) dry; strong, fine, granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and few fine and medium woody roots; many very fine interstitial pores; 35 percent pebble-size coarse fragments; very strongly acid; clear, smooth boundary. 6 to 12 inches thick.

B1—8 to 16 inches, reddish-brown (5YR 3/3) gravelly light clay loam, reddish brown (5YR 4/4) dry; moderate, very fine and fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium woody roots; common very fine interstitial pores; 25 percent pebble-size coarse fragments; very strongly acid; abrupt, smooth boundary. 0 to 10 inches thick.

B2—16 to 29 inches, dark reddish-brown (5YR 3/4) gravelly clay loam, yellowish red (5YR 5/6) dry; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few medium roots; many very fine tubular pores; 35 percent pebble-size fragments; very strongly acid; gradual, smooth boundary. 10 to 18 inches thick.

C—29 to 48 inches, yellowish-red (5YR 4/6) very cobbly clay loam, yellowish red (5YR 5/6) dry; massive; slightly hard, friable, sticky and plastic; common fine tubular

pores; 40 percent cobblestones, stone-size coarse fragments, and 30 percent pebbles; very strongly acid.

IIR—48 inches, fractured basalt bedrock.

The A horizon is 7.5YR or 5YR in hue, moist or dry, and has a dry value of 4 or 5 and a moist value of 2 or 3. It has a chroma of 2 or 3 when moist and 3 or 4 when dry. The B horizon has a moist value of 3 or 4. Depth to underlying bedrock ranges from 40 to 50 inches. The amount of coarse fragments ranges from 25 to 35 percent in the A horizon and from 35 to 60 percent in the B2 horizon. A few rock outcrops occur in some places.

Included with this soil in mapping were about 10 percent Marty and Blachly soils and 10 percent Kilchis soils.

Runoff is rapid on this Klickitat soil, and the hazard of erosion is high. Available water capacity is 2 to 4 inches. Permeability is moderate. Rooting depth is somewhat restricted by the high content of coarse fragments in the subsoil and in the substratum.

This soil is used mainly for timber production, water supply, and wildlife habitat. Because slopes are steep and the percentage of coarse fragments throughout the surface layer and subsoil is high, this soil has severe limitations to use. It is not suited to cultivated crops. Capability unit VIs–1; woodland suitability group 3f2; wildlife group 5.

Klickitat gravelly clay loam, 50 to 75 percent slopes (KKG).—This soil has rock outcrops in some places, and about 15 percent of this mapping unit is Kilchis soils.

Runoff is very rapid on this Klickitat soil and the hazard of erosion is high.

This soil is used for woodland (fig. 17), water supply, and wildlife habitat. Because slopes are steep, it is unsuitable for cultivation. Capability unit VIIs–1; woodland suitability group 3r2; wildlife group 5.

Malabon Series

The Malabon series consists of deep, well-drained soils that formed in mixed alluvium. These soils are on broad Willamette Valley terraces. Slopes are 0 to 3 percent.

Where these soils are not cultivated, the vegetation is oak, grass, and blackberry, poison-oak, and other shrubs. Elevation ranges from 190 to 300 feet. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 210 days.

In a representative profile, the surface layer is very dark grayish-brown silty clay loam about 6 inches thick. The subsoil is very dark grayish-brown, very dark brown, and dark-brown silty clay loam and silty clay about 36 inches thick. The substratum is dark yellowish-brown and dark-brown silty clay loam and clay loam that extends to a depth of 60 inches or more.

Malabon soils are used mainly for cereal grain, grass seed, hay, and pasture. They are also used for wildlife habitat (fig. 18) and for recreation.

Malabon silty clay loam (Ma).—This soil occupies broad terraces in the Willamette Valley.

Representative profile, 1 mile north of Oliver Butte, in the SW¼NW¼ sec. 14, T. 14 S., R. 5 W.:

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) light silty clay loam, dark grayish brown (10YR 4/2) dry; weak, medium, granular structure and weak, fine, subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many fine interstitial and tubular pores; medium acid; abrupt, smooth boundary. 4 to 8 inches thick.

B1—6 to 13 inches, very dark grayish-brown (10YR 3/2; 10YR 2/2, uncrushed) silty clay loam, brown (10YR 4/3) dry; moderate, fine, subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine and fine tubular pores; medium acid; clear, smooth boundary. 6 to 10 inches thick.

B21t—13 to 23 inches, very dark brown (10YR 3/3; 10YR 2/2, uncrushed) silty clay, dark brown (10YR 4/3) dry; moderate, fine and medium, subangular blocky structure; hard, firm, sticky and plastic; many very fine and fine tubular pores; common very fine roots; common moderately thick clay films; medium acid; clear, wavy boundary. 8 to 14 inches thick.

B22t—23 to 35 inches, dark-brown (10YR 3/3) silty clay, dark brown (10YR 4/3) dry; moderate, medium, subangular blocky structure; hard, firm, sticky and very plastic; many very fine and fine tubular pores; few very fine roots; common, moderately thick, very dark brown (10YR 2/3) clay films; medium acid; abrupt, smooth boundary. 8 to 12 inches thick.

IIB3t—35 to 42 inches, dark-brown (10YR 4/3) heavy silty clay loam, brown (10YR 5/3) dry; weak, coarse,

Figure 17.—**Douglas-fir on Klickitat gravelly clay loam, 50 to 75 percent slopes. Clear-cut area was cable logged.**

Figure 18.—Farm pond constructed on Malabon silty clay loam is used for fish and waterfowl. The soil has slopes of 0 to 3 percent.

subangular blocky structure; hard, firm, sticky and plastic; many very fine and fine pores; common moderately thick clay films; slightly acid; clear, smooth boundary. 5 to 20 inches thick.

IIC1—42 to 57 inches, dark yellowish-brown (10YR 4/4) clay loam, brown (10YR 5/3) dry; massive; hard, firm, sticky and plastic; many very fine tubular pores; moderately thick clay films in pores; slightly acid; abrupt, smooth boundary. 8 to 18 inches thick.

IIIC2—57 to 65 inches, dark-brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; massive; hard, firm, sticky and plastic; many very fine pores; moderately thick clay films in some pores; slightly acid.

Depth to bedrock is 60 inches or more. As much as 15 percent pebbles occurs throughout the soil in some places. The A and B horizons are 10YR or 7.5YR in hue. The A horizon has a moist value and chroma of 2 or 3, a dry value of 4 or 5, and a dry chroma of 2 or 3. The Ap horizon commonly is silty clay loam in texture but is silt loam in some areas. In some places the lower part of the B horizon is stratified silty clay loam, clay loam, or coarser textured material. The C horizon is stratified sand and gravel.

Included with this soil in mapping was about 5 percent Coburg and Willamette soils.

Runoff is slow on this Malabon soil, and the hazard of erosion is none to slight. Rooting depth is 5 feet or more. Permeability is moderately slow. Available water capacity is 9 to 12 inches. Workability is good. This soil is subject to flooding in areas that are along streams.

This soil is used mainly for cereal grain, grass seed, hay, pasture, vegetable crops, specialty crops, wildlife habitat, and recreation. Capability unit IIs–2; wildlife group 1.

Marty Series

The Marty series consists of deep, well-drained soils that formed in colluvium weathered from coarse-grained, intrusive igneous rocks. These soils are on the mountainous uplands in the Coast Range. Slopes are 3 to 60 percent.

The vegetation is Douglas-fir and alder and some hemlock and noble fir at higher elevations. The understory is vine maple, salal, oceanspray, swordfern, and brackenfern. Elevation ranges from 800 to 3,000 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is 46° to 50° F., and the average frost-free season is about 150 to 190 days.

In a representative profile, the surface layer is dark reddish-brown gravelly loam about 16 inches thick. The subsoil is dark reddish-brown, reddish-brown, and yellowish-red clay loam and loam that extends to a depth of 60 inches or more.

Marty soils are used for timber production, water supply, and wildlife habitat. None of these soils are cultivated.

Marty gravelly loam, 3 to 25 percent slopes (MGD).—This soil occupies the sides of mountains. Slopes average 20 percent.

Representative profile, 10 miles west of Philomath, in the SW¼SW¼ sec. 9, T. 12 S., R. 7 W.:

A11—0 to 6 inches, dark reddish-brown (5YR 3/3) gravelly loam, reddish brown (5YR 4/4) dry; strong, fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine interstitial pores; 20 percent fine shot and coarse fragments; very strongly acid; clear, smooth boundary. 4 to 9 inches thick.

A12—6 to 16 inches, dark reddish-brown (5YR 3/4) gravelly loam, reddish brown (5YR 4/4) dry; strong, fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; 20 percent fine shot and coarse fragments; very strongly acid; clear, smooth boundary. 7 to 11 inches thick.

B1—16 to 31 inches, dark reddish-brown (5YR 3/4) heavy loam, reddish brown (5YR 4/4) dry; moderate, very fine, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; few diorite pebbles; very strongly acid; abrupt, smooth boundary. 0 to 17 inches thick.

IIB21—31 to 40 inches, reddish-brown (5YR 4/4) light clay loam, yellowish red (5YR 4/6) dry; moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common fine roots; many very fine and fine tubular pores; 5 percent diorite pebbles; very strongly acid; clear, smooth boundary. 8 to 12 inches thick.

IIB22—40 to 65 inches, yellowish-red (5YR 4/6) clay loam, reddish brown (5YR 5/4) dry; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and plastic; many very fine and fine tubular pores; 10 percent diorite pebbles; very strongly acid.

The A horizon has a moist value of 2 or 3. It is 7.5YR or 5YR in hue. The content of coarse fragments ranges from few to 25 percent. The B horizon is 2.5YR or 5YR in hue. The content of coarse fragments ranges from few to 25 percent. Depth to bedrock is 60 inches or more.

Included with this soil in mapping were about 5 percent Blachly soils, 5 percent Klickitat soils, and 3 percent Slickrock soils.

Runoff is medium on this Marty soil, and the hazard of erosion is moderate. Root penetration is deep. Permeability is moderately slow. Available water capacity is 8.5 to 12 inches.

This soil is used for timber production, water supply, and wildlife habitat. Small acreages are sometimes pastured. Capability unit IVe–3; woodland suitability group 2o1; wildlife group 5.

Marty gravelly loam, 25 to 60 percent slopes (MGF).—This soil occupies steep sides of mountains. Slopes average about 45 percent.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for timber production, water supply, and wildlife habitat. Capability unit VIe–1; woodland suitability group 2r1; wildlife group 5.

McAlpin Series

The McAlpin series consists of deep, moderately well drained soils that formed in alluvium weathered from basic igneous rocks. These soils are in areas along tributary streams and drainageways in the foothills in the northern half of the county. Slopes are 0 to 3 percent.

Where these soils are not cultivated, the vegetation is Douglas-fir, white fir, shrubs, and grass. Elevation ranges from 250 to 450 feet. Average annual precipitation is 40 to 60 inches, average annual temperature is 50° to 52° F., and the average frost-free season is 165 to 210 days.

In a representative profile the surface layer is dark-brown silty clay loam about 14 inches thick. The subsoil is very dark grayish-brown, dark-brown, and brown silty clay that extends to a depth of 60 inches or more.

McAlpin soils have been cleared in most areas and are used for small grain, grass seed, hay, and pasture. They are also used for recreation and wildlife habitat.

McAlpin silty clay loam (Mn).—This soil occupies alluvial terraces and fans. Slopes are 0 to 3 percent.

Representative profile, 4½ miles southwest of Philomath, in the NW¼NE¼ sec. 32, T. 12 S., R. 6 W.:

Ap—0 to 6 inches, dark-brown (7.5YR 3/2) silty clay loam, brown (7.5YR 4/3) dry; moderate, very fine and fine, granular structure; hard, friable, slightly sticky and plastic; many very fine roots; many very fine interstitial pores; strongly acid; abrupt, smooth boundary. 4 to 8 inches thick.

A12—6 to 14 inches, dark-brown (7.5YR 3/2) silty clay loam, brown (7.5YR 4/2) dry; moderate, very fine and fine, subangular blocky structure; hard, friable, slightly sticky and plastic; many very fine roots; many very fine interstitial and tubular pores; medium acid; gradual, smooth boundary. 6 to 8 inches thick.

B21—14 to 20 inches, very dark grayish-brown (7.5YR 3/2) light silty clay, dark brown (7.5YR 3/3) crushed, dark grayish brown (7.5YR 4/2) dry; moderate, fine, subangular blocky structure; very hard, friable, sticky and plastic; many very fine roots; many very fine and few fine and medium tubular pores; medium acid; clear, smooth boundary. 6 to 15 inches thick.

B22—20 to 32 inches, dark-brown (7.5YR 4/4) silty clay, dark reddish-brown (5YR 3/4) coatings, brown (7.5YR 5/4) dry; moderate, fine and medium, subangular blocky structure; very hard, firm, sticky and plastic; few roots; many very fine and few fine and medium tubular pores; medium acid; clear, smooth boundary. 9 to 16 inches thick.

B3—32 to 60 inches, brown (7.5YR 5/4) silty clay, pink (7.5YR 7/4) dry; common, fine and medium, distinct, strong-brown (7.5YR 5/8) and dark-brown (7.5YR 4/2) mottles; weak, medium, subangular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; many very fine and fine tubular pores; few black concretions; medium acid.

The A horizon ranges from 10YR to 7.5YR in hue. The B horizon ranges from silty clay loam to silty clay in texture. Distinct mottles occur below a depth of 24 to 36 inches. A few coarse fragments are in the lower part of the B horizon in some places. Gravel or bedrock is at a depth of 40 inches or more.

Included with this soil in mapping were about 5 percent Abiqua soils and 3 percent Waldo soils.

Runoff is slow on this McAlpin soil, and the hazard of erosion is slight. Available water capacity is 8 to 10 inches. Permeability is moderately slow. Rooting depth is deep but is somewhat restricted by a seasonal, temporary high water table.

This soil is used mainly for cereal grain, grass seed, hay and pasture, wildlife habitat, and recreation. A small area of this soil is in unimproved pasture and woodland. Some areas on alluvial bottom lands are subject to stream overflow. Capability unit IIw–3; wildlife group 1.

McBee Series

The McBee series consists of deep, moderately well drained soils that formed in alluvium weathered from mixed sedimentary and igneous rocks. These soils are on flood plains along the major rivers and streams. Slopes are 0 to 3 percent.

Where these soils are not cultivated, the vegetation is Douglas-fir, ash, wild rose, snowberry, blackberry, and grass. Elevation ranges from 190 to 300 feet. Average annual precipitation is 40 to 45 inches, average annual temperature is 52° to 54° F., and the average frost-free season is 165 to 210 days.

In a representative profile the surface layer is dark grayish-brown silty clay loam about 8 inches thick. The subsoil is dark-brown silty clay loam about 27 inches thick. The substratum is dark grayish-brown silt loam that extends to a depth of 60 inches or more.

McBee soils are used for small grain, pasture, hay, vegetable and specialty crops, wildlife habitat, and recreation.

McBee silty clay loam (Ms).—This soil is on alluvial flood plains.

Representative profile, 3½ miles northeast of Corvallis, in the SW¼SE¼ sec. 8, T. 11 S., R. 4 W.:

Ap—0 to 8 inches, dark grayish-brown (10YR 3/2) silty clay loam, dark brown (10YR 4/3) dry; moderate, fine and medium, granular structure; hard, friable, slightly sticky and plastic; many very fine roots; many very fine interstitial pores; slightly acid; abrupt, smooth boundary. 6 to 9 inches thick.

B1—8 to 18 inches, dark-brown (10YR 3/3) silty clay loam, dark brown (10YR 4/3) dry; moderate, fine and medium, subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine and fine tubular pores; slightly acid; clear, smooth boundary. 7 to 12 inches thick.

B2—18 to 27 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; common, fine, faint, brown (7.5YR 4/4) mottles; moderately, medium, subangular blocky structure; hard, friable, sticky and plastic; common roots; many very fine and fine tubular pores; slightly acid; gradual, smooth boundary. 8 to 16 inches thick.

B3—27 to 35 inches, dark-brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; common, medium, distinct, dark grayish-brown (10YR 4/2) and dark-brown (7.5YR 4/4) mottles; weak, medium, subangular (7.5YR 4/4) mottles; moderate, medium, subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; many very fine and few fine and medium tubular pores; neutral; gradual; smooth boundary. 6 to 10 inches thick.

C—35 to 60 inches, dark grayish-brown (10YR 4/2) silt loam, brown (10YR 5/3) dry; many, fine and medium, prominent, yellowish-red (5YR 4/6) and gray (10YR 5/1) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine tubular pores; neutral.

The A horizon ranges from heavy silt loam to silty clay loam in texture. The B horizon has a moist chroma of 2 or 3. Layers or lenses of gravel or sand occur in the lower part of the B horizon and in the C horizon in some places. Distinct or prominent mottles occur below a depth of 20 inches.

Included with this soil in mapping were about 2 percent Chehalis soils and 5 percent Wapato soils.

Runoff is slow on this McBee soil, and the hazard of erosion is slight. Available water capacity is 10.5 to 12 inches. Permeability is moderate. Rooting depth is somewhat restricted by a fluctuating seasonal water table. This soil is subject to overflow about once in 3 to 5 years.

This soil is used for small grain, grass seed, hay, and pasture. It is used for pole beans, corn, and other cannery crops when irrigated. Capability unit IIw–5; wildlife group 1.

Mixed Alluvial Land

Mixed alluvial land (MX) consists of areas of recent alluvium on the nearly level to gently undulating active flood plain adjacent to the Willamette River. In many places the areas are incised by overflow channels. This mapping unit is made up of mixed soil materials that occur in such an intricate pattern that it is not practical to map them separately.

The dark-brown surface material has a dominant texture of gravelly sand, sandy loam, loam, or silt loam. The dark-brown and yellowish-brown underlying material is stratified very gravelly sand, sandy loam, and loam. This soil is well-drained to excessively drained. Some small, poorly drained areas are in old sloughs.

This land type is subject to frequent flooding. Rapidly flowing floodwaters cause severe riverbank erosion and gouging. Much soil is removed, mixed, and redeposited elsewhere. Some small, nearly level areas are cultivated. Most of the areas, however, are in a dense stand of shrubs that have an overstory of cottonwood, alder, ponderosa pine, and Douglas-fir. A few grassy openings occur within these stands of brush and trees. This land type is used mainly for wildlife habitat and recreation. Capability unit VIIw–1; wildlife group 1.

Mulkey Series

The Mulkey series consists of well-drained, moderately deep soils that formed in colluvium weathered from intrusive igneous rocks under fern and grass vegetation. They are on peaks and ridges in the mountainous area of the Coast Range. Slopes are 5 to 25 percent.

The vegetation is grass and fern and some noble fir, Douglas-fir, and hemlock. Elevation ranges from 3,000 to 4,000 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is 43° to 45° F., and the frost-free season is 120 to 150 days.

In a representative profile the surface layer is very dark brown loam and gravelly loam about 19 inches thick. The subsoil is dark-brown cobbly loam about 9 inches thick. Diorite bedrock is at a depth of about 28 inches.

Mulkey soils are generally used for wildlife habitat, as watershed, and for recreation. Where trees have been established on these soils, the areas are also used for timber production.

Mulkey loam, 5 to 25 percent slopes (MYD).—This soil occupies broad ridges and smooth side slopes. Average slopes are about 15 percent.

Representative profile, three-fourths of a mile northwest of the summit of Marys Peak, in the NE¼SE¼ sec. 20, T. 12 S., R. 7 W.:

A11—0 to 11 inches, very dark brown (7.5YR 2/1) loam, dark brown (7.5YR 3/2) dry; moderate, very fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine interstitial pores; 5 percent pebbles; extremely acid; gradual, smooth boundary. 6 to 13 inches thick.

A12—11 to 19 inches, very dark brown (7.5YR 2/3) gravelly loam, dark brown (10YR 4/3) dry; moderate, very fine, granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; many fine and very fine interstitial pores; 10 percent pebbles and 10 percent cobblestones; very strongly acid; clear, smooth boundary. 8 to 12 inches thick.

B2—19 to 28 inches, dark-brown (10YR 3/3) cobbly loam, brown (10YR 5/3) dry; moderate, very fine and fine, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; black ped coatings; few very fine roots; few fine and very fine interstitial pores; 30 percent cobblestones and stones; very strongly acid; abrupt, irregular boundary. 6 to 10 inches thick.

IIR—28 inches, diorite bedrock and a few thin tongues of soil material from the B2 horizon in fractures.

The A horizon ranges from 5YR to 7.5YR in hue. The B horizon ranges from 10YR to 7.5YR in hue. Depth to bedrock ranges from 20 to 40 inches. The content of coarse fragments in the B horizon ranges from 20 to 35 percent.

Included with this soil in mapping were about 5 percent Klickitat soils and 10 percent a Kilchis soil.

Runoff is medium on this Mulkey soil, and the hazard of erosion is moderate. Available water capacity is 3 to 6.5 inches. Permeability is moderately rapid. Root penetration is limited by bedrock to a depth of 20 to 40 inches.

This soil is used for grazing, water supply, and wildlife habitat. It is used for timber production in a few areas where trees have become established. Capability unit VIe–1; woodland suitability group 5o1; wildlife group 5.

Nehalem Series

The Nehalem series consists of deep, well-drained soils that formed in mixed alluvium from sedimentary and igneous rocks on lower stream terraces and on flood plains along rivers and streams in the Coast Range. Slopes are 0 to 3 percent.

Where these soils are not cultivated, the vegetation is Douglas-fir, western redcedar, alder, shrubs, and fern. Elevation ranges from 400 to 700 feet. Average annual precipitation is 60 to 90 inches, average annual air temperature 48° to 50° F., and the average frost-free season is 160 to 190 days.

In a representative profile the surface layer is dark-brown silt loam and silty clay loam about 18 inches thick. The subsoil is dark-brown silty clay loam that extends to a depth of 60 inches or more.

Nearly all areas of Nehalem soils have been cleared for cultivation. They are used for cereal grain, hay, and pasture. These soils are also used for recreation and wildlife habitat.

Nehalem silt loam (Ne).—This soil occupies flood plains of the tributary valleys of the Coast Range. Slopes are 0 to 3 percent.

Representative profile, 3½ miles north of Summit, in the NE¼SE¼ sec. 20, T. 10 S., R. 7 W.:

Ap—0 to 9 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate, fine, granular and very fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; strongly acid; abrupt, smooth boundary. 5 to 10 inches thick.

A12—9 to 18 inches, dark-brown (7.5YR 3/3) silty clay loam, brown (10YR 5/3) dry; moderate, very fine, subangular blocky structure and fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; very strongly acid; clear, smooth boundary. 5 to 10 inches thick.

B2—18 to 34 inches, dark-brown (7.5YR 3/4) silty clay loam, brown (7.5YR 5/4) dry; moderate, very fine, subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine tubular pores; very strongly acid; clear, smooth boundary. 15 to 25 inches thick.

B3—34 to 60 inches, dark-brown (7.5YR 4/4) silty clay loam, brown (7.5YR 5/4) dry; few, fine, faint, brown (7.5YR 4/2) and strong-brown (7.5YR 5/6) mottles; weak, fine and medium, subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; common very fine tubular pores; very strongly acid.

The A horizon has a moist value and chroma of 2 or 3. The B horizon ranges from silt loam to silty clay loam in texture. Where this soil merges into areas of Brenner soils, some fine, distinct mottles occur in the lower part of the B horizon. Some areas are underlain by layers of sandy alluvium.

Included with this soil in mapping were as much as 10 percent Brenner soils and as much as 20 percent moderately well drained and somewhat poorly drained soils.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is 10 to 12 inches. Permeability is moderate. The lower areas along stream channels are subject to occasional flooding. In some areas root penetration is restricted by a seasonal, fluctuating water table at a depth of 24 to 40 inches.

This soil is used for small grain, hay, pasture, wildlife habitat, and recreation. Only small areas remain in native vegetation. This soil has slight restrictions to use because of seasonal flooding. Capability unit IIw–6; wildlife group 1.

Newberg Series

The Newberg series consists of deep, somewhat excessively drained soils that formed in mixed sandy alluvium. These soils are on recent flood plains along major streams and rivers. Slopes are 0 to 3 percent.

Where these soils are not cultivated, the vegetation is Douglas-fir, ponderosa pine, cottonwood, shrubs, and grass. Elevation ranges from 190 to 300 feet. Average annual precipitation is 40 to 45 inches, average annual temperature is 52° to 54° F., and the average frost-free season is 165 to 210 days.

In a representative profile the surface layer is very dark grayish-brown fine sandy loam about 8 inches thick. The next layer is dark-brown fine sandy loam about 10 inches thick. The substratum is dark-brown and brown fine sandy loam to a depth of about 30 inches. Below this, to a depth of about 46 inches, is mixed very dark grayish-brown to dark-brown loamy fine sand. The underlying material is dark-brown fine sandy loam that extends to a depth of 60 inches or more.

Newberg soils are used for small grain, hay, pasture, orchard crops, and specialty crops. They are also used for recreation and wildlife habitat.

Newberg fine sandy loam (Ng).—This soil is on recent alluvial flood plains. Slopes are 0 to 3 percent.

Representative profile, 4½ miles northeast of Corvallis, in the SE¼SW¼ sec. 17, T. 11 S., R. 4 W.:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, dark brown (10YR 4/3) dry; weak, fine, subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; common fine interstitial pores; medium acid; abrupt, smooth boundary. 7 to 12 inches thick.

AC—8 to 18 inches, dark-brown (10YR 3/3) fine sandy loam, dark brown (10YR 4/3) dry; weak, fine, subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores; slightly acid; clear, smooth boundary. 6 to 12 inches thick.

C1—18 to 30 inches, dark-brown (10YR 3/3 and 4/3) fine sandy loam, brown (10YR 5/3) dry; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many very fine interstitial pores; slightly acid; clear, wavy boundary. 8 to 14 inches thick.

IIC1—30 to 46 inches, mixed dark-brown (10YR 3/3 and 4/3), very dark grayish-brown (10YR 3/2), and dark grayish-brown (10YR 4/2) loamy fine sand, brown (10YR 5/3) dry; single grain; loose, nonsticky and nonplastic; many interstitial pores; few very fine roots; slightly acid; clear, wavy boundary. 15 to 22 inches thick.

IIIC2—46 to 60 inches, dark-brown (10YR 3/3 and 4/3) fine sandy loam, brown (10YR 5/3) dry; massive; soft, very friable, nonsticky and nonplastic; many interstitial pores; few very fine roots; slightly acid.

The A horizon ranges from fine sandy loam to sandy loam in texture. The soil is underlain by coarse sand or gravel below a depth of 40 inches in some places.

Included with this soil in mapping were about 5 percent Cloquato soils and 5 percent Camas soils or 10 percent Pilchuck soils.

Runoff is slow on this Newberg soil, and the hazard of erosion is slight to moderate. Available water capacity is 7.5 to 9 inches. Permeability is moderately rapid. Root penetration is deep. This soil is subject to flooding every 2 to 6 years.

This soil is used for small grain, hay, pasture, orchards, recreation, and wildlife habitat. Some small areas are in natural vegetation. This soil is used for beans, corn, mint, berries, and other specialty crops when irrigated. Capability unit IIw–4; wildlife group 1.

Newberg loam (Nm).—This soil is similar to Newberg fine sandy loam, except that the texture is loam in the upper 20 inches (fig. 19).

Runoff is slow. The hazard of erosion is slight to moderate. Available water capacity is 8 to 10 inches.

This soil is used for small grain, hay, pasture, orchards, recreation, and wildlife habitat. When irrigated it is used for beans, corn, mint, berries, and other specialty crops. Capability unit IIw–2; wildlife group 1.

Figure 19.—**Irrigated pole beans on Newberg loam. Slopes are 0 to 3 percent.**

Peavine Series

The Peavine series consists of moderately deep, well-drained soils that formed in colluvium and residuum weathered from sedimentary rocks. Slopes are 3 to 60 percent.

The vegetation is Douglas-fir, bigleaf maple, alder, salal, hazelnut, oceanspray, and brackenfern. Elevation ranges from 750 to 1,100 feet. Average annual precipitation is 60 to 90 inches, average annual temperature is 48° to 50° F., and the average frost-free season is 160 to 190 days.

In a representative profile the surface layer is dark-brown and dark reddish-brown silty clay loam and silty clay about 12 inches thick. The subsoil is reddish-brown, yellowish-red, and red silty clay and clay, about 28 inches thick, that is underlain by yellowish-red, weathered shale bedrock.

Peavine soils are used for timber production, water supply, and wildlife habitat. Some of the soils that have slopes of less than 30 percent are used for unimproved pasture.

Peavine silty clay loam, 30 to 60 percent (PEF).—This soil occupies narrow ridges and sides of mountains. Average slopes are about 45 percent.

Representative profile, 1½ miles west of Hoskins, in the NW¼NW¼ sec. 25, T. 10 S., R. 7 W.:

A1—0 to 6 inches, dark-brown (7.5YR 3/3) silty clay loam, brown (7.5YR 5/3) dry; moderate, fine, granular structure; slightly hard, friable, sticky and plastic; many roots; many very fine interstitial pores; very strongly acid; clear, smooth boundary. 3 to 7 inches thick.

A3—6 to 12 inches, dark reddish-brown (5YR 3/4) silty clay, reddish brown (5YR 5/4) dry; moderate, medium, subangular blocky structure; hard, friable, sticky and plastic; many very fine and few fine and medium roots; many very fine tubular pores; very strongly acid; clear, smooth boundary. 0 to 8 inches thick.

B1t—12 to 18 inches, reddish-brown (5YR 4/4) silty clay, reddish brown (5YR 5/4) dry; moderate, fine and medium, subangular blocky structure; hard, firm, sticky and very plastic; many very fine and few fine and medium roots; many very fine tubular pores; few thin and moderately thick clay films in pores; very strongly acid; clear, smooth boundary. 0 to 8 inches thick.

B2t—18 to 29 inches, red (2.5YR 4/6) clay, red (2.5YR 5/6) dry; moderate, medium, subangular blocky structure; very hard, firm, very sticky and very plastic; common fine and medium roots; many very fine tubular pores; common moderately thick clay films; 15 percent fragments of weathered shale; very strongly acid; clear, smooth boundary. 8 to 15 inches thick.

B3t—29 to 40 inches, yellowish-red (5YR 4/6) clay, yellowish red (5YR 5/6) dry; weak, fine, subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; dark-red (2.5YR 3/6) clay films on coarse fragments; 30 percent weathered shale pebbles; very strongly acid; clear, smooth boundary. 7 to 12 inches thick.

R—40 to 55 inches, yellowish-red (5YR 4/6) partly consolidated shale bedrock, yellowish red (5YR 5/6) dry; fractures filled with red (2.5YR 5/6) clay films; coarse fragments; very strongly acid.

The content of weathered siltstone or shale fragments ranges from 0 to 35 percent. Depth to underlying bedrock ranges from 30 to 40 inches.

Included with this soil in mapping was about 10 percent Apt, Honeygrove, and Bohannon soils.

Runoff is rapid on this Peavine soil, and the hazard of erosion is high. Root penetration is restricted by bedrock at a depth of 30 to 40 inches. Permeability is moderately slow. Available water capacity is 6 to 7 inches.

This soil is used for timber production, water supply, and wildlife habitat. Because slopes are steep, this soil is not suited to cultivation. Capability unit VIe–1; woodland suitability group 2c3; wildlife group 5.

Peavine silty clay loam, 3 to 30 percent slopes (PEE).—This soil has slopes that average about 20 percent.

Runoff is medium, and the hazard of erosion is moderate to high.

This soil is used for timber production, water supply, and wildlife habitat. Small areas are in unimproved pasture. Capability unit IVe–3; woodland suitability group 2c1; wildlife group 5.

Philomath Series

The Philomath series consists of shallow, well-drained soils that formed in colluvium derived from basic igneous rocks. These soils are on low foothills and uplands. Slopes are 3 to 45 percent.

Where these soils are not cultivated, the vegetation is Oregon white oak, grass, wild rose, and poison-oak. Elevation ranges from 350 to 1,000 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is 50° to 53° F., and the average frost-free season is 165 to 210 days.

In a representative profile (fig. 20) the surface layer is very dark brown silty clay and clay about 18 inches thick. It is underlain by a partly weathered basalt bedrock at a depth of about 18 inches.

Most areas of the Philomath soils are not cultivated. They are generally used for homesites and unimproved pasture. Small areas are used for cereal grain, hay, and improved pasture. These soils are also used for water supply and wildlife habitat.

Philomath silty clay, 12 to 45 percent slopes (PhE).—This soil is on foothills. Slopes average about 25 percent.

Representative profile, 2 miles west of Corvallis on Bald Hill, in the SW¼SE¼ sec. 31, T. 11 S., R. 5 W.:

A11—0 to 2 inches, very dark brown (10YR 2/2) silty clay, very dark grayish brown (10YR 3/2) dry; strong, fine and very fine, subangular blocky structure; hard, friable, sticky and plastic; many roots; many fine interstitial pores; slightly acid; abrupt, smooth boundary. 2 to 6 inches thick.

A12—2 to 9 inches, very dark brown (10YR 2/2) clay, very dark grayish brown (10YR 3/2) dry; strong, fine and medium, subangular blocky structure; very hard, very firm, very plastic and very sticky; common roots; many fine and very fine tubular pores; slightly acid; clear, wavy boundary. 4 to 10 inches thick.

A13—9 to 18 inches, very dark brown (10YR 2/2) clay that has black (10YR 2/1) coatings, very dark grayish brown (10YR 3/2) dry; weak, fine, prismatic structure and strong, fine, subangular blocky structure; very hard, very firm, very plastic and very sticky; common very fine roots; many very fine tubular pores; few weathered rock fragments in lower part; neutral; abrupt, wavy boundary. 6 to 10 inches thick.

IIR—18 inches, partly weathered, variegated, dark yellowish-brown (10YR 4/4) and light-gray (10YR 6/2) basalt bedrock that has very dark brown (10YR 2/2) organic stains and reddish-brown (5YR 4/4) clay films in cracks and fractures.

The A13 horizon has a moist chroma of 2 or 3. The content of fragments of basalt ranges from a trace to as much as 20 percent. The underlying bedrock ranges from soft, weathered basalt to hard, unweathered basalt. Depth to the R horizon ranges from 12 to 20 inches.

Figure 20.—**Profile of Philomath silty clay, 3 to 12 percent slopes. This soil has severe limitations to most uses because of shallow depth to bedrock.**

Included with this soil in mapping were about 10 percent Dixonville soils and 5 percent Ritner and Witham soils.

Runoff is medium to rapid on this Philomath soil, and the hazard of erosion is moderate to high. Rooting depth is shallow. Permeability is slow. Available water capacity is 1.5 to 3 inches.

This soil is used mainly for unimproved pasture. It is also used for improved pasture, water supply, and wildlife habitat. Capability unit VIe–2; wildlife group 4.

Philomath silty clay, 3 to 12 percent slopes (PhC).—This soil has slopes that average about 9 percent.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for cereal grain, hay, pasture, homesites, water supply, and wildlife habitat. Capability unit IVe–1; wildlife group 3.

Pilchuck Series

The Pilchuck series consists of deep, excessively drained and somewhat excessively drained soils that formed in sandy alluvium. Slopes are 0 to 3 percent. These soils are on recent flood plains along the Willamette River.

Where these soils are not cultivated, the vegetation is Douglas-fir, ponderosa pine, cottonwood, shrubs, and grass. Elevation ranges from 190 to 300 feet. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the average frost-free season is 165 to 210 days.

In a representative profile the surface layer is very dark grayish-brown fine sandy loam about 8 inches thick. The substratum is very dark grayish-brown, black, and very dark gray fine sand and loamy fine sand that extend to a depth of 60 inches or more.

Pilchuck soils are used for cereal grain, hay, and pasture. They are used for orchards, berries, and vegetable crops when irrigated. They are also used for recreation and wildlife habitat.

Pilchuck fine sandy loam (Pk).—This soil is on recent alluvial flood plains. Slopes are 0 to 3 percent.

Representative profile, 2 miles west of Albany, in the NE¼SE¼ sec. 2, T. 11 S., R. 4 W.:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) fine sandy loam, brown (10YR 5/3) dry; weak, fine, granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many interstitial pores; neutral; abrupt, wavy boundary. 5 to 9 inches thick.

IIC1—8 to 23 inches, mixed very dark grayish-brown (10YR 3/2) and black (10YR 2/1) fine sand, yellowish brown (10YR 5/4), dark grayish brown (10YR 4/2), and black (10YR 2/1) dry; single grain; loose, nonsticky and nonplastic; common very fine roots; many interstitial pores; neutral; abrupt, wavy boundary. 10 to 22 inches thick.

IIC2—23 to 28 inches, very dark grayish-brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; many interstitial pores; neutral; abrupt, wavy boundary. 0 to 12 inches thick.

IIIC3—28 to 60 inches, very dark gray (10YR 3/1) fine sand, gray (10YR 5/1) dry; single grain; loose, nonsticky and nonplastic; many interstitial pores; few very fine roots; neutral.

The A horizon ranges from fine sandy loam to sandy loam in texture. It has a moist chroma of 2 or 3. The C horizon ranges from loamy fine sand to sand in texture. A few pebbles occur throughout the profile in some places.

Included with this soil in mapping was about 10 percent Camas and Newberg soils.

Runoff is slow on this Pilchuck soil, and the hazard of erosion is slight to moderate. Available water capacity is 3 to 6 inches. Permeability is rapid. Rooting depth is somewhat restricted in some places by the coarse-textured substratum. This soil is subject to flooding about every 2 to 4 years.

This soil is used for pasture, hay, small grain, wildlife habitat, and recreation. It is also used for berries and vegetable crops when irrigated. Capability unit IVw–2; wildlife group 1.

Price Series

The Price series consists of deep, well-drained soils that formed in colluvium and residuum weathered from basic igneous rock. These soils are on uplands that extend west into the mountainous areas. Slopes are 3 to 60 percent.

The vegetation is Douglas-fir, grand fir, Oregon white oak, bracken-fern, trailing blackberry, snowberry, and poison-oak. Elevation ranges from 400 to 1,800 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is 49° to 54° F., and the average frost-free season is 165 to 200 days.

In a representative profile the surface layer is dark reddish-brown silty clay loam about 5 inches thick. The subsoil is dark reddish-brown silty clay and gravelly clay about 45 inches thick. Partly weathered basalt bedrock is at a depth of about 50 inches.

Price soils are used mainly for timber production, water supply, and wildlife habitat. Some small areas are used for cereal grain, hay, and pasture.

Price silty clay loam, 12 to 20 percent slopes (PrD).—This soil occupies sides of mountains. Average slopes are about 15 percent.

Representative profile, 5½ miles north of Corvallis, in the NE¼SE¼ sec. 35, T. 10 S., R. 5 W.:

A1—0 to 5 inches, dark reddish-brown (5YR 3/3) silty clay loam, reddish brown (5YR 4/4) dry; strong, very fine, granular structure; slightly hard, friable, sticky and plastic; many very fine and few fine and medium roots; many fine interstitial pores; 5 percent pebbles and cobblestones; medium acid; clear, smooth boundary. 5 to 9 inches thick.

B1—5 to 20 inches, dark reddish-brown (5YR 3/4) light silty clay, reddish brown (5YR 4/4) dry; moderate, very fine, subangular blocky structure; hard, friable, sticky and plastic; common very fine and few fine and medium roots; many very fine tubular pores; 15 percent pebbles and cobblestones; strongly acid; clear, smooth boundary. 10 to 18 inches thick.

B21—20 to 36 inches, dark reddish-brown (2.5YR 3/4) gravelly clay, reddish brown (2.5YR 4/4) dry; moderate, medium, subangular blocky structure; hard, firm, very sticky and very plastic; common very fine to medium roots; many very fine tubular pores; 15 percent pebbles and 10 percent cobblestones; few black coatings on ped surfaces; strongly acid; clear, smooth boundary. 9 to 20 inches thick.

B22—36 to 50 inches, dark reddish-brown (2.5YR 3/4) gravelly clay, reddish brown (2.5YR 4/4) dry; weak, medium, subangular blocky structure; very hard, firm, very sticky and very plastic; few roots; common very fine and fine tubular pores; 20 percent pebbles and 15 percent cobblestones; common black coatings on ped surfaces; strongly acid; clear, wavy boundary. 12 to 25 inches thick.

R—50 inches, partly weathered basalt bedrock; few tongues of soil material, dark red (2.5YR 3/6) moist and red (2.5YR 4/6) dry; many, large, black stains on rock fragments.

The A horizon has a moist value and chroma of 2 or 3. It is 7.5YR or 5YR in hue. The content of coarse fragments ranges from a few to 15 percent. The B horizon has a moist value and chroma of 3 or 4. It ranges from heavy silty clay loam to clay in texture. The content of coarse fragments in the B2 horizon ranges from 20 to 35 percent. Depth to underlying bedrock ranges from 40 to 60 inches.

Included with this soil in mapping was about 10 percent Ritner and Dixonville soils. Also included was about 5 percent Jory soils.

Runoff is medium on this Price soil, and the hazard of erosion is moderate. Root penetration is limited by bedrock at a depth of 40 to 60 inches. Permeability is moderately slow. Available water capacity is 5 to 9 inches.

This soil is used for cereal grain, hay, and pasture, water supply, timber, and wildlife habitat. Capability unit IIIe–1; woodland suitability group 2c4; wildlife group 3.

Price silty clay loam, 3 to 12 percent slopes (PrC).—This soil has slopes that average about 7 percent.

Runoff is slow to medium. The hazard of erosion is slight.

This soil is used for small grain, hay and pasture, woodland, water supply, and wildlife habitat. Capability unit IIe–2; woodland suitability group 2c4; wildlife group 3.

Price-Ritner complex, 20 to 30 percent slopes (PTE).—The soils of this complex occupy sides of mountains and have an average slope of 25 percent. This complex is about 65 percent Price soils and 30 percent Ritner soils. Included in mapping was about 5 percent Dixonville, Witzel, and Jory soils.

Runoff is rapid. The hazard of erosion is high.

The soils of this complex are used mainly for pasture, timber, water supply, and wildlife habitat. Because of steepness and the high hazard of erosion, these soils have severe limitations to use for cultivated crops. Capability unit IVe–1; woodland suitabiliy group 2c4; wildlife group 4.

Price-Ritner complex, 30 to 60 percent slopes (PTF).—The soils in this complex occupy the sides of mountains and have an average slope of about 45 percent. This complex is 60 percent Price soils and 30 percent Ritner soils.

Included in mapping was about 10 percent Dixonville, Witzel, and Jory soils.

Runoff is very rapid. The hazard of erosion is high.

The soils in this complex are used for timber production, water supply, and wildlife habitat. Because they are steep to very steep, these soils have severe limitations to use and are not suited to cultivation. Capability unit VIe–2; woodland suitability group 2c5; wildlife group 4.

Ritner Series

The Ritner series consists of moderately deep, well-drained soils that formed in colluvium weathered from basic igneous rocks. These soils are on foothills that merge into mountainous topography. Slopes are 12 to 75 percent.

The vegetation is Douglas-fir, bigleaf maple, and Oregon white oak and an understory of brackenfern, trailing blackberry, hazelnut, and poison-oak. Elevation ranges from 600 to 1,800 feet. Average annual precipitation ranges from 40 to 60 inches, average annual air temperature is 49° to 54° F., and the frost-free season is 165 to 200 days.

In a representative profile the surface layer is dark reddish-brown gravelly silty clay loam about 5 inches thick. The subsoil is dark reddish-brown gravelly silty clay loam, gravelly silty clay, and very cobbly silty clay about 35 inches thick. It is underlain by fractured basalt bedrock at a depth of about 40 inches.

Ritner soils are used mostly for timber production, unimproved pasture, water supply, and wildlife habitat. A few small areas are used for improved pasture and cereal grain.

Ritner-Price complex, 30 to 75 percent slopes (RPG).—The soils in this complex occupy sides of mountains and have an average slope of about 55 percent. This complex is 60 percent Ritner soils and 30 percent Price soils. These soils are so closely associated that it is not practical to map them separately. Included in mapping was about 10 percent Dixonville, Witzel, and Jory soils.

Representative profile of a Ritner soil, 5 miles north of Corvallis, in the SE¼NW¼ sec. 3, T. 11 S., R. 5 W.:

A1—0 to 5 inches, dark reddish-brown (5YR 3/4) gravelly silty clay loam, reddish brown (5YR 4/4) dry; strong, fine, granular structure; hard, friable, sticky and plastic; many roots; many very fine interstitial pores; 20 percent fine and medium pebbles; medium acid; clear, smooth boundary, 4 to 9 inches thick.

B1—5 to 15 inches, dark reddish-brown (2.5YR 3/4) gravelly heavy silty clay loam, reddish brown (2.5YR 4/4) dry; strong, fine, subangular blocky structure; hard, friable, sticky and plastic; many roots; many very fine tubular pores; 30 percent pebbles; medium acid; clear, smooth boundary, 5 to 10 inches thick.

B21—15 to 24 inches, dark reddish-brown (2.5YR 3/4) gravelly silty clay, reddish brown (2.5YR 4/4) dry; moderate, fine, subangular blocky structure; hard, firm, sticky and very plastic; many roots; common very fine tubular pores; 20 percent pebbles and 20 percent cobblestones; strongly acid; clear, smooth boundary. 6 to 16 inches thick.

B22—24 to 40 inches, dark reddish-brown (2.5YR 3/4) very cobbly silty clay, reddish brown (2.5YR 4/4) dry; moderate, medium, subangular blocky structure; hard, firm, sticky and very plastic; few very fine roots; few very fine tubular pores; 40 percent cobblestones and 15 percent pebbles; few clay films in pores; strongly acid; abrupt, irregular boundary. 10 to 20 inches thick.

IIR—40 inches, fractured basalt bedrock with few thin tongues of B22 horizon in fractures; red clay coatings on surfaces of rock fragments.

Coarse fragments of pebbles and cobblestones range from 10 to 30 percent in the A and B1 horizon and from 35 to 75 percent in the B2 horizon. The A horizon ranges from 10YR to 5YR in hue and has a value of 2 or 3 when moist. Chroma ranges from 2 to 4 when moist and is 3 or 4 when dry. The texture of the A horizon ranges from clay loam to gravelly silty clay loam. The B horizon ranges from 5YR to 2.5YR in hue and has a moist value of 3 or 4. It has a moist and dry chroma that ranges from 4 to 6. It is dominantly silty clay in texture but ranges from heavy silty clay loam to clay.

Runoff is very rapid, and the hazard of erosion is high. Rooting depth is 30 to 40 inches. Permeability is moderately slow. Available water capacity is 3 to 6 inches.

Because slopes are steep, none of this complex is cultivated. About 95 percent of the acreage has been cut over and is regenerating into poorly stocked stands of Douglas-fir. A few small areas are in natural grass and are used for grazing. The main uses are timber production, water supply, and wildlife habitat. Capability unit VIIs–1; woodland suitability group 3r3; wildlife group 4.

Ritner-Price complex, 12 to 30 percent slopes (RPE).—The soils in this complex have slopes that average about 20 percent.

Runoff is rapid, and the hazard of erosion is moderate to high.

This complex is used for woodland, water supply, and wildlife habitat. Some small areas are used for improved pasture and cereal grain. Most of the acreage has been cut over and is regenerating into young stands of Douglas-fir. This complex is not well suited to cultivation, because of the 12 to 30 percent slopes, excess coarse fragments, and, in places, low available water capacity. Capability unit VIs–1; woodland suitability group 3f1; wildlife group 4.

Riverwash

Riverwash (Rw) consists mainly of barren alluvial land along the Willamette River. It is made up of gravel and cobblestones in a sandy matrix. It is exposed during periods of low water, and it is subject to shifting during normal high water and when the water is at flood stage.

This land type is used as a source of sand and gravel. It has limited use for wildlife habitat and recreation. Capability unit VIIIw–1; wildlife group 1.

Salem Series

The Salem series consists of deep, well-drained soils that formed in gravelly mixed alluvium. These soils are in small areas on broad valley terraces in the Willamette Valley. Slopes are 0 to 3 percent.

Where these soils are not cultivated, the vegetation is Douglas-fir, ponderosa pine, maple, oak, poison-oak, blackberry, and grass. Elevation ranges from 250 to 300 feet. Average annual precipitation is 40 to 45 inches, average air temperature is 52° to 54° F., and the frost-free season is 165 to 210 days.

In a representative profile the surface layer is very dark brown gravelly loam about 8 inches thick. The subsoil is dark-brown and very dark brown gravelly clay loam about 16 inches thick. The substratum consists of multicolored very gravelly sand that extends to a depth of 60 inches or more.

Salem soils are used for cereal grain, grass seed, hay, pasture, wildlife habitat, and recreation. They are used for vegetable crops and berries when irrigated.

Salem gravelly loam (Sa).—This soil is on broad valley terraces.

Representative profile, three-fourths of a mile northeast of Monroe, in the NW¼NW¼ sec. 27, T. 14 S., R. 5 W.:

Ap—0 to 8 inches, very dark brown (10YR 2/2) gravelly loam, dark grayish brown (10YR 4/2) dry; moderate, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; 25 percent pebbles; slightly acid; abrupt, smooth boundary. 6 to 12 inches thick.

B21t—8 to 16 inches, very dark brown (10YR 2/3) gravelly clay loam, dark brown (10YR 4/3) dry; moderate, very fine and fine, granular structure and weak, fine, subangular blocky structure; slightly hard, friable, sticky and plastic; many, very fine roots; many fine and very fine interstitial pores; common moderately thick films in pores and few thin clay films on peds; 25 percent pebbles; slightly acid; clear, wavy boundary. 8 to 20 inches thick.

B22t—16 to 24 inches, dark-brown (10YR 3/3) gravelly clay loam, brown (10YR 4/3) dry; weak, very fine and fine, subangular blocky structure parting to moderate, fine, granular structure; hard, friable, sticky and plastic; common very fine roots; many very fine tubular pores; few thin clay films on peds, on pebbles, and in pores; 25 percent pebbles and cobblestones; slightly acid; abrupt, wavy boundary. 0 to 14 inches thick.

IIC1—24 to 28 inches, multicolored very gravelly sand; massive; hard, firm, nonsticky and nonplastic; very few roots; silica coatings on undersides of pebbles; slightly acid; clear, wavy boundary. 4 to 9 inches thick.

IIC2—28 to 60 inches, multicolored very gravelly sand; single grain; loose, nonsticky and nonplastic; silica coatings on undersides of coarse fragments; slightly acid.

Depth to the very gravelly horizons ranges from 20 to 30 inches. The profile ranges from 10YR to 7.5YR in hue. The Ap horizon has a moist value and chroma of 2 or 3. The Ap horizon ranges from gravelly loam to gravelly clay loam in texture. It has a content of gravel that ranges from 20 to 25 percent. The Bt horizon ranges from gravelly clay loam to gravelly silty clay loam in texture and is 20 to 35 percent pebbles.

Included with this soil in mapping was about 10 percent Malabon and Coburg soils.

Permeability is moderate in the subsoil of this Salem soil and very rapid in the substratum. Runoff is slow, and the hazard of erosion is none too slight. Available water capacity is 3.5 to 7.0 inches. Roots are restricted by the very gravelly substratum. Workability is good, except for small areas of very gravelly soil.

This soil is used mainly for small grain, grass seed, hay and pasture crops, wildlife habitat, and recreation. Limited acreages of vegetables, berries, and specialty crops are grown when irrigated. Capability unit IIs–1; wildlife group 1.

Slickrock Series

The Slickrock series consists of deep, well-drained soils that formed in colluvium weathered from sandstone on mountainsides. Slopes are 3 to 50 percent.

The vegetation is Douglas-fir, hemlock, and alder and an understory of vine maple, swordfern, salal, and brackenfern. Elevation ranges from 850 to 2,500 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is 46° to 50° F., and the average frost-free season is 145 to 190 days.

In a representative profile the surface layer is very dark brown and very dark grayish-brown gravelly loam about 14 inches thick. The subsoil is dark-brown and dark yellowish-brown gravelly loam that extends to a depth of about 60 inches or more.

Slickrock soils are used for timber production, water supply, and wildlife habitat. None of these soils are cultivated.

Slickrock gravelly loam, 25 to 50 percent slopes (SLF).—This soil is on sides of mountains. Slopes average about 30 percent.

Representative profile, 6½ miles west of Kings Valley, in the SE¼SW¼ sec. 15, T. 10 S., R. 7 W.:

A—0 to 6 inches, very dark brown (10YR 2/2) gravelly loam, dark brown (10YR 4/3) dry; moderate, very fine, granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and few medium to coarse roots; many very fine interstitial pores; 20 percent fine pebbles; very strongly acid; clear, smooth boundary. 3 to 7 inches thick.

A3—6 to 14 inches, very dark grayish-brown (10YR 3/2) gravelly loam, dark brown (10YR 4/3) dry; moderate, fine, granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and few medium to coarse roots; many very fine interstitial pores; 20 percent fine pebbles; very strongly acid; clear, smooth boundary, 0 to 8 inches thick.

B21—14 to 25 inches, dark-brown (10YR 3/3) gravelly heavy loam, brown (10YR 5/3) dry; moderate, very fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few fine to coarse roots; common very fine interstitial pores; 25 percent pebbles; very strongly acid; clear. smooth boundary. 6 to 12 inches thick.

B22—25 to 35 inches, dark-brown (10YR 3/4) gravelly heavy loam, brown (10YR 5/3) dry; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few fine and medium roots; common very fine tubular pores; 25 percent pebbles and 10 percent cobblestones; very strongly acid; clear, smooth boundary. 8 to 12 inches thick.

B3—35 to 60 inches, dark yellowish-brown (10YR 4/4) gravelly loam, pale brown (10YR 6/3) dry; weak, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine to medium roots; many very fine tubular pores; 25 percent pebbles and 10 percent cobblestones; very strongly acid; clear, smooth boundary.

The A horizon has a dry value of 4 or 5 and a moist chroma of 2 or 3. It ranges from gravelly loam to gravelly silt loam in texture. The content of coarse fragments of sandstone ranges from 15 to 35 percent. The B horizon ranges from 10YR to 7.5YR in hue. It is gravelly loam, gravelly clay loam, and gravelly silty clay loam in texture. The content of coarse fragments ranges from 20 to 35 percent. Depth to bedrock is more than 40 inches.

Included with this soil in mapping were about 10 percent Apt and Bohannon soils and 5 percent Blachly soils.

Runoff is rapid on this Slickrock soil, and the hazard of erosion is high. Root penetration is deep and is not restricted. Permeability is moderate. Available water capacity is 5 to 10 inches.

This soil is used mostly for timber production, water supply, and wildlife habitat. Some small acreages are in pasture. Capability unit VIe–1; woodland suitability group 2r1; wildlife group 5.

Slickrock gravelly loam, 3 to 25 percent slopes (SLD).—This soil has slopes that average about 20 percent.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mostly for woodland, water supply, and wildlife habitat. Some small areas are in natural pasture. Capability unit IVe–3; woodland suitability group 2o1; wildlife group 5.

Veneta Series

The Veneta series consists of deep, moderately well drained to well drained soils that formed in silt and old, weathered, gravelly alluvium. These soils are on terraces above the main floor of the Williamette Valley. Slopes are 2 to 20 percent.

Where these soils are not cultivated, the vegetation is Douglas-fir and oak and an understory of poison-oak, wild rose, and snowberry. Elevation ranges from 300 to 450 feet. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the average frost-free period is 165 to 210 days.

In a representative profile the surface layer is dark-brown and dark yellowish-brown silt loam and silty clay loam about 19 inches thick. The subsoil is dark-brown silty clay loam, silty clay, and clay that extends to a depth of 60 inches or more.

Veneta soils are used mainly for cereal grain, hay, pasture, grass seed, orchards, wildlife habitat, and recreation.

Veneta silt loam, 2 to 7 percent slopes (VeB).—These soils occupy old terrace remnants. Slopes average about 5 percent.

Representative profile, one-fourth mile north of the Inavale School, in the SE¼SE¼ sec. 6, T. 13 S., R. 5 W.:

Ap1—0 to 8 inches, dark-brown (10YR 3/3) silt loam, pale brown (10YR 6/3) dry; moderate, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial pores; strongly acid; abrupt, smooth boundary. 6 to 9 inches thick.

Ap2—8 to 12 inches, dark yellowish-brown (10YR 3/4) silty clay loam, brown (10YR 5/3) dry; weak, coarse, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; strongly acid; clear, smooth boundary. 4 to 8 inches thick.

A3—12 to 19 inches, dark-brown (7.5YR 3/4) silty clay loam, brown (7.5YR 5/4) dry; moderate, very fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; strongly acid; clear, smooth boundary. 0 to 8 inches thick.

B1—19 to 27 inches, dark-brown (7.5YR 4/4) silty clay loam, brown (7.5YR 5/4) dry; moderate, very fine, subangular blocky structure; hard, firm, sticky and plastic; many very fine and fine tubular pores; common very fine roots; common, moderately thick, dark-brown coatings; strongly acid; abrupt, smooth boundary. 0 to 9 inches thick.

IIB21t—27 to 36 inches, dark-brown (7.5YR 4/4) silty clay, brown (7.5YR 5/4) dry; strong, fine, angular blocky structure; very hard, very firm, very sticky and very plastic; many very fine and fine tubular pores; few very fine roots; common moderately thick clay films; medium acid; clear, smooth boundary. 8 to 10 inches thick.

IIB22t—36 to 60 inches, dark-brown (7.5YR 4/4) clay, strong brown (7.5YR 5/6) dry; strong-brown (7.5YR 5/6) variegations; strong, medium, angular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; many very fine and fine tubular pores; nearly continuous, moderately thick, reddish-brown (5YR 4/4) clay films; medium acid.

In some places distinct mottles are present below a depth of 24 to 30 inches.

Included with this soil in mapping were about 5 percent Veneta, loamy subsoil variant, and 5 percent Hazelair, well-drained variant, Hazelair, and Bellpine soils.

Runoff is slow on this Veneta soil, and the hazard of erosion is slight. Root penetration is deep. Permeability is slow. Available water capacity is 7.5 to 10 inches.

This soil is used for cereal grain, grass seed, hay, pasture, orchards, and wildlife habitat. Capability unit IIe–2; wildlife group 3.

Veneta silt loam, 7 to 20 percent slopes (VeD).—This soil has slopes that average about 12 percent.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for small grain, grass seed production, hay, pasture, recreation, and wildlife habitat. Small areas are in woodlots and natural pasture. Capability unit IIIe–1; wildlife group 3.

Veneta Series, Loamy Subsoil Variant

The Veneta series, loamy subsoil variant, consists of moderately deep, well-drained soils that formed in colluvium weathered from sedimentary bedrock. These soils occupy low, rolling foothills that have broad, gently sloping tops and steep sides. Slopes are 2 to 30 percent.

Where these soils are not cultivated, the vegetation is Oregon white oak, Douglas-fir, shrubs, and grass. Elevation ranges from 300 to 500 feet. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 210 days.

In a representative profile the surface layer is dark-brown and dark yellowish-brown loam about 11 inches thick. The subsoil is dark-brown and strong-brown clay loam about 29 inches thick. Weathered sandstone bedrock is at a depth of about 40 inches.

The Veneta soils, loamy subsoil variant, are used for cereal grain, grass seed, orchards, hay, pasture, wildlife habitat, and homesites.

Veneta loam, loamy subsoil variant, 2 to 7 percent slopes (VnB).—This soil is on broad ridges. Average slopes are about 5 percent.

Representative profile, 1 mile north of the Oak Grove School, in the NE¼SE¼ sec. 26, T. 10 S., R. 4 W.:

A11—0 to 5 inches, dark-brown (10YR 3/3) loam, brown (10YR 5/3) dry; moderate, fine and very fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine tubular and interstitial pores; slightly acid; clear, wavy boundary. 4 to 8 inches thick.

A12—5 to 11 inches, dark yellowish-brown (10YR 3/4) loam, brown (10YR 5/3) dry; weak, very fine, subangular blocky structure parting to moderate, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine tubular pores; slightly acid; clear, wavy boundary. 5 to 10 inches thick.

B1—11 to 21 inches, dark-brown (7.5YR 4/4) clay loam, brown (7.5YR 5/4) dry; moderate, fine and medium, subangular blocky structure; hard, friable, slightly sticky and plastic; common very fine and fine roots; many fine and very fine tubular pores; very few thin clay films in worm casts; common very fine and fine manganese shots 1 to 2 millimeters in size; medium acid; clear, wavy boundary. 7 to 12 inches thick.

B21t—21 to 33 inches, dark-brown (7.5YR 4/4) clay loam, brown (7.5YR 5/4) dry; moderate, medium and fine, subangular blocky structure; very hard, firm, sticky and plastic; common, very fine, fine and medium roots; many very fine, fine, and medium tubular pores;

few thin clay films; few medium and large manganese stains; medium acid; abrupt, wavy boundary. 6 to 15 inches thick.

IIB22t—33 to 40 inches, strong-brown (7.5YR 5/6) heavy clay loam, light-brown (7.5YR 6/4) dry; moderate, fine and medium, subangular blocky structure; hard, firm, sticky and plastic; common fine and very fine roots; common fine and very fine tubular pores; many, moderately thick, dark-brown (7.5YR 4/4) clay films; 10 percent fragments of weathered sandstone; common large and medium manganese stains; medium acid; clear, wavy boundary. 6 to 10 inches thick.

IIC—40 inches, weathered sandstone.

The A horizon ranges from 10YR to 7.5YR in hue and has a dry value of 5 or 6. The B horizon ranges from 10YR to 7.5YR in hue. In the B2 horizon the content of coarse fragments of sedimentary rock ranges from few to 20 percent. Depth to sedimentary bedrock ranges from 30 to 40 inches.

Included with this soil in mapping were about 5 to 10 percent Hazelair soils and 5 percent other Veneta soils.

Runoff is slow to medium on this Veneta soil, loamy subsoil variant, and the hazard of erosion is slight. Root penetration is moderately deep. Permeability is moderately slow. Available water capacity is 6 to 8 inches.

This soil is used for cereal grain, grass seed, hay, pasture, orchards, wildlife habitat, and homesites. Capability unit IIe–2; wildlife group 3.

Veneta loam, loamy subsoil variant, 7 to 20 percent slopes (VnD).—This soil has slopes that average about 15 percent.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for cereal grain, hay, pasture, orchards, and wildlife habitat. Capability unit IIIe–1; wildlife group 3.

Veneta loam, loamy subsoil variant, 20 to 30 percent slopes (VnE).—This soil has slopes that average about 25 percent.

Runoff is rapid, and the hazard of erosion is high.

This soil is used mostly for natural and cultivated pasture and wildlife habitat. Small areas are in woodland. Capability unit IVe–1; wildlife group 4.

Waldo Series

The Waldo series consists of deep, poorly drained soils that formed in recent alluvium. These soils are on bottom lands of streams and drainageways in the tributary valleys of the foothills. Slopes are 0 to 3 percent.

Where these soils are not cultivated, the vegetation is tussock, sedge, willow, ash, and grass. Elevation ranges from 250 to 450 feet. Average annual precipitation is 40 to 60 inches, average temperature is 50° to 52° F., and the frost-free season is 165 to 210 days.

In a representative profile the surface layer is black heavy silty clay loam and silty clay about 11 inches thick. The subsoil is dark-gray and gray clay about 37 inches thick. The substratum is gray silty clay that extends to a depth of 60 inches or more.

Waldo soils are used for pasture, hay, small grain, grass seed, wildlife habitat, and recreation.

Waldo silty clay loam (Wa).—This soil is in areas along the streams and drainageways of the foothills. Slopes are 0 to 3 percent.

Representative profile, one-half mile south of Inavale School, in the NW¼SE¼ sec. 7, T. 13 S., R. 5 W.:

Ap—0 to 6 inches, black (10YR 2/1) heavy silty clay loam, dark gray (10YR 4/1) dry; strong, fine, granular structure; hard, friable, sticky and very plastic; many very fine interstitial pores; strongly acid; abrupt, smooth boundary. 4 to 7 inches thick.

A12—6 to 11 inches, black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; reddish-brown mottles along root channels; moderate, fine, granular structure and very fine, subangular blocky structure; hard, friable, very sticky and very plastic; many very fine roots; many very fine interstitial and tubular pores; strongly acid; clear, smooth boundary. 3 to 6 inches thick.

B21g—11 to 21 inches, dark-gray (N 4/0) clay, gray (N 6/0) dry; common, medium, prominent, reddish-brown (5YR 4/4) and strong-brown (7.5YR 5/6) mottles; weak, medium, prismatic structure and moderate, medium, angular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine roots; common very fine tubular pores; few, thin, black coatings on ped surfaces; strongly acid; gradual, smooth boundary. 6 to 12 inches thick.

B22g—21 to 31 inches, dark-gray (N 4/0) clay, gray (N 6/0) dry; common, coarse, prominent, strong-brown (7.5YR 5/6) mottles; weak, medium, prismatic structure and moderate, medium, angular blocky structure; extremely hard, very firm, very sticky and very plastic; common very fine roots; common very fine tubular pores; strongly acid; clear, smooth boundary. 7 to 12 inches thick.

B23g—31 to 48 inches, gray (N 5/0) clay, light gray (N 7/0) dry; common, coarse, prominent, yellowish-red (5YR 5/6) mottles; moderate, medium, angular blocky structure; very hard, very firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; strongly acid; clear, smooth boundary. 0 to 20 inches thick.

Cg—48 to 60 inches, gray (5Y 5/1) silty clay, light gray (N 7/0) dry; many, coarse, prominent, strong-brown (7.5YR 5/8) mottles; massive; hard, firm, sticky and very plastic; medium acid.

The A horizon ranges from 10YR to 7.5YR in hue and has a moist chroma of 1 or 2. The B horizon is neutral or 2.5Y to 5Y in hue. It has a moist value of 3 or 4 in the upper part and 4 or 5 in the lower part. Depth to the C horizon ranges from 30 to 48 inches. In some areas a few pebbles and cobblestones of basalt are throughout the profile.

Included with this soil in mapping were about 5 percent McAlpin soils and 5 percent Bashaw soils.

Runoff is slow on this Waldo soil, and the hazard of erosion is slight. Rooting depth is limited by a seasonal high water table. Permeability is slow. Available water capacity is 9 to 11 inches. Workability is fair.

This soil is used for pasture, hay, small grain, grass seed, wildlife habitat, and recreation. Capability unt IIIw–1; wildlife group 2.

Wapato Series

The Wapato series consists of deep, poorly drained soils that formed in mixed alluvium. These soils are in swales and depressional areas on recent alluvial flood plains. Slopes are 0 to 3 percent.

Where these soils are not cultivated, the vegetation is willow, ash, tussock, sedge, and grass. Elevation ranges from 190 to 300 feet. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 210 days.

In a representative profile the surface layer is very dark grayish-brown silty clay loam about 14 inches thick. The subsoil is dark grayish-brown, dark-gray, and gray silty clay loam that extends to a depth of 60 inches or more.

Wapato soils are used for pasture, hay, small grain, grass seed, and wildlife habitat.

Wapato silty clay loam (Wc).—This soil is in small areas on the flood plains of major streams.

Representative profile, 1½ miles southwest of Granger, in the NW¼NW¼ sec. 17, T. 11 S., R. 4 W.:

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; few, fine, distinct, dark-brown (7.5YR 4/4) mottles; moderate, fine and medium, subangular blocky structure; hard, friable, slightly sticky and plastic; few very fine roots; common very fine irregular pores; slightly acid; abrupt, smooth boundary. 6 to 9 inches thick.

A12—6 to 14 inches, very dark grayish-brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; many, fine, distinct, strong-brown (7.5YR 5/6) and dark-gray (10YR 4/1) mottles; moderate, fine and medium, subangular blocky structure and fine, granular structure; hard, friable, sticky and plastic; few very fine roots; many very fine and fine tubular pores; slightly acid; clear, wavy boundary. 4 to 10 inches thick.

B21g—14 to 20 inches, dark grayish-brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; many, fine and medium, distinct, reddish-brown (5YR 4/4) and strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; many very fine tubular pores; slightly acid; gradual, wavy boundary. 5 to 8 inches thick.

B22g—20 to 31 inches, dark-gray (N 4/0) silty clay loam, gray (N 6/0) dry; many, medium and coarse, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; many very fine tubular pores; medium acid; gradual, wavy boundary. 9 to 22 inches thick.

B23g—31 to 37 inches, dark-gray (10YR 4/1) silty clay loam, light grayish brown (10YR 6/2) dry; many, fine and medium, distinct, yellowish-brown (7.5YR 5/6) mottles; moderate, fine and very fine, subangular blocky structure; hard, firm, sticky and plastic; many, very fine, and few fine and medium tubular pores; medium acid; gradual, wavy boundary. 0 to 10 inches thick.

B3g—37 to 60 inches, gray (10YR 5/1) silty clay loam, light grayish brown (10YR 6/2) dry; many, medium and coarse, distinct, strong-brown (7.5YR 5/6) and yellowish-red (5YR 4/6) mottles; weak, fine, subangular blocky structure; hard, friable, sticky and plastic; no roots; many very fine and fine pores; medium acid.

The A horizon has a moist value of 2 or 3. It ranges from silty clay loam to silt loam in texture. Mottles are either throughout the A horizon or only in the lower part. The B horizon is neutral in color or ranges from 10YR to 2.5Y in hue. The upper part of the B horizon has a moist value of 3 or 4. The lower part of the B horizon is stratified with layers of silt loam or loam in some places. A few pebbles occur in the B horizon in some places. Sand and gravel are below a depth of 60 inches in some places.

Included with this soil in mapping was about 10 percent McBee soils and soils that have a thick, dark-colored surface layer.

Runoff is slow on this Wapato soil, and the hazard of erosion is slight to moderate. Rooting depth is restricted by a high water table in winter and in spring. Permeability is moderately slow. Available water capacity is 10 to 12 inches. This soil is subject to overflow. Workability is good.

This soil is used for pasture, hay, small grain, grass seed, and wildlife habitat. Drainage is needed for most crops. Suitable drainage outlets are usually lacking or are inadequate. Capability unit IIIw–1; wildlife group 2.

Willamette Series

The Willamette series consists of deep, well-drained soils that formed in silty alluvium on broad terraces above floodplains in the Willamette Valley. Slopes are 0 to 12 percent.

Where these soils are not cultivated, the vegetation is grass, hazelnut, wild blackberry, Douglas-fir, and Oregon white oak. Elevation ranges from 200 to 300 feet. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 210 days.

In a representative profile the surface layer is very dark grayish-brown and dark-brown silt loam about 21 inches thick. The subsoil is dark-brown silty clay loam about 36 inches thick. The substratum is dark-brown silt loam that extends to a depth of 60 inches or more.

Willamette soils are used for pasture, hay, small grain, vegetable crops, orchards, grass seed, berries, wildlife habitat, and recreation.

Willamette silt loam, 0 to 3 percent slopes (WeA).—This soil is on broad valley terraces. Slopes average about 2 percent.

Representative profile, 5 miles northeast of Corvallis, in the NW¼SE¼ sec. 7, T. 11 S., R. 4 W.:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2; 10YR 2/2, uncrushed) silt loam, brown (10YR 5/3) dry; moderate, fine, granular structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial pores; medium acid; abrupt, smooth boundary. 5 to 7 inches thick.

A12—7 to 15 inches, very dark grayish-brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate, fine, granular structure and weak, fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine interstitial pores; medium acid; clear, smooth boundary. 4 to 9 inches thick.

A3—15 to 21 inches, dark-brown (10YR 3/3) heavy silt loam, brown (10YR 5/3) dry; moderate, fine and medium, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine pores; medium acid; clear, smooth boundary. 0 to 12 inches thick.

B1—21 to 31 inches, dark-brown (10YR 3/3) silty clay loam, brown (10YR 5/3) dry; weak, medium, prismatic structure parting to moderate, medium, subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; many very fine and fine pores; common, moderately thick, very dark grayish-brown coatings on ped surfaces; medium acid; clear, smooth boundary. 7 to 11 inches thick.

B2t—31 to 45 inches, dark-brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; few, faint, dark reddish-brown (7.5YR 4/4) mottles; weak, medium, prismatic structure and moderate, medium and coarse, subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine pores; few, moderately thick, dark yellowish-brown (10YR 3/4) clay films on ped surfaces and in pores; common, fine, black stains on peds; slightly acid; gradual, smooth boundary. 10 to 24 inches thick.

B3t—45 to 57 inches, dark-brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; weak, coarse, subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine pores; few, thin, dark yellowish-brown (10YR 3/4) clay films on peds and few moderately thick clay films in pores; slightly acid; gradual, smooth boundary. 0 to 12 inches thick.

C—57 to 60 inches, dark-brown (10YR 4/3) heavy silt loam, pale brown (10YR 6/3) dry; few, medium, black

stains; massive; hard, friable, slightly sticky and slightly plastic; many very fine pores; few, moderately thick, dark reddish-brown (7.5YR 4/4) clay films in pores; slightly acid.

The A horizon has a dry color value of 4 or 5 and a dry chroma of 2 or 3. In places faint mottles that have a chroma higher than 2 are between depths of 30 and 40 inches; distinct mottles are below a depth of 40 inches.

Included with this soil in mapping were 10 percent Woodburn soils and 5 percent Amity soils.

Runoff is slow on this Willamette soil, and the hazard of erosion is none to slight. Rooting depth is unrestricted. Permeability is moderate. Available water capacity is 11 to 13 inches.

This soil is used for pasture, hay, small grain, orchards, grass seed, wildlife habitat, and recreation. It is used for vegetable and specialty crops when irrigated. Capability unit I–1; wildlife group 1.

Willamette silt loam, 3 to 12 percent slopes (WeC).—This soil has slopes that average about 7 percent.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for small grain, hay and pasture, orchards, grass seed, vegetable crops, berries, wildlife habitat, and recreation. Capability unit IIe–1; wildlife group 1.

Winchuck Series, Silty Subsoil Variant

The Winchuck series, silty subsoil variant, consists of deep, well-drained soils that formed in mixed alluvium weathered from sedimentary and basic igneous rocks. These soils are on stream and river terraces, alluvial fans, and foothills in tributary valleys of the Coast Range. Slopes are 2 to 7 percent.

Where these soils are not cultivated, the vegetation is Douglas-fir, hemlock, alder, and western redcedar and an understory of shrubs and fern. Elevation ranges from 400 to 700 feet. Average annual precipitation is 60 to 90 inches. average annual air temperature is 48° to 50° F., and the average frost-free season is 160 to 190 days.

In a representative profile the surface layer is dark-brown silt loam about 6 inches thick. The subsoil is dark-brown, dark yellowish-brown, and yellowish-brown silty clay loam, silt loam, and loam that extends to a depth of 60 inches or more.

Most of the acreage of Winchuck soils, silty subsoil variant, has been cleared for cultivation. It is used mainly for hay, pasture, wildlife habitat, and recreation.

Winchuck silt loam, silty subsoil variant, 2 to 7 percent slopes (WhB).—This soil is in tributary valleys of the Coast Range. Slopes average about 4 percent.

Representative profile, one-half mile east of the Lincoln County line, in the SW¼SE¼ sec. 19, T. 11 S., R. 7 W.:

Ap—0 to 6 inches, dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate, fine, granular structure; hard, friable, slightly sticky and slightly plastic; many roots; many interstitial pores; very strongly acid; clear, smooth boundary. 4 to 8 inches thick.

B1—6 to 11 inches. dark-brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; fine, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many roots; many fine and medium interstitial pores; very strongly acid; clear, wavy boundary. 4 to 7 inches thick.

B21t—11 to 18 inches, dark yellowish-brown (10YR 3/4) silty clay loam, (10YR 4/4, crushed) brown (10YR 5/3) dry; moderate, fine and medium, subangular blocky structure; hard, friable, sticky and plastic; many roots; many fine and very fine pores; few thin clay films; few, fine, black stains; very strongly acid; clear, wavy boundary. 6 to 10 inches thick.

B22t—18 to 24 inches, dark yellowish-brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) dry; moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; many roots; many very fine tubular pores; few, moderately thick and common, thin, dark-brown (7.5YR 3/4) clay films; very strongly acid; gradual, wavy boundary. 5 to 8 inches thick.

B22t—24 to 32 inches, dark yellowish-brown (10YR 4/4) silty clay loam, yellowish brown (10YR 5/4) dry; moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; few roots; many very fine and fine pores; common, moderately thick, dark-brown (7.5YR 3/4) clay films; extremely acid; gradual, wavy boundary. 6 to 12 inches thick.

B31t—32 to 44 inches, dark yellowish-brown (10YR 4/4) silt loam, yellowish brown (10YR 5/4) dry; weak, coarse, subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few roots; many fine and very fine pores; common thin clay films; extremely acid; gradual, wavy boundary. 6 to 10 inches thick.

IIB32t—44 to 60 inches, yellowish-brown (10YR 5/4) loam, light yellowish brown (10YR 6/4) dry; many, medium, light brownish-gray (10YR 6/2) mottles; weak, coarse, subangular blocky structure; hard, friable, slightly sticky and slightly plastic; no roots; common fine pores; few moderately thick clay films; common black stains; extremely acid.

The A horizon has a moist value and chroma of 2 or 3. The B horizon ranges from silt loam or loam to silty clay loam in texture. Distinct mottles or gravel occurs at a depth of 40 inches or more in places.

Included with this soil in mapping were 5 percent Nehalem soils and 2 percent Brenner soils.

Runoff is slow on this Winchuck soil, silty subsoil variant, and the hazard of erosion is slight to moderate. Root penetration is unrestricted. Permeability is moderate, and the available water capacity is 9 to 12 inches.

This soil is used mainly for hay, pasture, wildlife habitat, and recreation. Most of this soil has been cleared of forest vegetation. Capability unit IIe–3; wildlife group 1.

Witham Series

The Witham series consists of deep, somewhat poorly drained soils that formed in alluvium. These soils are on terraces, foot slopes, and fans. Slopes are 2 to 7 percent.

Where these soils are not cultivated, the vegetation is Oregon white oak, Douglas-fir, wild rose, poison-oak, snowberry, and grass. Elevation ranges from 250 to 450 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is 52° to 54° F., and the average frost-free season is 165 to 210 days.

In a representative profile the surface layer is very dark grayish-brown silty clay loam about 4 inches thick. The subsoil is very dark grayish-brown and dark-brown silty clay and clay about 25 inches thick. The substratum is very dark grayish-brown clay that extends to a depth of 60 inches or more.

Witham soils are used for hay, pasture, cereal grain, and wildlife habitat.

Witham silty clay loam, 2 to 7 percent slopes (WkB).—This soil is on alluvial terraces and fans. Slopes are 2 to 7 percent (fig. 21).

Figure 21.—**Profile of Witham silty clay loam, 2 to 7 percent slopes, showing vertical cracks caused by clayey subsoil that has high shrink-swell potential.**

Representative profile, 2½ north of Corvallis, in the SW¼SW¼NW¼ sec. 15, T. 11 S., R. 5 W.:

A1—0 to 4 inches, very dark grayish-brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate, medium and fine, granular structure; slightly hard, friable, sticky and plastic; many very fine roots; many interstitial pores; strongly acid; clear, smooth boundary. 3 to 6 inches thick.

B1—4 to 12 inches, very dark grayish-brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; moderate, coarse and medium, subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine roots; many interstitial pores; very dark brown (10YR 2/2) coatings on peds; strongly acid; gradual, smooth boundary. 0 to 12 inches thick.

B21—12 to 21 inches, dark-brown (10YR 3/3) clay, dark brown (10YR 4/3) dry; weak, coarse, prismatic structure and moderate, coarse, subangular blocky structure; extremely hard, very firm, very sticky and very plastic; few very fine roots; many very fine tubular pores; few, fine, black concretions; common, yellowish-brown weathered fragments 1 to 2 millimeters in size and a few hard pebbles; few slickensides that do not intersect; medium acid; gradual, smooth boundary. 6 to 12 inches thick.

B22—21 to 29 inches, dark-brown (10YR 3/3) clay, brown (10YR 5/3) dry; few, fine, distinct, yellowish-brown 10YR 5/4 and 10YR 5/6) and dark-brown (7.5YR 4/4) mottles; weak, coarse, prismatic structure and weak, coarse, subangular blocky structure; extremely hard, very firm, very sticky and very plastic; few very fine roots; many fine and very fine tubular pores; few, fine, black concretions and pebbles; many, yellowish-brown, weathered fragments 1 to 2 millimeters in size; few slickensides that do not intersect; medium acid; gradual, wavy boundary. 6 to 12 inches thick.

C—29 to 60 inches, very dark grayish-brown (10YR 3/2) clay; many, medium, distinct, strong-brown (7.5YR 5/6) mottles; massive; extremely hard, very firm, very sticky and very plastic; few very fine roots; few fine pebbles; few very fine pores; common fine and medium slickensides that do not intersect; common, medium black stains; medium acid.

The A horizon ranges from silty clay loam to silty clay in texture. It has a moist chroma and value of 2 or 3. It is 10YR or 2.5Y in hue. Depth to distinct mottles ranges from 16 to 30 inches. Depth to bedrock or gravel ranges from 40 to 60 inches or more.

Included with this soil in mapping were about 10 percent Waldo and Bashaw soils and 5 percent Dixonville soils.

Runoff is slow to medium on this Witham soil, and the hazard of erosion is slight. Rooting depth is restricted by the clayey texture and by a high seasonal water table. Permeability is very slow, and the available water capacity is 6 to 9 inches.

This soil is used for hay, pasture, cereal grain, and wildlife habitat. Most areas of this soil are in unimproved pasture. Capability unit IIIe–2; wildlife group 2.

Witzel Series

The Witzel series consists of shallow, well-drained soils that formed in colluvium weathered from basic igneous rocks. Slopes are 30 to 75 percent.

The vegetation is Douglas-fir, Oregon white oak, snowberry, poison-oak, grass, and brackenfern. Elevation ranges from 500 to 1,700 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is 50° to 52° F., and the average frost-free season is 165 to 200 days.

In a representative profile the surface layer is dark-brown very cobbly loam about 6 inches thick. The subsoil is dark reddish-brown very cobbly clay loam about 9 inches thick and is underlain by fractured basalt bedrock at a depth of about 15 inches.

Witzel soils are used for timber production, grazing, water supply, and wildlife habitat.

Witzel very cobbly loam, 30 to 75 percent slopes (WlG).—This soil is on sides of hills. Slopes average about 60 percent.

Representative profile, 4½ miles north of Corvallis, in the NE¼SE¼ sec. 3, T. 11 S., R. 5 W.:

A1—0 to 6 inches, dark-brown (7.5YR 3/2) very cobbly loam, brown (7.5YR 4/4) dry; moderate, very fine and fine,

granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; 20 percent pebbles and 30 percent cobblestones; medium acid; gradual, smooth boundary. 4 to 6 inches thick.

B2—6 to 15 inches, dark reddish-brown (5YR 3/3) very cobbly clay loam, reddish-brown (5YR 4/4) dry; weak, fine, subangular blocky structure parting to very fine and fine, granular structure; slightly hard, friable, sticky and plastic; many very fine roots; many very fine interstitial pores; 35 percent cobblestones, 15 percent stones, and 15 percent pebbles; medium acid; irregular boundary. 7 to 15 inches thick.

IIR—15 inches, fractured basalt bedrock that has thin tongues of material from the B2 horizon in fractures.

The A horizon is very cobbly loam, very cobbly clay loam, or cobbly silt loam in texture. The content of coarse fragments ranges from 20 to 60 percent. The A horizon ranges from 7.5YR to 5YR in hue. The B horizon ranges from very cobbly clay loam to very cobbly silty clay loam in texture. The content of coarse fragments ranges from 50 to 65 percent. Depth to bedrock ranges from 12 to 20 inches.

Included with this soil in mapping were about 5 percent Price soils and 10 percent Ritner and Dixonville soils.

Runoff is very rapid on this Witzel soil, and the hazard of erosion is high. Available water capacity is 1 to 2 inches. Permeability is moderately slow. Root penetration is limited to a depth of about 12 to 20 inches by the underlying basalt bedrock.

This soil is used for timber production, grazing, water supply, and wildlife habitat. It has severe limitations to use because of shallow depth, a high content of coarse fragments, and very steep slopes; and it is unsuitable for cultivation. Because of the shallow depth the rooting zone for trees is very limited. Capability unit VIIs–1; woodland suitability group 5d1; wildlife group 5.

Woodburn Series

The Woodburn series consists of deep, moderately well drained soils that formed in silty alluvium. These soils are on broad terraces above the flood plain in the Willamette Valley. Slopes are 0 to 3 percent.

Where these soils are not cultivated, the vegetation is native grass, hazelnut, poison-oak, wild blackberry, Douglas-fir, and Oregon white oak. Elevation ranges from 200 to 300 feet. Average annual precipitation is 40 to 45 inches, average annual air temperature is 52° to 54° F., and the frost-free season is 165 to 210 days.

In a representative profile the surface layer is very dark grayish-brown and dark-brown silt loam about 16 inches thick. The subsoil is dark-brown silt loam and silty clay loam that extends to a depth of 60 inches or more.

Woodburn soils are used for pasture, hay, small grain, vegetable crops, orchards, grass seed, berries, wildlife habitat, and recreation.

Woodburn silt loam, 0 to 3 percent slopes (WoA).—This soil is on broad valley terraces.

Representative profile, 5 miles northeast of Corvallis, in the NW¼SE¼ sec. 4, T. 11 S., R. 4 W.:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate, fine, granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; medium acid; abrupt, smooth boundary. 6 to 10 inches thick.

A3—8 to 16 inches, dark-brown (10YR 3/2) silt loam, brown (10YR 5/3) dry; moderate, fine, subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine rots; many very fine pores; medium acid; clear, wavy boundary. 0 to 8 inches thick.

B1—16 to 24 inches, dark-brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; moderate, fine, subangular blocky structure; hard, friable, slightly sticky and plastic; common very fine roots; many very fine tubular pores; thin, clean, sand and silt grains on ped surfaces; medium acid; clear, smooth boundary. 0 to 9 inches thick.

B21t—24 to 32 inches, dark-brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; common, medium, distinct, dark-brown (7.5YR 4/4) and grayish-brown (10YR 5/2) mottles; weak, medium, prismatic structure and moderate, medium, subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine and fine tubular pores; common, clean, fine sand and silt coatings on ped surfaces; common, thin, dark-brown (10YR 3/3) clay films on ped surfaces and in pores; few fine concretions and few black stains; medium acid; clear, smooth boundary. 7 to 11 inches thick.

B22t—32 to 48 inches, dark-brown (10YR 4/3) silty clay loam, pale brown (10YR 6/3) dry; common, medium, distinct, dark-brown (7.5YR 4/4) and grayish-brown (10YR 5/2) mottles and a few, dark reddish-brown (5YR 3/3) and black (N 2/0) mottles; weak, medium, prismatic structure parting to moderate, coarse, subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine tubular pores; common moderately thick and thin clay films on ped surfaces and in pores; slightly acid; clear, smooth boundary. 6 to 21 inches thick.

B3t—48 to 60 inches, dark-brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; common, fine, distinct, dark-brown (7.5YR 4/4) and dark reddish-brown (5YR 3/2) mottles; weak, coarse, subangular blocky structure; hard, friable, sticky and plastic; many very fine and fine tubular pores; few moderately thick clay films in pores and few thin clay films on peds; slightly acid.

The A horizon has a dry value of 4 or 5 and a dry chroma of 2 or 3. The B horizon has a moist chroma of 2 or 3 and ranges from 10YR to 7.5YR in hue. Depth to distinct mottles ranges from 20 to 30 inches.

Included with this soil in mapping were about 5 percent Amity soils and 10 percent Willamette soils.

Runoff is slow to medium on this Woodburn soil, and the hazard of erosion is none to slight. Available water capacity is 11 to 13 inches. Permeability is slow. Rooting depth is somewhat restricted by a seasonal water table in winter and in spring. Workability is good.

This soil is used for pasture, hay, small grain, grass seed, vegetable crops, berries, wildlife habitat, and recreation. Capability unit IIw–3; wildlife group 1.

Woodburn silt loam, 3 to 12 percent slopes (WoC).—This soil is on fans and foot slopes in the low foothills. Slopes average about 6 percent. The profile of this soil is similar to the profile of Woodburn silt loam, 0 to 3 percent slopes, except that a layer of clay is at a depth between 30 and 40 inches or more in some places. Also, where this soil merges into the foothills, coarse fragments of sedimentary rock make up as much as 35 percent of the lower part of the B horizon. Sedimentary bedrock is at a depth of 40 inches or more.

Included with this soil in mapping were as much as 20 percent similar soils and as much as 15 percent contrasting soils. Some soils that have a silty clay loam surface layer and a silty clay subsoil were also included, as well as some soils that are somewhat poorly drained.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used for cereal grain, hay, pasture, wildlife habitat, and recreation Capability unit IIe–4; wildlife group 1.

Use and Management of Soils

This section explains how the soils can be managed for crops and pasture and gives the estimated average yields of principal crops grown under a high level of management. Then it explains how the soils can be managed as woodland and wildlife habitat and for community development. Finally, it discusses the use of the soils in engineering.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, forest trees, or engineering.

In the capability system, the kinds of soils are grouped at three levels: the capability class, subclass, and unit. These groupings are discussed 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, defined as follows:

Class I soils have few 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, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, 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 largely to pasture, range, woodland, or wildlife (none in this Area).

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, and esthetic purposes.

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 some parts of the United States but not in this survey area, shows that the chief limitation is climatic that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–2 or IIIw–7. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units

In this subsection, each capability unit in the Benton County Area is discussed and suggestions are given for the use and management of the soils in each unit. The names of soil series represented in each capability unit are named in the description of that unit, but this does not mean that all the soils of a given series are in that unit. To find the names of all the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

CAPABILITY UNIT I–1

This capability unit consists of well-drained silty clay loams and silt loams of the Abiqua and Willamette series. These soils formed in alluvium on broad valley terraces. Slopes are 0 to 3 percent. Average annual precipitation is 40 to 60 inches, and the frost-free season is about 165 to 210 days.

Permeability is moderately slow or moderate. Runoff is slow or very slow, and the hazard of erosion is none to slight. The available water capacity is 7.5 to 13 inches. The effective rooting depth is 40 inches or more.

Flooding is not a concern on these soils. Erosion is not a concern if rains are of normal intensity.

All the climatically adapted crops that require good drainage grow well on these soils. The major crops are wheat, barley, oats, field corn, orchard crops, grasses, and

forage crops. When the soils are irrigated, sweet corn, strawberries, mint, hops, and pasture plants are commonly grown.

Returning all crop residue to the soil and using a rotation that includes grasses or legumes or grass-legume mixtures at least 25 percent of the time help to maintain fertility and tilth.

Small grain and grasses respond to nitrogen, row crops respond to nitrogen and phosphorus, and legumes respond to phosphorus and sulfur. In many places legumes grown on these soils also respond to lime.

Water can be applied by furrow, border, or sprinkler irrigation, but sprinkler irrigation is most commonly used. Leveling for irrigation or surface drainage can be done with little effort or injurious effect. Irrigation water generally is available from wells.

CAPABILITY UNIT IIe-1

This capability unit consists of well-drained silty clay loams and silt loams of the Abiqua and Willamette series. These soils formed in alluvium on bottom lands and terraces. Slopes range from 3 to 12 percent. Average annual precipitation is 40 to 60 inches, and the frost-free season is about 165 to 210 days.

Permeability is moderate or moderately slow. Runoff is slow to medium, and the hazard of erosion is slight to moderate. The available water capacity is 7.5 to 13 inches. Effective rooting depth is more than 40 inches.

The soils are used mainly for grass seed, cereal grains, orchard crops, and forage crops. When irrigated, they are used for vegetable crops, strawberries, cranberries, and specialty crops of many kinds.

Cross-slope farming and one or more of the following practices help to control erosion: minimum tillage, residue management, cover crops, and mulching. Runoff and erosion can also be controlled by properly managing crop residue and by using a cropping system in which grasses and legumes are grown at least 50 percent of the time.

Small grain and grasses respond to nitrogen, row crops commonly respond to nitrogen and phosphorus, and legumes respond to phosphorus and sulfur. In many places legumes grown on these soils also respond to lime.

The soils can be irrigated by sprinkler or furrow systems. Irrigation increases the hazard of erosion. Water should be applied carefully, preferably by sprinkler, at rates low enough to control runoff and erosion. Water for irrigation is available from some reservoirs and streams. Water for irrigation for Willamette soils generally is available from wells.

Drainageways do not normally cross these soils. Where drainageways are present, planting them to grass reduces the hazard of erosion.

CAPABILITY UNIT IIe-2

This capability unit consists of well drained and moderately well drained loams, silt loams, and silty clay loams of the Bellpine, Dixonville, Jory, Price, and Veneta series and of the Veneta series, loamy subsoil variant. These soils formed in alluvium and colluvium on foothills and terraces. Average annual precipitation is 40 to 60 inches, and the frost-free season is about 165 to 210 days.

Permeability is moderately slow or slow. Runoff is slow to medium, and the hazard of erosion is slight. The available water capacity is 3 to 11 inches. Effective rooting depth ranges from about 20 to more than 60 inches.

These soils are suited to a wide range of crops, but they are used mainly for grass seed, cereal grains, orchard crops, and forage crops.

Erosion can be easily controlled by fairly simple means, such as farming across the slope, keeping tillage to a minimum, or growing a winter cover crop. Returning all crop residue to the soils and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 50 percent of the time also help to control erosion, increase fertility, and improve tilth.

Small grain and grasses respond to nitrogen, row crops respond to nitrogen and phosphorus, and legumes respond to phosphorus and sulfur. Extra nitrogen is needed if crop residue is plowed under.

The soils can be irrigated by sprinkler or furrow systems. Irrigation increases the hazard of erosion, and water should be applied carefully, preferably by sprinkler or contour methods, at rates low enough to prevent runoff. These soils generally are not irrigated. Irrigation water generally must be stored in reservoirs, and sites are limited.

Planting grass in drainageways helps to prevent gullying.

CAPABILITY UNIT IIe-3

Winchuck silt loam, silty subsoil variant, 2 to 7 percent slopes, is the only soil in this capability unit. This soil is well drained and formed in alluvium on fans, foot slopes, and terraces along streams and rivers in the Coast Range. Average annual precipitation is 60 to 90 inches, and the frost-free season is about 160 to 190 days.

Permeability is moderate. Runoff is slow, and the hazard of erosion is slight to moderate. The available water capacity is 9 to 12 inches. The effective rooting depth is 60 inches or more.

This soil is used mainly for hay, pasture, and cereal grains. This soil generally is not suited to cultivated crops, because of low fertility, excessive cloudiness, and high rainfall. Grasses and legumes can be established and maintained if fertilizer and amendments are used. Douglas-fir grows well on this soil, and the soil is well suited to intensive woodland management.

Trafficability is poor during long wet periods.

Cross-slope farming, grassed waterways, and a winter cover crop help to control erosion. A cropping system in which grasses or legumes are grown at least 25 percent of the time helps to control erosion and increase fertility.

Small grain and grasses respond to nitrogen, and legumes respond to phosphorus and sulfur. Legumes grown on this soil also respond to lime.

In some areas this soil is irrigated, generally by sprinkler. Irrigation water is available from adjacent streams.

CAPABILITY UNIT IIe-4

Woodburn silt loam, 3 to 12 percent slopes, is the only soil in this capability unit. This soil is moderately well drained and formed in alluvium on fans and foot slopes. Slopes are 3 to 12 percent. Average annual precipitation is 40 to 60 inches, and the frost-free season is about 165 to 210 days.

Permeability is slow. Runoff is slow to medium, and the hazard of erosion is slight to moderate. The available

water capacity is 11 to 13 inches. Effective rooting depth is somewhat restricted by a seasonal high water table in winter and spring.

This soil is suited to row crops, small grain, forage crops, vegetables, and many specialty crops, but, because of moderate drainage limitations, choice of crops is restricted. Long-lived, deep-rooted, deciduous fruit and nut trees, strawberries, raspberries, and alfalfa are unfavorably affected in places. Row crops, forage crops, small grain, and grasses for seed are better suited to this soil than are most other crops.

Cross-slope farming, grassed waterways, rough tillage, winter cover crops, or stubble mulching help to control erosion. Crop residue management and a cropping system in which grasses or legumes or mixtures of grasses and legumes are grown at least 50 percent of the time help to reduce runoff and erosion and also to maintain favorable fertility and tilth.

Small grain and grasses respond to nitrogen, row crops commonly respond to nitrogen and phosphorus, and legumes respond to phosphorus and sulfur. In many places legumes grown on this soil respond to lime.

This soil can be irrigated by the sprinkler method. Irrigation increases the hazard of erosion, and water should be applied carefully, preferably by sprinkler, at rates low enough to prevent runoff. Water for irrigation is available streams, rivers, and sloughs.

This soil needs drainage for maximum use and production. Seepage from higher areas can be controlled by interception and random drains.

CAPABILITY UNIT IIw–1

Amity silt loam is the only soil in this capability unit. This soil is somewhat poorly drained and formed in alluvium on broad valley terraces. Slopes are 0 to 2 percent. Average annual precipitation is 40 to 45 inches, and the frost-free season is 165 to 210 days.

Permeability is moderately slow. Runoff is slow, and the hazard of erosion is none to slight. The available water capacity is 9 to 12 inches. The effective rooting depth is restricted by a seasonal high water table.

Erosion is not a concern if rains are of normal intensity.

Crops grow well on this soil, but the choice of crops is restricted because of the seasonal high water table. Deep-rooted crops are not suitable. This soil is better suited to row crops, forage crops, small grain, and grasses for seed than to most other crops. When drained and irrigated, the soil is suitable for a wider range of crops, but deep-rooted crops and crops sensitive to moisture are unfavorably affected in places.

Regular additions of organic matter are needed. Returning all crop residue to the soil and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 25 percent of the time help to maintain fertility and tilth.

Small grain and grasses respond to nitrogen, row crops commonly respond to nitrogen and phosphorus, and legumes respond to phosphorus and sulfur. Legumes also respond to lime.

This soil can be irrigated by sprinkler, furrow, or border methods. Sprinklers are satisfactory and are the most common method. Irrigation water should be applied carefully and at rates low enough to prevent runoff. Adequate water for irrigation can generally be obtained from wells.

This soil needs drainage for maximum use and production. It has moderately severe limitations for drainage, but, where outlets are available, it responds readily to open or closed drainage systems. It generally requires improved outlets to insure adequate subsurface drainage and to lower the seasonal high water table.

CAPABILITY UNIT IIw–2

This capability unit consists of somewhat excessively drained to well-drained silty clay loams, silt loams, and loams of the Chehalis, Cloquato, and Newberg series. These soils formed in alluvium on flood plains. Slopes are 0 to 3 percent. Average annual precipitation is 40 to 45 inches, and the frost-free season is 165 to 210 days.

Permeability is moderately rapid or moderate. Runoff is slow, and the hazard of erosion is slight to moderate. The available water capacity is 8 to 13 inches. The effective rooting depth is 40 inches or more.

Flooding occurs about once in 2 to 6 years, but it occurs several times in some years on some of the soils. There is a hazard of debris damage from flooding if orchards are planted on these soils. Erosion caused by seasonal overflow is a concern on these soils.

These soils are as productive as those in capability unit I–1 and are used for row and forage crops, small grain, grass seed, and orchard crops. When irrigated, vegetables and many specialty crops are grown. All crops not requiring late harvest are suitable for these soils.

Growing cover crops in winter and early in spring and diking in some areas help to control erosion. Diking increases the hazard of erosion, however, in years when the dikes are topped by overflow. Other practices that help to control erosion and that help to maintain fertility and tilth are returning all crop residue to the soil and using a cropping system that includes grasses or legumes or grass-legume mixtures grown at least 25 percent of the time.

Small grain and grasses respond to nitrogen, row crops commonly respond to nitrogen and phosphorus, and legumes respond to phosphorous and sulfur. In many places legumes grown on these soils also respond to lime.

These soils can be irrigated by sprinkler or furrow systems. Sprinklers are the most satisfactory method because, in places, leveling exposes subsurface horizons that have rapid premeability.

Use of these soils for orchards or crops requiring installation of poles, such as berries and hops, increases the hazard of debris accumulation and in places causes severe gullying. Irrigation water is available from shallow wells, streams, rivers, and sloughs.

CAPABILITY UNIT IIw–3

This capability unit consists of moderately well drained silty clay loams and silt loams of the Coburg, McAlpin, and Woodburn series. These soils formed in alluvium on fans, bottom lands, and terraces. Slopes are 0 to 3 percent. Average annual precipitation is 40 to 60 inches, and the frost-free season is 165 to 210 days.

Permeability is moderately slow or slow. Runoff is slow to medium, and the hazard of erosion is none to slight. The available water capacity is 8 to 13 inches. Effective rooting depth is somewhat restricted by a seasonal high water table.

Erosion is not a concern if rains are of normal intensity.

These soils are well suited to row and forage crops, small grain, and grass seed. When the areas are irrigated, vegetables and many of the specialty crops grow well on these soils. The choice of crops is more restricted because of the seasonal high water table. Long-lived, deep-rooted crops, deciduous fruit and nut trees, strawberries, caneberries, and alfalfa are unfavorably affected. Row crops, forage crops, grain, and grasses for seed are better suited to these soils than are other crops.

Returning all crop residue to the soils and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 25 percent of the time help to reduce runoff and erosion and to maintain fertility and tilth.

Small grain and grasses respond to nitrogen, row crops respond to nitrogen and phosphorus, and legumes respond to phosphorus and sulfur. In many places legumes grown on these soils also respond to lime.

These soils can be irrigated by sprinkler, furrow, or border systems. Sprinkler irrigation is the usual method. Irrigation water should be applied carefully at rates low enough to prevent runoff and soil movement. In places water for irrigation is available from reservoirs, streams, or wells.

These soils need drainage for maximum use and production. Seepage from higher areas can be controlled by interception and random drains. Runoff can be controlled by natural grassed waterways and a vegetative cover.

CAPABILITY UNIT IIw-4

Newberg fine sandy loam is the only soil in this capability unit. This soil is somewhat excessively drained and formed in alluvium on flood plains. Slopes are 0 to 3 percent. Average annual precipitation is 40 to 45 inches, and the frost-free season is 165 to 210 days.

Permeability is moderately rapid. Runoff is slow, and the hazard or erosion is slight to moderate. The soil is subject to flooding every 2 or 3 years. The available water capacty is 7.5 to 9 inches. Roots can penetrate to a depth of 40 inches and more.

The soil is used for row and forage crops, small grain, grasses for seed, strawberries, caneberries, vegetables, and many specialty crops. It is used for many of the root crops that are harvested late in fall.

An adequate winter cover of cover crops or crop stubble helps to control erosion. The erosion hazard is increased by harvesting some crops late in fall, because establishment or adequate growth is prevented in many places. The erosion hazard is also increased if the soil is left bare or is tilled in winter. Dikes are effective in most years, but dikes increase erosion in areas where the dikes are topped by high water. This soil can be protected and fertility and tilth can be maintained by properly managing crop residue and by using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 25 percent of the time.

Small grain and grasses respond to nitrogen, row crops commonly respond to nitrogen and phosphorus, and legumes respond to phosphorus and sulfur. In many places legumes grown on this soil also respond to lime.

This soil is irrigated by sprinklers. Irrigation requires special management because the soil has moderately rapid permeability and the available water capacity is only 7.5 to 9 inches. Frequent irrigation is needed during dry, warm summers to maintain sufficient moisture for plant growth. Adequate irrigation water generally is available from shallow wells or streams.

The use of this soil for orchards or crops requiring the installation of yards increases the hazard of debris accumulation and causes severe gullying in many places.

CAPABILITY UNIT IIw-5

McBee silty clay loam is the only soil in this capability unit. This soil is moderately well drained and formed in alluvium on flood plains. Slopes are 0 to 3 percent. Average precipitation is 40 to 45 inches, and the frost-free season is 165 to 210 days.

Permeability is moderate. Runoff is slow, and the hazard of erosion is slight. The soil is subject to periodic flooding of short duration. The available water capacity is 10.5 to 12 inches. Rooting depth is restricted by a seasonal high water table.

The soil in this unit is used for row and forage crops, small grain, and grass seed. When irrigated, it is used for vegetables and many specialty crops. Long-lived, deep-rooted, deciduous fruit and nut trees, alfalfa, and other crops are unfavorably affected in places because of a seasonal high water table. Vegetable and specialty crops, forage crops, grain, and grasses for seed are better suited to these soils than are most other crops.

Winter and spring cover and, in some areas, diking help to control erosion. Diking increases the hazard of erosion, however, in years when the dikes are topped by high water. A cover crop is needed to protect this soil in most of the diked areas. Properly managing crop residue and using a cropping system in which grasses or legumes or a grass-legume mixture are grown at least 25 percent of the time help to maintain fertility and tilth and to control runoff and erosion.

Small grain and grasses respond to nitrogen, row crops commonly respond to nitrogen and phosphorus, and legumes respond to phosphorus and sulfur. In many places legumes grown on this soil also respond to lime.

The soil can be irrigated by sprinkler or furrow systems. Sprinklers are more satisfactory because in places leveling exposes gravelly or sandy subsurface horizons that have rapid permeability. Irrigation water is available from streams, sloughs, and shallow wells. Adequate water generally is available from all sources.

Areas of this soil that are subject to seepage from adjacent terraces or old stream channels need some drainage. The soil needs drainage for maximum production and use.

Use of this soil for orchards or crops, such as berries and hops, that require installation of yards increases the hazard of debris accumulation during floods and causes severe gullying in some places.

CAPABILITY UNIT IIw-6

Nehalem silt loam is the only soil in this capability unit. This soil is well drained and formed in mixed alluvium on stream terraces and flood plains. Slopes are 0 to 3 percent. Average annual precipitation is 60 to 90 inches, and the frost-free season is about 160 to 190 days.

Permeability is moderate. Runoff is slow, and the hazard of erosion is slight because of overflow. The available water capacity is 10 to 12 inches. Effective rooting depth is

about 40 inches or more, but it is restricted by a seasonal fluctuating water table in some places.

This soil is used mainly for hay, pasture, cereal grain, and some specialty crops.

Regular additions of organic matter are needed. Returning all crop residue to the soil and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 25 percent of the time help to reduce erosion and maintain fertility.

Small grain and grasses respond to nitrogen, row crops commonly respond to nitrogen and phosphorus, and legumes respond to phosphorus and sulfur. Legumes also respond to heavy applications of lime.

Irrigation is needed for maximum production of all crops. Water is sometimes available from streams and ponds.

CAPABILITY UNIT IIs-1

Salem gravelly loam is the only soil in this capability unit. This soil is well drained and formed in gravelly alluvium on terraces. Slopes are 0 to 3 percent. Average annual precipitation is 40 to 45 inches, and the frost-free season is 165 to 210 days.

Permeability is moderate. Runoff is slow, and the hazard of erosion is slight. The available water capacity is 3.5 to 7 inches. The effective rooting depth is restricted, at a depth of 20 to 30 inches, by the very gravelly substratum.

Erosion is not a concern if rains are of normal intensity.

This soil is used for row and forage crops, small grain, orchards, grasses for seed, strawberries, caneberries, and a few specialty crops.

Properly managing crop residue and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 25 percent of the time help to maintain fertility and tilth.

The gravelly surface layer is a slight limitation to cultivation. In areas the gravel reduces the available water capacity to the extent that the soil is slightly droughty.

Small grain and grasses respond to nitrogen, row crops respond to nitrogen and phosphorus, and legumes respond to phosphorus and sulfur. In many places legumes grown on this soil also respond to lime.

Sprinklers are used to apply irrigation water. Other methods of applying water are less desirable, because this soil is too shallow over the very rapidly permeable substratum for leveling to be satisfactory. Deep cuts generally expose the very gravelly lower part of the subsoil or substratum.

CAPABILITY UNIT IIs-2

Malabon silty clay loam is the only soil in this capability unit. This soil is well drained and formed in alluvium on bottom lands and terraces. Slopes are 0 to 3 percent. Average annual precipitation is 40 to 60 inches, and the frost-free season is about 165 to 210 days.

Permeability is moderately slow. Runoff is slow, and the hazard of erosion is none to slight. The available water capacity is 9 to 12 inches. The effective rooting depth is 60 inches or more.

Erosion is not a concern if rains are of normal intensity.

All climatically adapted crops that require good drainage grow well on this soil. The major crops are wheat, barley, oats, orchard crops, grasses, and forage crops. When the soil is irrigated, sweet corn, strawberries, mint, and pasture generally are grown.

Returning all crop residue to the soil and using a cropping system that includes grasses or legumes grown at least 25 percent of the time help to maintain fertility and tilth.

Small grain and grasses respond to nitrogen, row crops respond to nitrogen and phosphorous, and legumes respond to phosphorus and sulfur. Legumes also respond to lime.

The soils can be irrigated by furrow, border, or sprinkler methods, but sprinkler irrigation is most commonly used. Leveling for irrigation or surface drainage can be done with little effort or injurious effect on the soils. Irrigation water generally is available from wells, rivers, and sloughs.

CAPABILITY UNIT IIIe-1

This capability unit consists of well drained and moderately well drained loams, silt loams, and silty clay loams of the Bellpine, Dixonville, Hazelair, Jory, Price, and Veneta series and of Veneta series, loamy subsoil variant. These soils formed in alluvium and colluvium on foothills and terraces. Slopes are 7 to 20 percent. Average annual precipitation is 40 to 60 inches, and the frost-free season is about 165 to 210 days.

Permeability is moderate or slow. Runoff is medium, and the hazard of erosion is moderate to high. The available water capacity is 3 to 11 inches. Effective rooting depth ranges from about 20 inches to more than 60 inches.

These soils are used mainly for grass seed, cereal grain, orchard crops, and pasture.

Cross-slope farming, grassed waterways, and a winter cover crop help to control erosion. Cover crops planted early in fall help to insure adequate growth. Returning all crop residue to the soils and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least two-thirds of the time help to reduce runoff and erosion and to maintain fertility and tilth.

Small grain and grasses respond to nitrogen, and legumes respond to phosphorus and sulfur. Legumes also respond to lime.

Irrigation is by the sprinkler method because of a moderate hazard of erosion and slopes that generally are not suited to contour irrigation. Irrigation requires special management because of excessive slopes common to these soils. These soils generally are not irrigated. Irrigation water is limited to water stored in reservoirs and ponds.

CAPABILITY UNIT IIIe-2

This capability unit consists of moderately well drained to somewhat poorly drained silt loams and silty clay loams of the Dupee, Hazelair, and Witham series. These soils formed in colluvium or alluvium on fans, terraces, and on low foothills. Slopes are 2 to 12 percent. Average annual precipitation is 40 to 60 inches, and the frost-free season is 165 to 210 days.

Permeability is moderately slow or very slow. Runoff is slow to medium, and the hazard of erosion is slight to moderate. The available water capacity is 3 to 14 inches. The effective rooting depth is 12 to 40 inches or more.

These soils are used for cereal grains, pasture, hay, and woodland.

Cross-slope farming and growing a winter cover crop, or using interception ditches and rough tillage, help to control erosion. Planting grasses in the drainageways helps to prevent gullying. Returning all crop residue to the soils and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 50

percent of the time are other practices that help to control erosion and that increase fertility and improve tilth.

Grains and grasses respond to nitrogen, and legumes regation needs to be stored in reservoirs, but sites generally respond to lime.

These soils generally are not irrigated. Water for irrigation needs to be stored in reservoirs, but sites generally are lacking.

These soils need drainage for maximum production and use. Open drainage ditches are subject to erosion unless they are properly laid out. Drainage generally can be accomplished by using interceptor drains and by using a random ditch system to drain wet spots in depressions. Runoff from higher areas can be intercepted by open ditches or grassed waterways.

CAPABILITY UNIT IIIe-3

Briedwell gravelly loam, 0 to 7 percent slopes, is the only soil in this capability unit. This soil is well drained and formed in alluvium and colluvium on terraces adjacent to the valley floor. Average annual precipitation is 40 to 60 inches, and the frost-free season is 165 to 210 days.

Permeability is moderate. Runoff is slow, and the hazard of erosion is slight to moderate. The available water capacity is 4 to 8 inches. Effective rooting depth ranges from 24 to 36 inches.

This soil is used for cereal grains, grass seed, pasture, and hay. Orchards and deep-rooted crops are not ordinarily grown on this soil, because depth to gravel is limited and this soil tends to be droughty.

Grassed waterways, cross-slope farming, and one of the following practices help to control erosion: residue management, rough tillage, winter cover, or stubble mulching. Cover crops planted early in fall help to insure adequate growth. Returning all crop residue to the soil and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 25 percent of the time are other practices that help to control erosion and that increase fertility and improve tilth. Where stubble mulching or crop residue is used, additional nitrogen is needed to prevent a decrease in production. In years when rain is lacking late in spring, this soil is quite droughty.

Small grain and grasses respond to nitrogen, and legumes respond to phosphorus and sulfur. Legumes also respond to lime.

This soil generally is not irrigated. Irrigation water must be stored in reservoirs, and suitable sites are not adequate. Irrigation water should be applied by sprinklers. Excessive irrigation or irrigation rates should be avoided to prevent runoff and seepage.

CAPABILITY UNIT IIIe-4

This capability unit consists of well-drained silty clays of the Apt and Honeygrove series. These soils formed in colluvium and alluvium on uplands of the Coast Range. Slopes are 3 to 12 percent. Average annual precipitation is 60 to 90 inches, and the frost-free season is 160 to 190 days.

Permeability is moderately slow. Runoff is medium, and the hazard of erosion is moderate. The available water capacity is 7.5 to 10 inches. Effective rooting depth is 40 inches or more.

The soils are used mainly for hay, pasture, and woodland. A few small areas are in cereal grains, hay, and pasture. These soils generally are not productive for cultivated crops, because of high rainfall. Grasses and legumes can be established and maintained by the use of fertilizer and amendments. Douglas-fir grows well on these soils, and the soils are well suited to intensive woodland management. Trafficability is poor during long wet periods.

Cross-slope farming, grassed waterways, and growing a winter cover crop help to control erosion. Cover crops should be planted in fall to insure adequate growth. Residue management and rotations are needed to reduce runoff and erosion if these soils are used for crops. Returning all crop residue to the soils and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 25 percent of the time help to control erosion, increase fertility, and improve tilth.

Small grain and grasses respond to nitrogen, and legumes respond to phosphorus and sulfur. Legumes also respond to lime.

CAPABILITY UNIT IIIw-1

This capability unit consists of poorly drained silt loams and silty clay loams of the Brenner, Concord, Conser, Waldo, and Wapato series. These soils formed in alluvium on flood plains and in depressions and drainageways on broad valley terraces. Slopes are 0 to 3 percent. Average annual precipitation is 40 to 90 inches, and the frost-free season is 160 to 210 days.

Permeability is moderately slow or slow. Runoff is slow, very slow, or ponded, and the hazard of erosion is none to moderate. The available water capacity is 7.5 to 12 inches. The effective rooting depth is restricted by a seasonal high water table.

Debris deposited by floods is a concern in some areas of Brenner, Conser, and Wapato soils. Erosion caused by seasonal overflow and inundation from higher areas is a concern on all of these soils.

These soils are used for small grain, pasture, and hay. Where they are drained, and when irrigated, a wide range of crops is grown. These soils are not suited to deep-rooted perennial crops in most areas, because adequate drainage outlets generally cannot be maintained during winter and spring.

Growing an annual winter cover crop and properly managing crop residue help to control erosion. Proper management of crop residue and use of a cropping system in which grasses or legumes or mixtures of grasses and legumes are grown at least 25 percent of the time also help to maintain fertility and tilth.

Small grain and grasses respond to nitrogen, row crops commonly respond to nitrogen and phosphorus, and legumes respond to phosphorus and sulfur. In many places legumes grown on these soils also respond to lime.

Irrigation is needed for maximum production of all crops. Application rates should be such that the soils are not overirrigated, causing a high water table. Water is sometimes available from streams and ponds.

These soils need drainage for maximum production and use. Drainage is generally hard to establish because of poor outlets, seasonal overflow, and inundation from higher areas. These soils respond readily to drainage if adequate outlets are provided.

CAPABILITY UNIT IVe-1

This capability unit consists of well-drained loams, gravelly silty clay loams, and silty clay loams of the Bell-

pine, Dixonville, Jory, Philomath, Price, and Ritner series, and Veneta series, loamy subsoil variant. These soils formed in colluvium from sedimentary and basic rock in the foothills. Slopes are mostly 20 to 30 percent but range from 2 to 30 percent. Average annual precipitation is 40 to 60 inches, and the frost-free season is 165 to 210 days.

Permeability is moderate to slow. Runoff is medium to rapid, and the hazard of erosion is moderate to high. The available water capacity is 1.5 to 11 inches. Effective rooting depth is 20 to more than 60 inches.

These soils are used mainly for pasture, hay, and woodland. Small acreages are used for cereal grains. Excess slopes, droughtiness, and hazard of erosion make them poorly suited to cultivation. Most of the Dixonville, Philomath, and Veneta, variant soils in this unit are in grass or grass-oak and are used for pasture. Bellpine, Jory, and Price-Ritner soils in this unit are mainly wooded, and they are well suited to the production of Douglas-fir and intensive woodland management.

If cultivated, these soils need contour cropping, crop residue, rough tillage or winter cover, and grassed waterways to help to control erosion. In many areas the length and shape of slopes make them unsuited to contouring. Returning all crop residue to the soils and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 75 percent of the time help to reduce runoff and erosion and to maintain fertility and tilth.

Small grain and grasses respond to nitrogen, and legumes respond to phosphorus and sulfur. Legumes also respond to lime.

CAPABILITY UNIT IVe-2

Briedwell gravelly loam, 7 to 20 percent slopes, is the only soil in this capability unit. This soil is well drained and formed in alluvium and colluvium on terraces and foothills adjacent to the valley floor. Average annual precipitation is 40 to 60 inches, and the frost-free season is 165 to 210 days.

Permeability is moderate. Runoff is medium, and the hazard of erosion is moderate. The available water capacity is 4 to 8 inches. Effective rooting depth is restricted by a very gravelly substratum at a depth of about 30 inches.

The soil is used mainly for pasture and hay. Orchards and deep-rooted crops are not suited to this soil, because of droughtiness caused by very gravelly clay loam at a depth of about 30 inches.

Grassed waterways, cross-slope farming, residue management, and a winter cover crop help to control erosion. Cover crops planted early in fall help to insure adequate growth. Returning all crop residue to the soil and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 50 percent of the time help to reduce runoff and erosion and to maintain fertility and tilth. If crop residue is used, additional nitrogen is needed to prevent decrease in production. In years when rain is lacking late in spring, the soil is droughty.

Small grain and grasses respond to nitrogen, and legumes respond to phosphorus and sulfur. Legumes also respond to lime.

The soil generally is not irrigated. Irrigation, if used, should be applied by sprinklers. Excessive irrigation should be avoided to prevent runoff.

CAPABILITY UNIT IVe-3

This capability unit consists of well-drained gravelly loams, silty clay loams, and clay loams of the Apt, Honeygrove, Marty, Peavine, and Slickrock series. These soils formed in colluvium from sedimentary and igneous rocks on uplands of the Coast Range. Slopes are 3 to 30 percent. Average annual precipitation is 60 to 120 inches, and the frost-free season is 145 to 190 days.

Permeability is moderate or moderately slow. Runoff is medium to rapid and the hazard of erosion is moderate to high. The available water capacity is 5 to 12 inches. Effective rooting depth is 30 to more than 60 inches.

These soils are used mainly for timber production. A few small areas are used for improved pasture. The high rainfall and excessive slopes make these soils poorly suited to cultivated crops. Pastures can be established and maintained by the use of fertilizer and amendments. Douglas-fir grows well on these soils, and these soils are well suited to intensive woodland management. Brush encroachment is a major management concern. These soils have poor trafficability during long wet periods.

Grasses respond to nitrogen, and legumes respond to phosphorus and sulfur. In places legumes also respond to lime.

CAPABILITY UNIT IVe-4

This capability unit consists of well-drained silty clay loams of the Apt, Blachly, and Honeygrove series. These soils formed in colluvium from sedimentary and basic rocks on uplands of the Coast Range. Slopes are 3 to 25 percent. Average annual precipitation is 60 to 120 inches, and the frost-free season is 150 to 190 days.

Permeability is moderately slow. Runoff is medium to rapid, and the hazard of erosion is moderate to high. The hazard of slump and slide is severe. The available water capacity is 7 to 10 inches. Effective rooting depth is 60 inches or more.

These soils are used mainly for timber production. A small acreage is in pasture. These soils generally are not productive and are poorly suited to farming. Pasture can be established by use of fertilizer and amendments. Douglas-fir grows well on these soils. They are well suited to intensive woodland management. Brush encroachment is a major management concern. Trafficability is poor during wet periods.

If cultivated, rough tillage, residue management, and winter cover crops are required to control erosion.

Grasses respond to nitrogen, and legumes respond to phosphorus and sulfur and in some places to lime.

Road cuts are unstable and have a medium to high slide hazard. Logging roads should be placed on ridges, if possible, to avoid excessive soil disturbance caused by large cuts and fills.

CAPABILITY UNIT IVw-1

Dayton silt loam is the only soil in this capability unit. It is poorly drained and formed in alluvium on broad terraces and in shallow depressions in drainageways. Slopes are 0 to 2 percent. Average annual precipitation is 40 to 45 inches, and the frost-free season is 165 to 210 days.

Permeability is very slow. Runoff is ponded to slow, and the hazard of erosion is slight. The available water capacity to a depth of about 15 inches is 3.75 to 4.5 inches and to a depth of 60 inches it is 7 to 9 inches. The effective rooting depth is restricted by a seasonal high water table.

Erosion is not a hazard, except where water has been concentrated by inadequate surface drainage.

This soil is used for small grain, grass seed, pasture, and hay. It is not suited to deep-rooted crops or crops sensitive to excess water in the root zone.

Residue management or winter cover crops help to control erosion. Returning all crop residue to the soil and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 25 percent of the time help to reduce runoff and erosion and to maintain fertility and tilth.

This soil is droughty during the dry summer months. If irrigated, care must be taken to prevent over-irrigation and drowning of crops.

This soil needs drainage for maximum production and use. Drainage is difficult to establish because of inadequate outlets and the shallow depth to the slowly permeable clay subsoil. Tile placed at close intervals below the clay subsoil provides the best drainage. Placing a porous material over the tile before backfilling helps to insure proper drainage.

Subsurface drainage is difficult to establish in areas where a thick clayey substratum underlies the clay subsoil. Unless adequate outlets can be provided, tile drainage in these areas is not effective. Adjustments must be made in tile depths and spacings to compensate for this condition.

Even if this soil is drained, control of the water table is difficult. Where suitable outlets for tile cannot be established, drainage is confined to surface removal of excess water.

CAPABILITY UNIT IVw-2

This capability unit consists of excessively drained gravelly sandy loams and fine sandy loams of the Camas and Pilchuck series. These soils formed in coarse-textured alluvium on bottom lands. Slopes are 0 to 3 percent. Average annual precipitation is 40 to 45 inches, and the frost-free season is 165 to 210 days.

Permeability is rapid or very rapid. Runoff is slow, and the hazard of erosion is slight to moderate because of seasonal overflow that occurs once in 2 to 6 years. The available water capacity is 1.5 to 6 inches.

These soils are used for small grain, pasture, and hay. If irrigated, they are used for all crops grown in the area. These soils are poorly suited to many crops, but they are cultivated because they often occur in small areas within areas of other soils on bottom lands.

Winter cover crops help to control erosion. Cover crops planted early in fall allow adequate rooting and top growth before a period of overflow. Stubble and other plant residue should be left on the surface during winter before incorporating them into the soils. Fertilization and irrigation are necessary in many years for early establishment of a cover crop. Returning all crop residue to the soils and using a cropping system in which grasses or legumes or grass-legume mixtures are grown at least 25 percent of the time help to reduce erosion and to maintain fertility and tilth.

Because of the generally low available water capacity of these soils, especially the Camas soils, frequent applications of irrigation water are necessary to maintain crops above the wilting point. Crops grown on the soils, as managed, generally are below the wilting point, and the crops are stunted and the production is low.

Gravel in the Camas soil makes tillage and seedbed preparation difficult. In many areas, the cobblestones and larger pebbles have been removed from the surface to make cultivation practical.

The use of these soils for crops requiring the installation of poles for berries or hops increases the hazard of debris accumulation during floods and causes severe gullying in many places.

CAPABILITY UNIT IVw-4

Bashaw clay is the only soil in this capability unit. This is a poorly drained soil that formed in fine alluvium on alluvial bottoms of tributary streams. Slopes are 0 to 3 percent. Average annual precipitation is 40 to 60 inches, and the frost-free season is 165 to 210 days.

Permeability is very slow. Runoff is slow or ponded, and the hazard of erosion is slight. A few areas are subject to flooding. The available water capacity is 8 to 10 inches. The effective rooting depth is restricted by a seasonal high water table.

Erosion is not a concern, because areas subject to overflow are in a backwater position, and damage to crops is by drowning or deposition. Some areas subject the flooding can be protected by intercepter ditches and establishment of adequate outlets and drainageways.

This soil is used for pasture, hay, and grass seed. Some areas have been smoothed and used for spring grain. Forage crops that are not sensitive to excessive moisture are better suited to this soil than are other crops.

Properly managing crop residue and using a cropping system in which grasses or legumes or mixtures of grasses and legumes are grown at least 25 percent of the time help to maintain fertility and tilth.

Small grain and grasses respond to nitrogen, and legumes respond to phosphorus, sulfur, and lime.

This soil cracks when dry and takes water readily. If saturated with water, this soil swells and the cracks close. Irrigation is difficult, and intake rates vary from rapid to very slow depending on the moisture content. Once the soil is wet, little water enters until the soil has dried and cracks open again. It is difficult to maintain a favorable moisture and air relationship in this soil.

This soil needs drainage, but because of a clay or silty clay texture and lack of soil structure, drainage is largely confined to removal of excess surface water. Tile drainage can be installed, and it is effective if suitable outlets can be provided.

Cultivation is difficult because the clayey or silty clay texture causes a narrow range of moisture content at which this soil can be cultivated and worked.

CAPABILITY UNIT IVw-5

Bashaw silty clay loam is the only soil in this capability unit. This is a poorly drained soil that formed in alluvium on bottom lands. Slopes are 0 to 3 percent. Average annual precipitation is 40 to 60 inches, and the frost-free season is 165 to 210 days.

Permeability is very slow. Runoff is slow or ponded, and the hazard of erosion is slight. The available water capacity is 8 to 10 inches. The effective rooting depth is restricted by a seasonal high water table.

This soil is used mainly for hay and pasture. Grass seed and spring grain are grown in some areas. Many areas are in thick stands of hardwoods and shrubs.

Properly managing crop residue and using a cropping system in which grasses or legumes or mixtures of grasses and legumes are grown at least 25 percent of the time help to maintain fertility and tilth.

Small grain and grass crops require nitrogen. Legumes respond to phosphorous, sulfur, and lime.

This soil requires drainage because of a high water table late in fall, in winter, and early in spring. If adequate outlets are available, tile drainage and open ditches are effective.

CAPABILITY UNIT VIe–1

This capability unit consists of well-drained silty clay loams and gravelly loams of the Apt, Blachly, Bohannon, Honeygrove, Marty, Mulkey, Peavine, and Slickrock series. These soils formed in colluvium from sedimentary and igneous rocks on uplands of the Coast Range. Slopes are 5 to 60 percent. Average annual precipitation is 60 to 120 inches, and the frost-free season is mainly 145 to 190 days but is as low as 120 to 150 days in areas of the Mulkey soil.

Permeability is moderately rapid to moderately slow. Runoff is rapid to medium, and the hazard of erosion is moderate or high. The available water capacity is 3 to 12 inches. Effective rooting depth is 20 inches to more than 60 inches.

These soils are used mainly for timber production. The high rainfall and the slopes make these soils unsuitable for cultivation. Douglas-fir and some hemlock and cedar grow well on these soils. Very steep slopes make woodland management difficult. Brush encroachment is a major management concern. The slide hazard is slight to high on these soils if roads are cut through. These soils have poor trafficability during long wet periods.

The Mulkey soil is mainly in natural stands of grass. The production of Douglas-fir on this soil is poor. The Mulkey soil has some small areas of stunted noble fir. Management is difficult in steeper areas, and the hazard of erosion is high. Erosion can be controlled by maintaining a ground cover of natural vegetation. The Mulkey soil is in this capability unit because its acreage is very small.

CAPABILITY UNIT VIe–2

This capability unit consists of well-drained clay loams, silty clay loams, silty clays, and gravely silty clay loams of the Bellpine, Dixonville, Jory, Philomath, Price, and Ritner series. These soils formed in colluvium derived from sedimentary and basic rocks in the foothills. Slopes are 30 to 60 percent. Average annual precipitation is 40 to 60 inches, and the frost-free season is 165 to 200 days.

For most of the soils in this unit, permeability is moderately slow or slow, runoff is rapid to very rapid, the hazard of erosion is high, the available water capacity is 4.5 to 11 inches, and effective rooting depth is 20 inches to more than 60 inches. The Philomath soil has medium to rapid runoff, moderate to high hazard of erosion, 1.5 to 3 inches available water capacity, and effective rooting depth of 15 to 20 inches.

The soils in this unit are used for woodland and pasture. The excessive slope makes them unsuitable for cultivation and makes woodland management difficult. Seeding of improved varieties of grasses is desirable but impractical on the steeper areas. The Philomath soil and some areas of Bellpine and Dixonville soils are in native oak and grass pasture. Douglas-fir grows well on the deep soils. Trafficability is poor during long wet periods. A permanent vegetative cover should be maintained to protect these soils from erosion.

CAPABILITY UNIT VIs–1

This capability unit consists of well-drained gravelly loams, gravelly silty clay loams, gravelly clay loams, loams, and silty clay loams of the Klickitat, Price, and Ritner series. These soils formed in colluvium and residuum from sedimentary and basic rocks in the foothills and in the Coast Range. Slopes are 5 to 50 percent. Average annual precipitation is 40 to 120 inches, and the frost-free season is 120 to 200 days.

Permeability is moderately rapid to moderately slow. Runoff is medium to very rapid, and the hazard of erosion is moderate to high. The available water capacity ranges from 2 to 6.5 inches. Effective rooting depth ranges from 20 to 50 inches.

These soils are used for woodland, timber production, and pasture. They are too steep or too shallow for cultivated crops. Ritner-Price and Klickitat soils are used mainly for the production of Douglas-fir, and they are well suited to this use.

CAPABILITY UNIT VIIe–1

Bohannon gravelly loam, 50 to 75 percent slopes, is the only soil in this capability unit. This soil formed in colluvium weathered from sandstone on mountainous uplands of the Coast Range. Elevation ranges from 1,000 to 3,500 feet. Average annual precipitation is 60 to 120 inches, and the frost-free season is 145 to 190 days.

Permeability is moderately rapid. Runoff is rapid, and the hazard of erosion is high. The available water capacity is 3 to 6 inches. The effective rooting depth is 20 to 40 inches.

This soil is used for woodland, water supply, and wildlife habitat. It has very severe limitations to use because of excessive slope, which makes it unsuitable for cultivated crops.

CAPABILITY UNIT VIIw–1

This capability unit consists of Mixed alluvial land that is shallow to deep. This is a well-drained, excessively drained, and poorly drained soil that is made up of mixed stratified alluvial materials that range from silt loam to very gravelly sand. It is on the recent flood plain of the Willamette River.

Permeability ranges from moderate to very rapid. The hazard of erosion is high. Available water capacity is 3 to 9 inches. The effective rooting depth ranges from less than 15 inches to 40 inches or more.

Erosion is a concern because of the rapidly flowing floodwaters that frequently inundate this land type and erode the river banks. Deposition of debris and fresh soil materials on this land type by floodwaters is common.

This unit is mainly in thick stands of brush and trees interspersed with some areas of natural grassland. A few small fields are in cultivation.

This unit should remain in permanent vegetative cover. Some areas are used as a source of sand and gravel. This land type has some use as camp and picnic grounds, and it is well suited to wildlife habitat. A limited amount of logging is done on this unit.

CAPABILITY UNIT VIIs–1

This capability unit consists of excessively drained to well-drained very cobbly loams, gravelly loams, gravelly silty clay loams, gravelly clay loams, and silty clay loams of the Kilchis, Klickitat, Price, Ritner, and Witzel series. These soils formed in colluvium and residuum from igneous and sedimentary rocks in the foothills and in the Coast Range. Slopes are 30 to 75 percent. Average annual precipitation is 40 to 120 inches, and the frost-free season is 120 to 200 days.

Permeability is moderately rapid to moderately slow. Runoff is very rapid, and the hazard of erosion is high. The available water capacity is 1 inch to 6.5 inches. The effective rooting depth is from 12 to 50 inches.

These soils are used mainly for timber production. The Bohannon, Ritner-Price, and Klickitat soils are suited to production of Douglas-fir. The Kilchis soil is shallow, and timber production is low. The Witzel soil is also shallow and is poorly suited to production of Douglas-fir because of droughtiness, and most areas are in natural stands of grass and oak. Woodland management is difficult on these soils because of cobblestones, stones, and excessive slope.

CAPABILITY UNIT VIIIw–1

This capability unit consists of Riverwash, which is cobbly, gravelly, and sandy. It is exposed along rivers at low water and is subject to shifting during periods of high water and floods.

In most areas this unit is a hazard to the normal flow of the river because of movement and deposition of materials in the channel. Some of these areas are used as a source of gravel and sand.

Predicted Yields [2]

The yield estimates in this survey are based on observations made by the soil scientists who surveyed the Area, on information furnished by farmers in the Area, and by State and Federal advisory personnel of the Extension Service, Soil Conservation Service, and Agricultural Experiment Station. Federal and county census data were also reviewed and considered. More information was available for some soils than for others. If little or no information was available, yield estimates were made by comparing the soils with similar soils.

Table 2 gives the estimated average yields of a few principal crops grown in the Area under a high level of management. The estimates are based on experiences, field trials, and research findings that will give the highest returns.

Several important limitations should be considered when using the yield estimates in table 2. First, the figures are estimates, or predictions. Second, the figures are averages that may be expected over a period of years. In any given year, therefore, the yields may be higher or lower than the average. Third, such characteristics of the soil as fertility and available water capacity, considered in making the estimates, may vary considerably. The information on yields and management practices in this part of the survey will be most helpful immediately after publication. To some extent it shows the relative productivity of the soils under similar management, which likely will remain constant.

New developments in crop breeding, insect and disease control, fertilizers, tillage, irrigation, and drainage can change much of the information on management and yields. Newer and better practices can always be substituted. To secure the latest information, contact the State and Federal farm advisory services.

Only those soils that are commonly used for cultivated crops, irrigated pasture, or orchards are included in table 2. Other soils, ordinarily used only for native pasture, woodland, or recreation and wildlife are not listed.

Yields for irrigated crops have not been entered in table 2 for those soils in areas where sufficient water generally is not available for irrigation.

Management by Crop

Predictions or estimates of yields are most useful if the management is described through which such yields were obtained. In the pages that follow, management is described for each crop named in table 2. Management is discussed by capability units or groups of capability units.

All requirements for plant nutrients are given for the elemental form; for example, the amount of the element phosphorus needed per acre is given. Recommendations for fertilizer and for use of other amendments are given in the "Oregon State University Fertilizer Guides" for various crops. These fertilizer guides are revised as new information becomes available for a particular crop. Fertilizer and lime should be applied according to needs as indicated by soil tests.

The gross irrigation requirement is the total amount of water per acre needed annually by the plant less the average effective precipitation. The irrigation requirement is calculated on the assumption that the irrigation system is 70 percent efficient.

To describe management of the specific crops, the soils of the Survey Area are divided into several groups for each crop. All the soils in each group require about the same management for that crop. Needed management is described for the soils in group 1. The management needed for subsequent groups is similar to that described for group 1, except that additional practices may be needed. The variations in management from that given for group 1 are described for each subsequent group of soils.

MANAGEMENT OF IRRIGATED BUSH BEANS

Group 1.—In this group are soils in capabilty units I–1, IIs–1, and IIs–2. A common rotation is 1 to 2 years of beans and 1 to 2 years of other horticultural or field crops. Seedbed preparation consists of moldboard plowing, harrowing one or two times, and rolling to produce a seedbed suitable for a precision planter. Planting can be done with a one- or two-row planter during April and May at a rate of 25 to 30 pounds of treated seed. Weed control is achieved by approved pre-emergence herbicides, cultivating three or four times, and hand hoeing where necessary. Fertilization needs include 100 to 150 pounds of nitrogen in a split application, and a minimum of 20 to 30 pounds of sulfur applied by broadcast, row, or irrigation water. Phosphorus and potassium need to be applied according to requirements indicated by soil tests.

[2] S. A. JACKSON, HAROLD WERTH, and MARTIN THINGVOLD, Benton County extension agents, helped to prepare this section.

TABLE 2.—*Predicted average acre yields of principal irrigated and dryland crops under a high level of management*

[Absence of a yield figure indicates that the soil is not suited to the crop or that the crop is not ordinarily grown on the soil]

Soil	Irrigated crops						Dryland crops				
	Bush beans	Sweet corn	Straw-berries	Pepper-mint	Pas-ture	Al-falfa	Spring barley	Winter wheat	Bent-grass	Sweet cherries	Fil-berts
	Tons	*Tons*	*Tons*	*Lbs.*	*A.U.M.*[1]	*Tons*	*Cwt.*	*Bu.*	*Cwt.*	*Tons*	*Tons*
Abiqua silty clay loam, 0 to 3 percent slopes	4	8	5. 5	75	20	6	30	75	4. 5	3. 0	1. 0
Abiqua silty clay loam, 3 to 5 percent slopes	4	8	5. 5	75	20	6	30	75	4. 5	3. 0	1. 0
Amity silt loam [2]	4	8	------	60	20	------	30	70	4. 0	------	------
Apt silty clay loam, 3 to 12 percent slopes	------	------	------	------	------	------	20	45	3. 5	------	------
Bashaw clay	------	------	------	------	12	------	20	------	3. 0	------	------
Bashaw silty clay loam	------	------	------	------	12	------	20	------	3. 0	------	------
Bellpine silty clay loam, 3 to 12 percent slopes	------	------	------	------	------	------	17	50	3. 0	2. 0	. 8
Bellpine silty clay loam, 12 to 20 percent slopes	------	------	------	------	------	------	17	50	3. 0	2. 0	. 8
Bellpine silty clay loam, 20 to 30 percent slopes	------	------	------	------	------	------	17	50	------	------	------
Brenner silt loam [2]	------	------	------	------	18	------	15	35	3. 5	------	------
Briedwell gravelly loam, 0 to 7 percent slopes	------	------	------	------	12	4	17	35	3. 0	------	------
Briedwell gravelly loam, 7 to 20 percent slopes	------	------	------	------	------	------	17	35	3. 0	------	------
Camas gravelly sandy loam	3	4	2. 2	50	12	3	12	20	3. 0	------	------
Chehalis silty clay loam	4. 5	8	5. 5	90	20	8	35	80	4. 5	3. 5	1. 0
Cloquato silt loam	4. 5	8	5. 5	90	20	8	35	80	4. 5	3. 5	1. 0
Coburg silty clay loam [2]	4	8	3. 0	75	20	7	30	75	4. 0	2. 5	1. 0
Concord silt loam [2]	------	------	------	------	18	------	17	55	3. 5	------	------
Conser silty clay loam [2]	------	------	------	------	18	------	20	55	4. 0	------	------
Dayton silt loam [2]	------	------	------	------	15	------	17	------	3. 0	------	------
Dixonville silty clay loam, 3 to 12 percent slopes	------	------	------	------	------	------	15	40	2. 5	2. 0	. 4
Dixonville silty clay loam, 12 to 20 percent slopes	------	------	------	------	------	------	15	40	2. 5	2. 0	. 4
Dixonville silty clay loam, 20 to 30 percent slopes	------	------	------	------	------	------	15	40	------	------	------
Dupee silt loam, 3 to 12 percent slopes	------	------	------	------	------	------	20	40	4. 0	------	------
Hazelair silt loam, 3 to 12 percent slopes	------	------	------	------	------	------	17	40	3. 0	------	------
Hazelair complex, 3 to 12 percent slopes	------	------	------	------	------	------	17	40	3. 0	------	------
Hazelair complex, 12 to 20 percent slopes	------	------	------	------	------	------	17	40	3. 0	------	------
Honeygrove silty clay loam, 3 to 12 percent slopes	------	------	------	------	------	------	20	45	3. 5	------	------
Jory silty clay loam, 2 to 12 percent slopes	------	------	------	------	------	------	24	60	4. 0	3. 0	. 8
Jory silty clay loam, 12 to 20 percent slopes	------	------	------	------	------	------	24	60	4. 0	3. 0	. 8
Jory silty clay loam, 20 to 30 percent slopes	------	------	------	------	------	------	24	60	------	------	------
Malabon silty clay loam	4	8	4. 0	90	20	6. 5	35	75	4. 5	3. 0	1. 0
McAlpin silty clay loam [2]	4	8	3. 0	70	18	6	24	65	4. 0	2. 5	1. 0
McBee silty clay loam [2]	4	8	2. 5	70	19	5	24	65	3. 5	2. 5	1. 0
Nehalem silt loam	------	------	------	------	18	4. 5	20	60	4. 0	------	------
Newberg fine sandy loam	4	8	5	90	18	7	24	60	3. 0	3. 0	1. 0
Newberg loam	4	8	5	90	18	7. 5	30	65	3. 5	3. 0	1. 0
Philomath silty clay, 3 to 12 percent slopes	------	------	------	------	------	------	12	25	------	------	------
Pilchuck fine sandy loam	3. 5	4. 5	3. 5	50	12	4	15	30	3. 0	------	------
Price silty clay loam, 3 to 12 percent slopes	------	------	------	------	------	------	20	50	4. 0	2. 5	. 5
Price silty clay loam, 12 to 20 percent slopes	------	------	------	------	------	------	20	50	4. 0	2. 5	. 5
Price-Ritner complex, 20 to 30 percent slopes	------	------	------	------	------	------	20	50	------	------	------
Salem gravelly loam	4	8	4. 0	70	18	5. 5	20	45	4. 0	2. 5	. 8
Veneta loam, loamy subsoil variant, 2 to 7 percent slopes	------	------	------	------	------	------	20	45	2. 5	2. 0	. 7
Veneta loam, loamy subsoil variant, 7 to 20 percent slopes	------	------	------	------	------	------	20	45	2. 5	2. 0	. 7
Veneta loam, loamy subsoil variant, 20 to 30 percent slopes	------	------	------	------	------	------	20	45	------	------	------
Veneta silt loam, 2 to 7 percent slopes	------	------	------	------	17	------	20	60	3. 0	2. 5	1. 0
Veneta silt loam, 7 to 20 percent slopes	------	------	------	------	17	------	20	60	4. 0	2. 5	1. 0
Waldo silty clay loam [2]	------	------	------	------	18	------	20	50	4. 0	------	------
Wapato silty clay loam [2]	------	------	------	------	18	------	20	50	4. 0	------	------
Willamette silt loam, 0 to 3 percent slopes	4. 5	8	5. 5	90	20	7	35	80	4. 5	3. 5	1. 0

See footnotes at end of table.

TABLE 2.—*Predicted average acre yields of principal irrigated and dryland crops under a high level of management*—Con.

Soil	Irrigated crops						Dryland crops				
	Bush beans	Sweet corn	Straw-berries	Pepper-mint	Pas-ture	Al-falfa	Spring barley	Winter wheat	Bent-grass	Sweet cherries	Fil-berts
	Tons	*Tons*	*Tons*	*Lbs.*	*A.U.M.*[1]	*Tons*	*Cwt.*	*Bu.*	*Cwt.*	*Tons*	*Tons*
Willamette silt loam, 3 to 12 percent slopes	4. 5	8	5. 5	90	20	7	35	80	4. 5	3. 5	1. 0
Winchuck silt loam, silty subsoil variant, 2 to 7 percent slopes	------	------	--------	--------	18	5	20	60	4	--------	------
Witham silty clay loam, 2 to 7 percent slopes	------	------	--------	--------	15	------	20	45	3. 0	--------	------
Woodburn silt loam, 0 to 3 percent slopes [2]	4	8	3. 0	75	20	6	35	80	4. 0	3. 5	1. 0
Woodburn silt loam, 3 to 12 percent slopes [2]	4	8	3. 0	75	20	6	35	80	4. 0	3. 5	1. 0

[1] A.U.M. (animal-unit-month) is a term used to express the carrying capacity of pasture. It is the number of animal units, or 1,000 pounds of live weight, that can be grazed on an acre of pasture for a period of 30 days.

[2] Estimated yields are for soils that have been drained.

Lime needs to be applied at rates recommended by soil tests. To control pests and diseases, timely applications of fungicides and insecticides are necessary. Irrigation should be by sprinkler. Good water management includes such practices as proper timing, proper rate of application and distribution, and use of moisture-measuring devices. The gross irrigation water requirement is about 10 inches. Harvesting should be by mechanical bush-bean harvesters. Postharvest operations include disking twice. Conservation practices include using crop residue and planting a winter cover crop.

Group 2.—In this group are soils in capability units IIw–2, IIw–4, and IVw–2. Practices and specifications for this group are similar to those for group 1, except that soil stabilization practices are needed. These practices include a winter cover crop and permanent cover in annual overflow channels.

Group 3.—In this group are soils in capability unit IIw–5. Practices and specifications for this group are similar to those for group 1, except that soil stabilization and drainage practices are needed. These practices include a winter cover crop, permanent cover in annual overflow channels, and tile drainage.

Group 4.—In this group are soils in capability unit IIw–3. Practices and specifications for this group are similar to those for group 1, except that tile drainage is needed.

Group 5.—In this group are soils in capability unit IIe–1. Practices and specifications for this group are similar to those for group 1, except for the need of 1 to 5 tons of lime and cross-slope farming, rough tillage, and grassed waterways, or a winter cover crop and grassed waterways.

Group 6.—In this group are soils in capability unit IIe–4. Practices and specifications for this group are similar to those for group 1, except for the need of cross-slope farming and rough tillage or a winter cover crop and tile drainage.

Group 7.—In this group are soils in capability units IIw–1, IIIw–1, and IVw–1. Practices and specifications for this group are similar to those for group 1, except that clay tile or box drains are needed.

Group 8.—In this group are soils in capability units IIe–2, IIe–3, IIw–6, IIIe–1, IIIe–2, IIIe–3, IIIe–4, IVe–1, IVe–2, IVe–3, IVe–4, IVw–2, IVw–4, IVw–5, VIe–1, VIe–2, VIs–1, VIIe–1, VIIs–1, VIIw–1, and VIIIw–1. This group has soils that are too stony, too steep to cultivate, or otherwise not well suited to bush beans.

MANAGEMENT OF IRRIGATED SWEET CORN

Group 1.—In this group are soils in capability units I–1, IIs–1, and IIs–2. A suitable rotation is 2 to 3 years of sweet corn and green-manure crops and 1 to 2 years of other horticultural or field crops to improve soil tilth and reduce the disease hazard. Seedbed preparation consists of moldboard plowing and harrowing three or four times. Planting should be done with a corn planter in April and June, at a rate of 8 to 10 pounds of seed of approved varieties. Weed control can be achieved by a preplant or preemergence spray and cultivation as needed. Fertilization should include 100 to 125 pounds of nitrogen in a split application and 15 to 20 pounds of sulfur. Phosphorus and potassium need to be applied according to requirements indicated by soil tests. Liming should be at a rate of 1 to 3 tons for the legume in the rotation. Cultural practices include insect control with approved insecticide if needed. Irrigation should be by sprinkler, which is required to produce acceptable corn for processing. The gross irrigation water requirement is about 19 inches. Harvesting should be by machine. Preharvesting topping is a common practice to reduce damage by lodging and to improve machine harvesting efficiency. Conservation practices include use of crop residue.

Group 2.—In this group are soils in capability units IIw–2, IIw–4, and IVw–2. Practices and specifications for this group are similar to those for group 1, except that a winter cover crop or corn stalks left standing and a permanent cover in overflow channels are needed.

Group 3.—In this group are soils in capability unit IIw–5. Practices and specifications for this group are similar to those for group 1, except that tile drainage, winter cover crops or residue, and a permanent cover in annual overflow channels are needed.

Group 4.—In this group are soils in capability unit IIw–3. Practices and specifications for this group are similar to those for group 1, except that tile drainage is needed.

Group 5.—In this group are soils in capability unit IIe–1. Practices and specifications for this group are similar to those for group 1, except that 2 to 5 tons of lime should be applied for the legume in the rotation and cross-slope farming, rough tillage, and grassed waterways or a winter cover crop and grassed waterways are needed.

Group 6.—In this group are soils in capability unit IIe–4. Practices and specifications for this group are similar to those for group 1, except that cross-slope farming and rough tillage or a winter cover crop and tile drainage are needed.

Group 7.—In this group are soils in capability unit IIw–1. Practices and specifications for this group are similar to those for group 1, except that clay tile, box drains, or surface drainage are needed.

Group 8.—In this group are soils in capability units IIe–2, IIe–3, IIw–6, IIIe–1, IIIe–2, IIIe–3, IIIe–4, IIIw–1, IVe–1, IVe–2, IVe–3, IVe–4, IVw–1, IVw–4, IVw–5, VIe–1, VIe–2, VIs–1, VIIe–1, VIIs–1, VIIw–1, and VIIIw–1. This group has soils that are too stony, too steep to cultivate, or otherwise not well suited to sweet corn.

MANAGEMENT FOR IRRIGATED STRAWBERRIES

Group 1.—In this group are soils in capability units I–1, IIs–1, and IIs–2. A suitable rotation is 3 or 4 years of bearing strawberries and 4 or 5 years of crops other than legumes. Seedbed preparation consists of moldboard plowing, disking two or three times, harrowing two or three times, chiseling in fall, and land grading where needed. Planting can be done by machine in spring by using an acceptable processing variety and plant spacing of 18 to 22 inches and row spacing of 36 to 42 inches. Cultipack after planting. Chemicals are applied for weed control. Cultivate two to four times and hand hoe. Control runners and mow tops as an aid in sanitation and harvesting. Herbicides are applied in fall. To establish the crop, fertilizer needs include 60 to 90 pounds of nitrogen, 35 to 50 pounds of phosphorus, 65 to 100 pounds of potassium, and a sidedressing of 20 to 30 pounds of nitrogen in August. After establishment, annual rates are 60 to 90 pounds of nitrogen, 35 to 45 pounds of phosphorus, 65 to 100 pounds of potassium, 15 to 20 pounds of sulfur, and 1 pound of boron applied as a spray. If it is cold and wet in spring, apply 30 pounds of nitrogen and 20 pounds of phosphorus. Use boron soil test to determine the specific requirement. Lime is applied at a rate of 1 to 2 tons for the legumes in the rotation.

Strawberries are susceptible to a number of soil insects and diseases. Preplant soil fumigation is profitable in places, considering the high establishment costs and high gross-return potential. Soil insecticides are used for root weevil. Spraying is done five to six times to control insects and disease in spring and summer. Many weed, insect, and disease hazards can be controlled by following current recommendations for using approved pesticides. Irrigation should be by sprinkler. Good water management includes such practices as proper timing, proper rate of application and distribution, and use of moisture-measuring devices. Maintaining moisture at 75 percent or more of field capacity improves quantity and quality of crops. Supplemental water supplied by irrigation is required to produce maximum tonnage. Irrigation is generally required throughout the harvest season, which presents special management problems of timing rates and intervals that may conflict with hand harvesting requirements of 2- to 4-day intervals. The gross irrigation water requirement is about 16 inches. After harvest is complete the strawberries are allowed to go dormant until mid-August, when irrigation water and fertilizer are applied to begin new growth to maximize the following year's crop.

Group 2.—In this group are soils in capability units IIw–2, IIw–4, and IVw–2. Practices and specifications for this group are similar to those for group 1, except that winter cover and a permanent cover in annual overflow channels are needed.

Group 3.—In this group are soils in capability unit IIe–1. Practices and specifications for this group are similar to those for group 1, except that cross-slope farming, rough tillage, and grassed waterways or a winter cover crop and grassed waterways are needed.

Group 4.—In this group are soils in capability unit IIe–4. Practices and specifications for this group are similar to those for group 1, except that cross-slope farming and rough tillage or a winter cover and tile drainage are needed.

Group 5.—In this group are soils in capability units IIw–1, and IIw–3. Practices and specifications for this group are similar to those for group 1, except that clay tile is needed.

Group 6.—In this group are soils in capability unit IIw–5. Practices and specifications for this group are similar to those for group 1, except that winter cover, a permanent cover in annual overflow channels, and tile drainage are needed.

Group 7.—In this group are soils in capability units IIe–2, IIe–3, IIw–6, IIIe–1, IIIe–2, IIIe–3, IIIe–4, IIIw–1, IVe–1, IVe–2, IVe–3, IVe–4, IVw–1, IVw–4, IVw–5, VIe–1, VIe–2, VIs–1, VIIe–1, VIIs–1, VIIw–1, and VIIIw–1. This group has soils that are poorly drained; too droughty, too stony, too steep to cultivate; or otherwise not well suited to strawberries.

MANAGEMENT FOR IRRIGATED PEPPERMINT

Group 1.—In this group are soils in capability units I–1, IIs–1, and IIs–2. A common rotation is at least 5 to 8 years of mint followed by a row crop, cereal grain, or a grass or legume. Mint is seldom rotated back on the same field because of mint wilt, caused by an organism that lives in the soil for a long period. Seedbed preparation consists of moldboard plowing, disking two or three times, harrowing two or three times, and rolling. Planting should be done by a row planter in April or May, using disease free, healthy, viable root stock. Dry root stocks are a common cause of poor stands. Row spacings should be about 36 to 42 inches. Fertilizer rates should be 150 to 200 pounds of nitrogen, 35 to 55 pounds of phosphorus, and 45 to 70 pounds of potassium. About 30 pounds of sulfur should be applied each year. Fields needing lime should have an application before planting.

Weed control is achieved by using chemicals during pregrowth and cultivating by hand and machine and using chemicals during the growing season. To control pests and diseases, timely applications of fungicides and insecticides are necessary. Irrigation is essential for successful mint

production. Shallow-rooting characteristics of mint make irrigation management practices particularly important. On some soils mint requires irrigation every 3 or 4 days to maintain a minimum of 75 percent of field capacity, which increases yield significantly. Irrigation should be by sprinkler. Good water management includes such practices as proper timing, proper rate of application and distribution, and use of moisture-measuring devices. Gross irrigation water requirement is about 14 inches. However, much of the peppermint is excessively irrigated. Excess quantity per application does not offset the need for frequent applications.

Group 2.—In this group are soils in capability units IIw–2, IIw–4, and IVw–2. Practices and specifications for this group are similar to those for group 1, except that a winter cover and a permanent cover in annual overflow channels are needed.

Group 3.—In this group are soils in capability unit IIw–5. Practices and specifications for this group are similar to those for group 1, except that a winter cover, a permanent cover in annual overflow channels, and tile drainage are needed.

Group 4.—In this group are soils in capability units IIw–1 and IIw–3. Practices and specifications for this group are similar to those for group 1, except that tile drainage is needed.

Group 5.—In this group are soils in capability unit IIe–1. Practices and specifications for this group are similar to those for group 1, except that cross-slope farming and rough tillage or a winter cover crop are needed.

Group 6.—In this group are soils in capability unit IIe–4. Practices and specifications for this group are similar to those for group 1, except that cross-slope farming and rough tillage or a winter cover crop and tile drainage are needed.

Group 7.—In this group are soils in capability units IIe–2, IIe–3, IIw–6, IIIe–1, IIIe–2, IIIe–3, IIIe–4, IIIw–1, IVe–1, IVe–2, IVe–3, IVe–4, IVw–1, IVw–4, IVw–5, VIe–1, VIe–2, VIs–1, VIIe–1, VIIs–1, VIIw–1, and VIIIw–1. This group of capability units has soils that are poorly drained; too droughty, too stony, too steep to cultivate; or otherwise not well suited to peppermint.

MANAGEMENT OF IRRIGATED PASTURE

Group 1.—In this graup are soils in capability units I–1, IIs–1, and IIs–2. A suitable rotation is 4 to 8 years of pasture and 2 to 3 years of other field crops. Seedbed preparation consists of moldboard plowing, disking two to three times, harrowing two to five times, and cultipacking. Preplant operations should insure killing of undesirable perennial plants, particularly bentgrass. To establish the stand, fertilizer needs include 30 pounds of nitrogen, 20 to 30 pounds of sulfur, and 2 to 3 pounds of boron. Phosphorus and potassium need to be applied according to requirements indicated by soil tests. After the stand is established, annual applications should be 40 pounds of nitrogen and 20 to 30 pounds of sulfur late in February or early in March, followed by 30 to 40 pounds of additional nitrogen in split applications in May and August. Phosphorus, potassium, and boron need to be applied according to requirements indicated by soil tests. Liming should be at a rate of 1 to 3 tons.

Suitable seeding mixtures, using currently recommended varieties, are 10 pounds of orchardgrass and 2 pounds of white clover, 12 pounds of alta fescue and 2 pounds of white clover, or 10 pounds of orchardgrass and 5 pounds of alfalfa. Suitable planting dates are April 15 to June 1 or September 1 to 15. Irrigation should be by sprinkler. Good water management includes such practices as proper timing, proper rate of application and distribution, and use of moisture-measuring devices. The gross irrigation water requirement is about 22 inches during June 1 to September 20. Pasture management includes division of fields to provide 1 day of grazing per field or green chopping and feeding in dry lot. Twenty-four to 35 days should be allowed for regrowth, and the pasture should not be grazed while being irrigated. Pastures can be divided to provide for a weekly rotation, and 20 to 30 days should be allowed for regrowth. The season of use should be April through October. Weed control involves clipping three or four times per season and spot spraying with herbicide. Dung is spread three or four times per season with a spike-tooth harrow.

Group 2.—In this group are soils in capability units IIw–2, IIw–4, IIw–6, and IVw–2. Practices and specifications for this group are similar to those for group 1, except that spring planting dates are about May 15 to June 15 and a permanent cover is needed in annual overflow channels.

Group 3.—In this group are soils in capability units IIe–1, IIe–3, and IIe–4. Practices and specifications for this group are similar to those for group 1, except that cross-slope farming and grassed waterways are needed.

Group 4.—In this group are soils in capability unit IIIe–3. Practices and specifications for this group are similar to those for group 1, except that planting dates are April 15 to May 15 and cross-slope or contour farming and grassed waterways and liming at a rate of 2 to 5 tons are needed.

Group 5.—In this group are soils in capability units IVw–1, IVw–4, and IVw–5. Practices and specifications for this group are similar to those for group 1, except that the seeding mixture should be 6 pounds of alta fescue, 4 pounds of timothy, 2 pounds of white clover, 2 pounds of big trefoil or 15 pounds of perennial ryegrass and 2 pounds of white clover; also, tile drains and land grading for drainage are needed.

Group 6.—In this group are soils in capability unit IIw–5. Practices and specifications for this group are similar to those for group 1, except that the spring planting should be done from May 15 to June 15 and a permanent cover in annual overflow channels and tile drainage are needed.

Group 7.—In this group are soils in capability units IIw–1 and IIw–3. Practices and specifications for this group are similar to those for group 1, except that clay tile is needed.

Group 8.—In this group are soils in capability unit IIIw–1. Practices and specifications for this group are similar to those for group 1, except that the seeding mixture should be 6 pounds of alta fescue, 4 pounds of timothy, 2 pounds of white clover and 2 pounds of big trefoil or 15 pounds of perennial ryegrass and 2 pounds of white clover; also, tile drainage is needed.

Group 9.—In this group are soils in capability units IIe–2, IIIe–1, IIIe–2, IIIe–4, IVe–1, IVe–2, IVe–3, IVe–4, VIe–1, VIe–2, VIs–1, VIIe–1, VIIs–1, VIIw–1, VIIIw–1.

This group has soils that are too stony, too shallow, or too steep to cultivate, or that are otherwise not well suited to irrigated pasture.

MANAGEMENT OF IRRIGATED ALFALFA

Group 1.—In this group are soils in capability units I–1, IIs–1, and IIs–2. A suitable rotation is 4 to 5 years of alfalfa followed by 3 to 4 years of horticultural or field crops. Seedbed preparation involves moldboard plowing, disking two to five times, harrowing two to five times, and cultipacking. To establish the crop, boron, lime, phosphorus, and potassium need to be applied according to requirements indicated by soil tests, and sulfur at a rate of 20 to 40 pounds. Phosphorus, potassium, and boron need to be applied annually according to requirements indicated by soil tests, and sulfur is needed at a rate of 20 to 30 pounds. A currently recommended variety of the crop, inoculated and drilled immediately at a rate of 10 to 15 pounds per acre, should be planted May 1 to June 10 or August 15 to September 15. Correct inoculation procedures are important. Irrigation should be by sprinkler. Good water management includes such practices as proper timing, proper rate of application and distribution, and use of moisture-measuring devices. The gross water requirement is about 22 inches.

Clipping and herbicides should be used to control weeds during the year of establishment. Clean stands can be established by preplant and postplant use of recommended herbicides. On established stands herbicides should be used in October and in November to partially control grasses and broadleaf weeds. Harvesting involves mowing, conditioning, raking, and baling, or making silage out of the first cutting and hay out of the second and third cuttings.

Group 2.—In this group are soils in capability units IIe–1, IIe–3, and IIIe–3. Practices and specifications for this group are similar to those for group 1, except that lime should be applied at a rate of 2 to 5 tons, and cross-slope farming, grassed waterways, and a winter cover crop of small grain for fall-seeded alfalfa are needed.

Group 3.—In this group are soils in capability unit IIe–4. Practices and specifications for this group are similar to those for group 1, except that cross-slope farming or a winter cover crop and tile drainage are needed.

Group 4.—In this group are soils in capability unit IIw–3. Practices and specifications for this group are similar to those for group 1, except that clay tile is needed.

Group 5.—In this group are soils in capability units IIw–2, IIw–4, IIw–6, and IVw–2. Practices and specifications for this group are similar to those for group 1, except that a permanent cover is needed in overflow channels and spring planting should be done about May 15 to June 15.

Group 6.—In this group are soils in capability unit IIw–5. Practices and specifications for this group are similar to those for group 1, except that a permanent cover is needed in overflow channels, spring planting should be done about May 15 to June 15, and tile drainage is needed.

Group 7.—In this group are soils in capability units IIe–2, IIw–1, IIIe–1, IIIe–2, IIIe–4, IIIw–1, IVe–1, IVe–2, IVe–3, IVe–4, IVw–1, IVw–4, IVw–5, VIe–1, VIe–2, VIs–1, VIIe–1, VIIs–1, VIIw–1, and VIIIw–1. This group has soils that are poorly drained; excessively drained; too shallow, too steep to cultivate; or otherwise poorly suited to irrigated alfalfa.

MANAGEMENT OF DRYLAND SPRING BARLEY

Group 1.—In this group are soils in capability units I–1, IIs–1, and IIs–2. A suitable rotation is 2 years of grain and 4 years of grasses and legumes in rotation with other crops. Seedbed preparation consists of moldboard plowing, disking, and harrowing. Fertilization includes 40 pounds of nitrogen, 40 pounds of phosphorus, and 40 pounds of potassium. Lime needs are about 1 to 3 tons, and sulfur needs are 5 to 10 pounds for the legume in the rotation. One of the currently recommended varieties should be seeded at a rate of 100 pounds per acre. Yellow dwarf virus is a serious barley disease. Early planting, in March or in April, combined with a suitable fertilizer program, reduces the effects of this disease. Several varieties have some yellow dwarf resistance. A spring application of herbicides is needed to control broadleaf weeds and annual grasses. Harvesting is done by combine. Conservation practices include use of crop residue.

Group 2.—In this group are soils in capability units IIw–2, IIw–4, IIw–6, and IVw–2. Practices and specifications for this group are similar to those for group 1, except that a winter cover crop is needed and a permanent cover should be maintained in annual overflow channels.

Group 3.—In this group are soils in capability units IIw–1 and IIw–3. Practices and specifications for this group are similar to those for group 1, except that tile drainage is needed.

Group 4.—In this group are soils in capability unit IIw–5. Practices and specifications for this group are similar to those for group 1, except that a winter cover, a permanent cover in annual overflow channels, and tile drainage are needed.

Group 5.—In this group are soils in capability units IIe–1, IIe–2, and IIe–3. Practices and specifications for this group are similar to those for group 1, except that cross-slope farming, grassed waterways, and rough tillage are needed.

Group 6.—In this group are soils in capability unit IIe–4. Practices and specifications for this group are similar to those for group 1, except that cross-slope farming and rough tillage or a winter cover crop and tile drainage are needed.

Group 7.—In this group are soils in capability units IIIe–1, IIIe–2, IIIe–3, and IIIe–4. Practices and specifications for this group are similar to those for group 1, except that lime should be applied at a rate of 2 to 5 tons for the legume in the rotation and cross-slope farming, grassed waterways, and winter cover are needed.

Group 8.—In this group are soils in capability units IVe–1 and IVe–2. Practices and specifications for this group are similar to those for group 1, except that lime should be applied at a rate of 2 to 5 tons for the legume in the rotation and field stripcropping, grassed waterways, and winter cover or rough tillage, or contour farming, grassed waterways, and winter cover crops are needed.

Group 9.—In this group are soils in capability units IIIw–1 and IVw–1. Practices and specifications for this group are similar to those for group 1, except that clay tile, box tile, or open ditches are needed. Also in this group are soils in capability unit IVw–4 and IVw–5. Practices and specifications for this group are similar to those for

group 1, except that surface drainage and open ditches are needed.

Group 10.—In this group are soils in capability units IVe–3, IVe–4, VIe–1, VIe–2, VIs–1, VIIe–1, VIIs–1, VIIw–1, and VIIIw–1. This group has soils that are too shallow, too stony, and too steep to cultivate, or that are otherwise poorly suited to spring barley.

MANAGEMENT OF DRYLAND WINTER WHEAT

Group 1.—In this group are soils in capability units I–1, IIs–1, and IIs–2. A suitable rotation is 2 years of wheat and 2 years of red clover. Seedbed preparation consists of moldboard plowing followed by disking and harrowing. Fertilization includes 20 pounds of nitrogen applied in the fall and 40 to 50 pounds applied in March. Phosphorus and potassium need to be applied in fall according to requirements indicated by soil tests. When soil pH drops below 5.5, lime needs to be applied at a rate of 2 or 3 tons for the legume in the rotation. Sulfur needs are about 10 to 20 pounds. One of the currently recommended varieties should be seeded at the rate of 60 pounds per acre after October 15. For weed control, the type of herbicide needs to be adjusted to the kind and amount of infestation. A fall application of herbicide is desirable for control of annual grasses, and a spring application is needed for broadleaf weeds. Harvesting should be done by combine. Conservation practices include use of crop residue.

Group 2.—In this group are soils in capability units IIw–2, IIw–4, IIw–6, and IVw–2. Practices and specifications for this group are similar to those for group 1, except that a permanent cover is needed in annual overflow channels.

Group 3.—In this group are soils in capability units IIw–1 and IIw–3. Practices and specifications for this group are similar to those for group 1, except that tile drainage is needed.

Group 4.—In this group are soils in capability unit IIw–5. Practices and specifications for this group are similar to those for group 1, except that tile drainage and a permanent cover in overflow channels are needed.

Group 5.—In this group are soils in capability units IIe–1, IIe–2, IIe–3, IIIe–1, IIIe–2, IIIe–3, and IIIe–4. Practices and specifications for this group are similar to those for group 1, except that lime needs to be applied at a rate of 2 to 5 tons for the legume in the rotation and cross-slope farming and grassed waterways are needed.

Group 6.—In this group are soils in capability unit IIe–4. Practices and specifications for this group are similar to those for group 1, except that cross-slope farming and rough tillage or a winter cover crop and tile drainage are needed.

Group 7.—In this group are soils in capability units IVe–1 and IVe–2. Practices and specifications for this group are similar to those for group 1, except that lime should be applied at a rate of 2 to 5 tons for the legume in the rotation and field stripcropping and grassed waterways or contour farming and grassed waterways are needed.

Group 8.—In this group are soils in capability unit IIIw–1. Practices and specifications for this group are similar to those for group 1, except that clay tile or box drains are needed.

Group 9.—In this group are soils in capability units IVe–3, IVe–4, IVw–1, IVw–4, IVw–5, VIe–1, VIe–2, VIs–1, VIIe–1, VIIs–1, VIIw–1, and VIIIw–1. This group has soils that are poorly drained; excessively drained; too shallow, too steep to cultivate; or otherwise poorly suited to winter wheat.

MANAGEMENT OF DRYLAND BENTGRASS FOR SEED

Group 1.—In this group are soils in capability units I–1, IIs–1, IIs–2, IIw–2, IIw–4, and IVw–2. A fine seedbed is necessary for original establishment, but, once established, a bentgrass stand can be renovated when necessary by plowing and working down lightly. Fertilizer should be applied at a rate of 20 to 30 pounds of nitrogen in fall and 50 to 70 pounds of nitrogen in spring. Phosphorus and potassium should be applied as required by soil tests. Weeds should be controlled by herbicides applied in fall and in spring. Planting should be done in spring or in fall, using currently recommended varieties. Harvest operations include swathing in mid-August and combining when dry.

Group 2.—In this group are soils in capability units IIw–1, IIw–3, IIw–5, IIw–6, IIIw–1, IVw–1, IVw–4, and IVw–5. Practices and specifications for this group are similar to those for group 1, except that tile drainage is needed.

Group 3.—In this group are soils in capability unit IIIe–2. Practices and specifications for this group are similar to those for group 1, except that tile drainage and a winter cover of small grain for fall seedings of grass are needed.

Group 4.—In this group are soils in capability units IIe–1, IIe–2, IIe–3, IIe–4, IIIe–1, IIIe–3, IIIe–4, and IVe–2. Practices and specifications for this group are similar to those for group 1, except that a winter cover of small grain for fall seedings of grass is needed.

Group 5.—In this group are soils in capability units IVe–1, IVe–3, IVe–4, VIe–1, VIe–2, VIs–1, VIIe–1, VIIs–1, VIIw–1, and VIIIw–1. This group has soils that are too stony and too steep to cultivate or that are otherwise not well suited to bentgrass.

MANAGEMENT OF DRYLAND SWEET CHERRIES

Group 1.—In this group are soils in capability units I–1, IIs–1, and IIs–2. Suitable seed mixtures for greenmanure crops are 60 pounds of small grain and 40 pounds of common vetch or 10 pounds of crimson clover. Spacing of trees at 35 years or older should be 30 feet, and there should be 48 trees per acre. Fertilizer rates should be 2 pounds of nitrogen per tree and boron, as needed, to correct any deficiency. Liming should be applied at a rate of 1 to 3 tons for the legume. Weed control should be by summer fallow and spraying, as required. Cultural practices include pruning and the planting of every third tree in every row to the proper variety of pollenizer tree.

Group 2.—In this group are soils in capability units IIw–2 and IIw–4. Practices and specifications for this group are similar to those for group 1, except that winter cover crops and a permanent cover in annual overflow channels are needed.

Group 3.—In this group are soils in capability units IIe–1, IIe–2, and IIIe–1. Practices and specifications for this group are similar to those for group 1, except that lime should be applied at a rate of 2 to 4 tons for the legume, and cross-slope farming and grassed waterways

and rough tillage or winter cover and grassed waterways are needed.

Group 4.—In this group are soils in capability unit IIe–4. Practices and specifications for this group are similar to those for group 1, except that cross-slope farming and rough tillage or a winter cover crop and tile drainage are needed.

Group 5.—In this group are soils in capability unit IIw–5. Practices and specifications for this group are similar to those for group 1, except that tile drainage, a winter cover crop, and a permanent cover in annual overflow channels are needed.

Group 6.—In this group are soils in capability unit IIw–3. Practices and specifications for this group are similar to those for group 1, except that clay tile is needed.

Group 7.—In this group are soils in capability units IIw–1, IIw–6, IIe–3, IIIe–2, IIIe–3, IIIe–4, IIIw–1, IVe–1, IVe–2, IVe–3, IVe–4, IVw–1, IVw–2, IVw–4, IVw–5, VIe–1, VIe–2, VIs–1, VIIe–1, VIIs–1, VIIw–1, and VIIIw–1. This group has soils that are poorly suited to sweet cherries.

MANAGEMENT OF DRYLAND FILBERTS

Group 1.—In this group are soils in capabiliy units I–1, IIs–1, and IIs–2. Spacing of trees at 15 years or older should be 20 feet by 20 feet and there would be 75 trees per acre. Fertilizer rates should be 100 to 125 pounds of nitrogen applied between February 15 and March 15. For other fertilizer requirements the county horticulturist should be consulted. Lime should be applied at a rate of 1 to 3 tons if legumes are used for a green-manure crop. Currently recommended varieties should be grown for the shelled trade. Weeds should be controlled by summer fallow and spot sprays. Cultural practices include cultivating less than 3 or 4 inches deep, controlling suckers chemically, and systematically pruning every fifth row for 5 years for rejuvenation of the entire orchard. Half the material pruned is wood. Conservation practices include use of crop residue.

Group 2.—In this group are soils in capability units IIw–2 and IIw–4. Practices and specifications for this group are similar to those for group 1, except that winter cover crops and a permanent cover in annual overflow channels are needed.

Group 3.—In this group are soils in capability unit IIw–5. Practices and specifications for this group are similar to those for group 1, except that a winter cover crop, a permanent cover in annual overflow channels, and tile drainage are needed.

Group 4.—In this group are soils in capability units IIe–1, IIe–2, and IIIe–1. Practices and specifications for this group are similar to those for group 1, except that lime should be applied at a rate of 2 to 4 tons for the legume if used for a cover crop, and cross-slope farming, grassed waterways, and rough tillage or winter cover crops and grassed waterways are needed.

Group 5.—In this group are soils in capability unit IIe–4. Practices and specifications for this group are similar to those for group 1, except that lime should be applied at a rate of 2 to 4 tons for the legume if used for a cover crop, and cross-slope farming, grassed waterways, and rough tillage or a winter cover crop, and tile drainage are needed.

Group 6.—In this group are soils in capability unit IIw–3. Practices and specifications for this group are similar to those for group 1, except that clay tile is needed.

Group 7.—In this group are soils in capability units IIe–3, IIw–1, IIw–6, IIIe–2, IIIe–3, IIIe–4, IIIw–1, IVe–1, IVe–2, IVe–3, IVe–4, IVw–1, IVw–2, IVw–4, IVw–5, VIe–1, VIe–2, VIs–1, VIIe–1, VIIs–1, VIIw–1, and IIIw–1. This group has soils that are poorly drained or excessively drained; too shallow, too stony, too steep to cultivate; or otherwise poorly suited to filberts.

Woodland [3]

This section contains interpretations of the soils in the Area for woodland use and management. The interpretive items that have been made and correlated to the survey are native tree species, site quality for Douglas-fir, understory vegetation, seedling mortality, plant competition, equipment limitations, erosion hazard, windthrow hazard, notes on special products, and land use and management.

The soils on the valley floor and many of the soils of the low foothills have almost all been cleared of timber. The foreseeable economic conditions do not indicate a return of these soils to use as woodland. These soils consequently have not been considered in this section.

Originally, the broad valley floor and low foothills were in heavy timber interspersed with openings. Most openings were made by recurring fires, some of which may have been set by Indians to maintain these openings. It was a common practice for early settlers to set fire to dry fern and grass areas early in spring to keep older burns and logged areas free of brush and trees for use as pasture.

Part of the valley floor was originally covered mainly by Douglas–fir, grand fir, and western redcedar. Ash and Oregon white oak occupied poorly drained areas. The low foothills were in stands of Douglas-fir, grand fir, and Oregon white oak. Some natural grass openings were on the south slopes.

On the upper slopes of the foothills and at higher elevations, the forests consist of Douglas-fir stands and varying amounts of red alder, bigleaf maple, western redcedar, and western hemlock. The amount of western hemlock increases with elevation. Noble fir is on the higher peaks.

There were 110,200 acres classed as commercial forest land in the Survey Area in 1963 (*12*).

A large part of the mature and overmature forests has been harvested. As a result, most of the forested area is in regrowth of even-aged stands up to 70 years old. Many of the regrowth stands, in turn, have been harvested.

Tree farms are well established and range in size from small privately owned tracts to industry-owned tracts of 30,000 acres. The level of forest management is moderately high and includes reforestation of the harvested areas by planting and seeding. A small amount of precommercial thinning, weeding, and intermediate harvest is carried out for optimum stand development.

Douglas-fir is used for lumber, plywood, poles, and piling. Alder and bigleaf maple are used mainly for furniture, whereas oak is used as fuel and for some specialized wood products. There are now 10 sawmills and 4 plywood mills operating in the survey area. There is a demand for floral greenery of conifer boughs, huckleberry, and salal

[3] WALTER M. FERGERSON, woodland conservationist, Soil Conservation Service, helped to prepare this section.

sprays and swordfern fronds. Cascara bark is used for medicine. Hemlock and true firs are used for lumber and pulp.

Woodland suitability groups of soils

Soils in the survey area have been placed in woodland groups, mainly according to their potential productivity for Douglas-fir. A woodland group consists of soils that have about the same capability for producing a similar kind of wood crop and that need about the same kind of management.

Woodland groups are identified by a three-part symbol, for example, 2c1. The first part is a numeral that corresponds to the site class or relative productivity of the soil: 1, *very high;* 2, *high;* 3, *moderately high;* 4, *moderate;* and 5, *low.*

The second part is a letter that indicates features that produce moderate or severe hazards or limitations in managing the soils for the production of wood crops. The letter *c* means that clay in the upper part of the soil is a limitation; *d*, that root depth is restricted; *f*, that the soil contains large amounts of coarse fragments; *o*, that the soil has no significant limitations for woodland management; *r*, that the soil has steep slopes; *s*, that the soils are sandy; *w*, that excessive water on or in the soil is a restriction; and *x*, that stones or rocks are a limitation.

The third part of the symbol distinguishes the groups according to degree of difficulty in applying woodland management. A numeral *3*, for example, means that woodland management is more difficult to apply than if the numeral were *1* or *2*.

Soils suited to a high level of management have certain characteristics. Generally, they have slopes of less than 30 percent and have moderate to high production potential and moderate to few serious limitations. Woodland suitability groups suited to a high level of management are 2o1, 2c1, 2c2, 2c4, and 3f2. Soils that have slopes of about 25 to 60 percent are suited, with some difficulty, to a high level of management. Very steep slopes offer increasing difficulty to such practices as thinning, pruning, and intermediate harvest cutting. The increasing difficulty of tractor logging influences the intermediate harvest cutting on such slopes. Woodland suitability groups suited to this level of management are 2c3, 2c5, 3f2, 2r1, and 3r1.

Extremely steep slopes, more than 50 or 60 percent, limit most operations. Regeneration on these slopes is practically limited to natural or artificial seeding and weeding by chemical applications. Thinning, pruning, and intermediate harvest cutting are extremely difficult on these slopes. Harvest cutting is expected to be done in blocks or areas of at least one high lead cable logging setting. Woodland suitability groups suited to this level are 3r2 and 3r3.

Woodland suitability groups 4c1, 5o1, and 5d1 have a low potential for producing commercial stands of timber and have one or more of the following limitations: very steep slopes; shallow, stony or cobbly soils; low available water capacity; and severe climatic conditions, such as heavy snow cover and high winds.

The interpretations given in this section were arrived at by observations as the survey progressed and from 52 temporary plots located to sample the important soil mapping units. The plots were located to represent the taxonomic soil mapping units at locations where natural timber stands occurred that were suitable for site determination. At each location a pit was dug or a soil boring made, and the soil was described and identified.

Tree measurements were made to determine site index by measuring an equal number of dominant and codominant trees. Where available, at least four trees were measured. Notes were made on the vegetation and on other interpretive items. These data were summarized and are shown by woodland suitability groups.

Douglas-fir is the dominant species and the only species for which complete production tables are available. Potential soil productivity, therefore, was rated only for Douglas-fir (*11*).

Potential soil productivity is expressed as site index or site class. Site index is the expected height of the dominant and codominant trees at age of 100 years. Site class is a range of site indices: Site class I, 185 plus; Site class II, 155 to 184; Site class III, 125 to 154; Site class IV, 95 to 124; Site class V, less than 95. Production shown in table 3 is for unmanaged, fully stocked, normal stands for several site indices and rotation ages and for two measurements.

Five factors that affect suitability of a site for wood products are related to the soils. These factors are equipment limitations, plant competition, seedling mortality, and the hazards of windthrow and erosion. They are discussed in the following paragraphs.

Equipment limitations are rated slight, moderate, or severe, according to the degree to which soil characteristics, such as slope, stoniness, and texture, limit the kind of equipment or the time of year the equipment can be used readily. The limitation is *slight* if the type of equip-

TABLE 3.—*Average annual growth of Douglas-fir by age and stated site classes*

PRODUCTION IN BOARD FEET PER ACRE, SCRIBNER SCALE, FOR TREES 12 INCHES OR MORE IN DIAMETER

Age	Site class III			Site class II		
	Site index 130	Site index 140	Site index 150	Site index 160	Site index 170	Site index 180
Years						
30	0	10	30	50	87	133
40	65	112	162	222	298	388
50	168	248	340	444	548	654
60	300	397	493	603	713	821
70	398	503	607	714	820	923
80	462	571	679	776	875	975
90	503	611	711	910	991	1080
100	524	628	724	818	904	989

CUBIC FEET PER ACRE, TOTAL STAND

30	99	110	120	127	137	144
40	117	131	144	154	164	172
50	126	141	155	166	177	186
60	129	145	158	170	181	191
70	130	146	158	170	181	190
80	128	142	155	167	178	186
90	124	138	150	162	173	182
100	119	133	145	156	166	176

ment use is not restricted but is limited for periods of a day or more by saturation of the soil during storms throughout the wet season, and slopes are 0 to 30 percent. The limitation is *moderate* if the type of equipment and operations are restricted by one or more factors, such as prolonged periods of saturation during the 6- to 8-month wet season, 30 to 50 percent slopes, stones, cobblestones, or outcrops. The limitation is *severe* if special equipment is needed or if the use of equipment is severely restricted by a high water table or by saturation of the soil beyond the normal 6- to 8-month wet season; more than 50 or 60 percent slopes; stones; escarpments; or lack of safety in operations.

Erosion hazard refers to the degree of potential soil erosion. For most of the soils under native plant cover, sheet erosion is not a problem. Most erosion occurs on disturbed or denuded areas, and the hazard is predicted for areas which are heavily burned and for roads, road cuts, and skid trails where water is concentrated. The rating is qualitative. The hazard is *slight* where gentle to moderate slopes and slow to medium runoff make erosion control negligible. The hazard is *moderate* where moderately steep to steep slopes having rapid runoff make erosion-control practices essential to prevent unnecessary erosion. The hazard is *severe* where very steep slopes and very rapid runoff necessitate intensive erosion-control practices, or specialized equipment and care in logging operations are needed to minimize soil disturbance.

Plant competition refers to the invasion and rate of growth of undesirable species on a soil when openings are made in the canopy. The limitation is *slight* if competition does not prevent adequate natural regeneration and early growth or does not interfere with adequate development of planted seedlings. The limitation is *moderate* if competition delays natural or artificial regeneration, both the establishment rate and the growth rate, but does not prevent the eventual development of fully stocked, normal stands. The limitation is *severe* if competition prevents adequate natural or artificial regeneration where no intensive site preparation and maintenance treatments, such as weeding, are used.

Seedling mortality refers to the expected loss of seedlings because of unfavorable soil conditions. Mortality is *slight* if not more than 25 percent of the seedlings die; *moderate* if 25 to 50 percent die, and *severe* if more than 50 percent die.

Windthrow hazard refers to the danger of trees being blown over by wind under normal conditions. These ratings are for normal stands and are not reliable for areas subject to concentration of high winds because of topography or clearcutting of adjacent areas. The limitation is *slight* where soils generally are well drained, trees are deep rooted, and windthrow presents no significant problem. It is *moderate* where rooting is restricted at moderate depths by bedrock or a seasonal water table and where a few trees are expected to blow down during periods of excessive soil moisture and high wind. It is *severe* where rooting is restricted at a shallow depth by bedrock or a seasonal water table, where many trees are expected to blow down during periods of excessive moisture and moderate or high winds, and where special management practices are needed to minimize losses.

Special woodland products are mentioned where they are significant. Such products include Christmas trees, swordfern, and greenery.

In the following paragraphs, the woodland groups are discussed. Not all soils in the survey area have been placed in these groups, because some of the soils are too extensively used for other crops of high value. Other soils are not well suited to conifers. The names of soil series represented are mentioned in the descripiton of each woodland group, but this does not mean that all soils in a given series are in the group. To find the names of all soils in any given woodland group, refer to the "Guide to Mapping Units" at the back of this soil survey.

WOODLAND SUITABILITY GROUP 2c1

This group consists of well-drained silty clay loams in the Apt, Honeygrove, and Peavine series. These soils occupy uplands and have slopes of 3 to 30 percent. Elevation ranges from 750 to 1,100 feet. Average annual precipitation is 60 to 90 inches, average annual air temperature is 48° to 50° F., and the growing season is 160 to 190 days.

Roots can penetrate to a depth of 20 to 40 inches or more. Available water capacity is 6 to 11 inches. Permeability is moderately slow. Runoff is medium to rapid. The hazard of erosion is moderate to high.

These soils produce good stands of Douglas-fir. Bigleaf maple and alder are common. Small amounts of western hemlock are at higher elevations. Other plants are brackenfern, vine maple, hazelnut, oceanspray, and swordfern.

Soils of this group are in site class II and have a site index of 160 to 180.

Equipment limitations are moderate. Trafficability is limited during wet seasons, when the soils are unstable. The soils are sticky and plastic when wet and are easily compacted.

Roads and landings need to be carefully laid out and protected from erosion by use of water-control structures. Roads on these soils require a maximum amount of base rock for all-season use. A few small areas of the soils in this group are used for pasture and other crops.

Plant competition is moderate. Old, nonstocked, cutover areas present special problems of competition from brush, fern, and alder in places.

Seedling mortality is slight. The climate favors tree growth. Natural regeneration is generally adequate, but supplemental site preparation and planting are necessary in places. Weeding and thinning generally are needed for best stand development.

The hazard of windthrow is slight.

Swordfern is an important commercial crop. These soils are well suited to Christmas trees.

WOODLAND SUITABILITY GROUP 2c2

This group consists of well-drained silty clay loams in the Apt, Blachly, and Honeygrove series. These soils occupy uplands and have slopes of 3 to 30 percent. Elevation ranges from 750 to 2,200 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is about 48° to 50° F., and the growing season is about 150 to 190 days.

Roots can penetrate to a depth of 40 inches or more. Available water capacity is 7 to 11 inches. Permeability is moderately slow. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

These soils produce good stands of Douglas-fir. Bigleaf maple is common. Western hemlock is mixed with fir at elevations above 1,500 feet. Red alder seeds in readily in disturbed areas. Understory plants are vine maple, red huckleberry, swordfern, oxalis, salal, and others.

Soils of this group are in site class II. Site index generally is 165, but measurements indicate that, above elevations of 1,500 feet, Blachly soils are 10 feet lower in site index in places.

Equipment limitations are moderate to severe. When road cuts are made through these soils, they are unstable when wet and are subject to a severe slide hazard. If possible, logging roads should be placed on upper surfaces or ridges to avoid excessive soil disturbance caused by large cuts and fills. When wet, these soils are sticky and plastic and compact easily, and the operation of equipment causes excessive soil disturbance.

Roads and landings and other critical areas need special attention to avoid erosion. Water bars, diversions, and seedings are needed. Roads on these soils require adequate amounts of base rock for all-season use.

Plant competition is moderate, and it develops rapidly after stand removal.

Seedling mortality is slight. These soils have favorable climatic conditions for tree growth. Natural regeneration is generally good, but supplemental site preparation, seeding, or planting are needed in places. Weeding and thinning are needed for good stand development.

The hazard of windthrow is slight.

Swordfern is an important commercial crop. These soils are well suited to Christmas trees.

WOODLAND SUITABILITY GROUP 2c3

This group consists of well-drained silty clay loams in the Apt, Blachly, Honeygrove, and Peavine series. They occupy uplands and have slopes of 25 to 60 percent. Elevation ranges from 750 to 2,200 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is about 48° to 50° F., and the growing season is about 150 to 190 days.

Roots can penetrate to a depth of 20 to 40 inches or more. Available water capacity is 6 to 11 inches. Permeability is moderately slow. Runoff is rapid, and the hazard of erosion is high.

These soils produce good stands of Douglas-fir. Bigleaf maple is common. Western hemlock is mixed with fir at elevations above 1,500 feet. Alder seeds in readily in disturbed areas. Understory plants are vine maple, red huckleberry, swordfern, oxalis, salal, and others.

Soils of this group are in site class II. Site index for the Blachly, Apt, and Honeygrove soils is 165 and generally is 160 for the Peavine soil, but measurement indicates that, above elevations of 1,500 feet, Blachly soils are 10 feet lower in site index in places.

Equipment limitations are moderate to severe. Trafficability is restricted by steepness and during wet seasons. When wet, these soils are unstable and are sticky and plastic and compact easily. Operation of equipment causes excessive soil disturbance.

Roads, landings, and other critical areas need special attention to avoid erosion. Water bars, diversions, and seedings are needed. Roads on these soils require adequate amounts of base rock for all-season use.

Plant competition is moderate. It develops rapidly after stand removal.

Seedling mortality is slight. These soils have favorable climatic conditions for tree growth. Natural regeneration is generally good, but supplemental site preparation, seeding, and planting are needed in places. Weeding and thinning are needed for good stand development.

The hazard of windthrow is slight.

Swordfern is an important commercial crop. These soils are not well suited to Christmas trees, because steepness causes difficulty in management and harvesting.

WOODLAND SUITABILITY GROUP 2c4

This group consists of well-drained silty clay loams and gravelly silty clay loams in the Bellpine, Jory, Price, and Ritner series. These soils occupy uplands and have slopes of 2 to 30 percent. Elevation ranges from 300 to 1,800 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is 49° to 54° F., and the growing season is 165 to 200 days.

Roots can penetrate to a depth of 20 to more than 40 inches. Available water capacity is 3.5 to 11 inches. Permeability is moderately slow to slow. Runoff is slow to rapid, and the hazard of erosion is slight to high.

These soils produce good stands of Douglas-fir. Oregon white oak mixed with Douglas-fir and grand fir are in places at lower elevations, especially on the Bellpine soils. Bigleaf maple and dogwood are common. Other plants include brackenfern, madrone, hazel, poison-oak, snowberry, and trailing blackberry.

Most of the soils of this group are in site class II. Site index generally is 155 to 160, but the moderately deep Bellpine soils have a site index of about 10 feet less in places at lower elevations.

Equipment limitations are moderate. Trafficability is limited during wet periods, when the soils are plastic and sticky and easily compacted. In places, roads and landings need water bars and grass seeding of cuts and fills to prevent erosion. Roads on these soils require a maximum amount of base rock for all-season use. Some areas of the soils in this group have been cleared and used for pasture and other crops.

Plant competition is moderate. Nonstocked, cutover areas present special problems of competition from grass, brush, and fern in places.

Seedling mortality is moderate. Natural regeneration is generally adequate, but supplemental site preparation and seeding or planting are needed in places.

The hazard of windthrow is slight.

These soils are well suited to Christmas trees.

WOODLAND SUITABILITY GROUP 2c5

This group consists of well-drained silty clay loam and gravelly silty clay loams in the Bellpine, Jory, Price, and Ritner series. These soils have slopes of 30 to 60 percent. About 10 percent of the group has slopes of more than 60 percent. Elevation ranges from 300 to 1,800 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is 49° to 52° F., and the growing season is 165 to 200 days.

Roots penetrate to a depth of 20 to more than 40 inches. Available water capacity is 6 to 11 inches. Permeability is is moderately slow to slow. Runoff is rapid to very rapid, and the hazard of erosion is high.

These soils produce good stands of Douglas-fir. Oregon white oak mixed with Douglas-fir and grand fir are in some places at the lower elevations, especially on the Bellpine soil. Bigleaf maple and dogwood are common. Other plants include brackenfern, madrone, hazel, poison-oak, snowberry, and trailing blackberry.

Most of the soils of this group are in site class II. Site index generally is 155 to 160, but the moderately deep Bellpine soil has a site index of about 10 feet less in places at lower elevations.

Equipment limitations are moderate to severe. Steepness limits some operations to cable logging.

Construction and maintenance of roads are difficult because of steepness and the hazard of slide.

Plant competition is moderate. Nonstocked, cutover areas present special problems of competition from grass, brush, and fern in places.

Natural regeneration is usually adequate, but supplemental site preparation and planting are needed in places.

The hazard of windthrow is slight.

These soils are not well suited to Christmas trees, because steepness causes difficulty in management and harvest operations.

WOODLAND SUITABILITY GROUP 2o1

This group consists of well-drained gravelly loams in the Marty and Slickrock series. These soils occupy uplands and have slopes of 3 to 25 percent. Elevation ranges from 800 to 3,000 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is about 46° to 50° F., and the growing season is 145 to 190 days.

Roots can penetrate to a depth of 40 to more than 60 inches. Available water capacity is 5 to 12 inches. Permeability is moderate or moderately slow. Runoff is medium, and the hazard of erosion is moderate.

These soils produce good stands of Douglas-fir. Bigleaf maple is common. Alder seeds in readily in disturbed areas. Western hemlock is generally in the understory and in mixtures with fir at higher elevations. Understory plants are vine maple, swordfern, brackenfern, oxalis. salal, and red huckleberry.

Soils of this group are in site class II. Site index for the Slickrock soils is 165, and site index for the Marty soils is 160. Measurements indicate that, above elevations of 2,000 feet, Slickrock and Marty soils are 10 feet lower in site index in places.

Equipment limitations are slight. Trafficability is good, except during very wet periods. Limitations to operation any kind of vehicle are few.

Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition generally is moderate, but it is severe at the lower elevations and in moist areas. In moist area, salal, brackenfern, and vine maple are very aggressive and often prevent establishment of conifers.

Seedling mortality is slight. These soils have favorable climatic conditions for tree growth. Natural regeneration is generally good, but supplemental site preparation, seeding, and planting are needed in places. Weeding and thinning are needed for good stand development.

The hazard of windthrow is slight.

Swordfern is abundant and is a good source of greenery. These soils are well suited to Christmas trees.

WOODLAND SUITABILITY GROUP 2r1

This group consists of well-drained gravelly loams in the Marty and Slickrock series. These soils occupy uplands and have slopes of 25 to 60 percent. Elevation ranges from 800 to 3,000 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is about 46° to 50° F., and the growing season is 145 to 190 days.

Roots can penetrate to a depth of 40 to more than 60 inches. Available water capacity is 5 to 12 inches. Permeablity is moderate or moderately slow. Runoff is rapid, and the hazard of erosion is high.

The soils produce good stands of Douglas-fir. Bigleaf maple is common. Western hemlock is mixed with fir above elevations of 1,500 feet. Alder seeds in readily in disturbed areas. Understory plants includes vine maple, swordfern, brackenfern, salal, and red huckleberry.

Soils of this group are in site class II. Site index for the Slickrock soils is 165, and site index for the Marty soils is 160. Measurement indicates that, above elevations of 2,000 feet, these Slickrock and Marty soils are 10 to 15 feet lower in site index in places.

Equipment limitations are moderate to severe. Trafficability is restricted by steepness. It is also restricted during very wet periods. In some areas cable logging is necessary because tractor logging causes excessive soil disturbance.

Roads and landings need water bars and grass seeding to prevent erosion. Roads on these soils require a minimum of base rock for all-season use.

Plant competition is moderate, but it is severe at lower elevations in some places because of competition from salal, fern, vine maple, and alder.

Seedling mortality is slight. These soils have favorable climatic conditions for tree growth. Natural regeneration is generally good, but supplemental site preparation, seeding, and planting are needed in places. Weeding and thinning are needed for good stand development.

The hazard of windthrow is slight.

Swordfern is an important commercial crop. These soils are not well suited to Christmas trees, because steepness causes difficulty in management and harvesting operations.

WOODLAND SUITABILITY GROUP 3f1

The only mapping unit in this group is the Ritner-Price complex, 12 to 30 percent slopes. These are well-drained gravelly silty clays and silty clay loams. Elevation ranges from 600 to 1,800 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is 49° to 54° F., and the growing season is about 165 to 200 days.

Roots can penetrate to a depth of 30 to 40 inches. Available water capacity is 3 to 6 inches. Permeability is moderately slow. Runoff is rapid, and the hazard of erosion is moderate to high.

These soils produce good stands of Douglas-fir. Bigleaf maple is common, particularly on northern slopes. Oregon white oak and mixed stands of oak-fir are common at lower elevations. Understory plants include poison-oak, hazel, trailing blackberry, snowberry, and brackenfern.

These soils are in site class III. Site index is 130.

Equipment limitations are moderate. The soils are stable, and trafficability is good. Stones interfere with such operations as site preparation, planting, and road

building. The soil forms a good road base, and cuts are quite stable.

Roads and landings should be protected with water bars and grass seeding to prevent erosion.

Plant competition is moderate, and it develops moderately slowly after stand removal. Old, nonstocked, cutover areas present special problems because of plant competition.

Seedling motality is moderate. Some loss can be expected from drought, particularly on southern slopes. Natural regeneration sometimes is spotty. Where this occurs, site preparation, seeding, and planting are needed. Weeding and thinning are needed for good stand development in places.

The hazard of windthrow is slight.

This soil is suited to Christmas trees.

WOODLAND SUITABILITY GROUP 3f2

The only soil in this group is Klickitat gravelly clay loam, 30 to 50 percent slopes. It is well drained and occupies uplands. Elevation ranges from 900 to 3,500 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is 45° to 50° F., and the growing season is 120 to 150 days.

Roots penetrate to a depth of about 24 to 50 inches. Available water capacity is 2 to 4 inches. Permeability is moderate. Runoff is rapid, and the hazard of erosion is high.

This soil produces good stands of Douglas-fir. Bigleaf maple is common, and alder is on lower parts of slopes. Hemlock is mixed with Douglas-fir at higher elevations. Common understory plants are salal, vine maple, oceanspray, trailing blackberry, and brackenfern.

This soil is in site class III. The site index is 140.

Equipment limitations are moderate to severe. Steepness limits some operations to cable logging and aerial seeding and weeding. Steepness, stones, and rock outcrops interfere with such operations as site preparation, planting, road building, and intermediate harvest cutting by tractor logging.

Construction and maintenance of roads is difficult because of steepness and rock outcrops. Roads and landings need to be carefully located, and water bars are needed to prevent erosion. Grass needs to be seeded in some critical aras to prevent erosion.

Plant competition is moderate; however, competition by grass on southern exposures is severe in places.

Seedling mortality is moderate. Natural regeneration generally is adequate, but supplemental site preparation and planting are needed in places.

The hazard of windthrow is slight, except for the inclusions of shallow soils, where it is severe.

This soil is not well suited to Christmas trees, because of steepness.

WOODLAND SUITABILITY GROUP 3r1

The only soil in this group is Bohannon gravelly loam, 25 to 50 percent slopes. This soil is well drained and occupies uplands. Elevation ranges from 1,000 to 3,500 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is about 46° to 50° F., and the growing season is 145 to 190 days.

Roots can penetrate to a depth of 20 to 40 inches. Available water capacity is 3 to 6 inches. Permeability is moderately rapid. Runoff is rapid, and the hazard of erosion is high.

This soil produces good stands of Douglas-fir. Bigleaf maple is common. Alder seeds in readily in disturbed areas. Western hemlock is generally in the understory and in mixture with fir at higher elevations. Understory plants are vine maple, swordfern, brackenfern, oxalis, salal, and red huckleberry.

This soil is in site class III. Site index is 145.

Equipment limitations are moderate to severe. Trafficability is good, except during very wet periods. Steepness limits some operations to cable logging and aerial seeding and weeding. Other operations, such as site preparation, planting, road building, and intermediate harvest cutting by tractor logging, are affected by steepness, shallowness, and stoniness.

Roads and landings need water bars and grass seeding to prevent erosion.

Plant competition generally is moderate, but it is severe at lower elevations. At lower elevations, salal, brackenfern, and vine maple are very aggressive and often retard establishment of conifers.

Seedling mortality is moderate. Natural regeneration is generally good, but supplemental site preparation, seeding, and planting are needed in places.

The hazard of windthrow is slight, except in included areas of more shallow soils.

Swordfern is abundant and is a good source of greenery. This soil is not well suited to Christmas trees, because of steepness.

WOODLAND SUITABILITY GROUP 3r2

This group consists of well-drained gravelly loams and gravelly clay loams in the Bohannan and Klickitat series. These soils occupy uplands and have slopes of 50 to 75 percent. Elevation ranges from 900 to 3,500 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is 45° to 50° F., and the growing season is 120 to 190 days.

Roots can penetrate to a depth of about 20 to 40 inches. Available water capacity is 2 to 6 inches. Permeability is moderately rapid to moderate. Runoff is very rapid, and the hazard of erosion is high.

These soils produce good stands of Douglas-fir. Bigleaf maple is common, and alder occurs on lower parts of slopes. Hemlock is mixed with fir at higher elevations. Common understory plants are salal, vine maple, oceanspray, red huckleberry, and brackenfern.

The soils in this group are in site class III. The site index for the Klickitat soils is 140. It is 145 for the Bohannon soils.

Equipment limitations are severe. The very steep slopes limit most operations to cable logging and aerial seeding and weeding. Very steep slopes, stones, and rock outcrops interfere with such operations as site preparation, planting, road building, and intermediate harvest cutting by tractor logging.

Construction and maintenance of roads is difficult because of very steep slopes and rock outcrops. Roads and landings need to be carefully located, and they need water bars in places to prevent erosion. Grass needs to be seeded in some critical areas to prevent erosion.

Plant competition is moderate. Competitive plants develop slowly after stand removal, but competition from grass on south exposures is moderate to severe.

Seedling mortality is moderate. Natural regeneration generally is adequate, but supplemental planting is needed in places.

The hazard of windthrow generally is slight, but in included areas of more shallow soils it is severe.

These soils are not well suited to Christmas trees, because the very steep slopes cause difficulty in management and harvest.

WOODLAND SUITABILITY GROUP 3r3

The only mapping unit in this group is Ritner-Price complex, 30 to 75 percent slopes. These are well-drained gravelly silty clay loams and silty clay loams. Elevation ranges from 600 to 1,800 feet. Average annual precipitation is 40 to 60 inches, average annual air temperature is 49° to 54° F., and the growing season is about 165 to 200 days.

Roots can penetrate to a depth of 30 to 40 inches. Available water capacity is 3 to 6 inches. Permeability is moderately slow. Runoff is very rapid, and the hazard of erosion is high.

These soils produce good stands of Douglas-fir. Bigleaf maple is common, particularly on northern slopes. Oregon white oak and mixed stands of oak-fir are common at lower elevations. Understory plants include poison-oak, hazel, trailing blackberry, snowberry, and brackenfern.

These soils are in site class III. Site index is 130.

Equipment limitations are severe. Steep to very steep slopes interfere with such operations as site preparation, planting, road building, and intermediate harvest cutting by tractor logging. Most operations are limited to cable logging.

The hazard of windthrow is slight.

These soils are not suited to Christmas trees, because the steep slopes cause difficulty in management and harvest operations.

WOODLAND SUITABILITY GROUP 4c1

This group consists of well-drained silty clay loams in the Dixonville series. These soils occupy uplands and have slopes of 3 to 50 percent. Elevation ranges from 350 to 1,000 feet. Average annual precipitation is 40 to 60 inches, average annual temperature is 52° to 54° F., and the growing season is 165 to 200 days.

Roots can penetrate to a depth of 20 to about 40 inches. Available water capacity ranges from 3 to 7 inches. Permeability is slow. Runoff is medium to very rapid, and the hazard of erosion is slight to high.

These soils have a low capability for producing commercial stands of conifers. Production of oak is moderate. The most common vegetation on these soils at lower elevations is grass and widely spaced clumps of Oregon white oak. Douglas-fir is at higher elevations in mixed stands with Oregon white oak. Common shrubs are poison-oak, wild rose, and snowberry.

These soils are in site class IV. Site index is 110.

Most areas of these soils are at lower elevations, and they are used for unimproved pasture. A few small areas are in improved pasture and cultivation.

Equipment limitations are moderate on these soils. When these soils are wet, they are sticky and plastic. The limitations to vehicle operation are severe because the vehicles cause excessive soil disturbance.

Roads and landings need protection against erosion in places. Construction of water-control structures and seeding of cuts and fills is necessary in places.

Plant competition for Douglas-fir from grasses and oak is severe.

Seedling mortality is severe. Natural regeneration of Douglas-fir is slow because of severe grass and oak competition. Supplemental site preparation and plantings are necessary.

The hazard of windthrow is slight.

Areas that have slopes of less than 20 percent are suited to Christmas trees. Steeper slopes make management and harvesting difficult.

WOODLAND SUITABILITY GROUP 5d1

This group consists of well-drained or excessively drained very cobbly loams in the Kilchis and Witzel series. These soils occupy uplands and have slopes of 30 to 100 percent. Elevation ranges from 500 to 4,000 feet. Average annual precipitation is 40 to 120 inches, average annual air temperature is 45° to 52° F., and the growing season is about 120 to 200 days.

Roots can penetrate to a depth of 12 to 20 inches. Available water capacity is 1 to 3 inches. Permeability is moderately rapid to moderately slow. Runoff is very rapid, and the hazard of erosion is high.

These soils produce Douglas-fir in clumps interspersed with wide spacings and openings of grass and fern. Hemlock is intermingled with Douglas-fir at high elevations, and noble fir is on the highest peaks. Understory plants include vine maple, salal, red huckleberry, thimbleberry, and, at high elevations, blue huckleberry.

Soils of this group are in site class V.

Equipment limitations are severe. The very steep slopes limit most operations to cable logging and aerial seeding and weeding.

Construction and maintenance of roads is difficult because of very steep slopes, rock outcrops, and shallow cobbly soils.

Plant competition is severe, and it develops slowly after stand removal.

Seedling mortality is severe. The soils are shallow and droughty, particularly on south slopes. Natural regeneration is often spotty or lacking. Natural or aerial seeding is the only available method to regenerate stands.

The hazard of windthrow is severe because of limited soil depth.

These soils are not suited to Christmas trees, because the very steep slopes make management and harvesting operations difficult. They have marginal suitability for the production of wood crops but are suited to some recreational uses and to watershed. The existing stands should be managed so that the least possible disturbance of the soil occurs.

WOODLAND SUITABILITY GROUP 5o1

The only soil in this group is Mulkey loam, 5 to 25 percent slopes. This soil is well drained. Elevation ranges from 3,000 to 4,000 feet. Average annual precipitation is 60 to 120 inches, average annual air temperature is about 43° to 45° F., and the growing season is about 120 to 150 days.

Roots can penetrate to a depth of 20 to 40 inches. The

available water capacity is 3 to 6.5 inches. Permeability is moderately rapid. Runoff is medium, and the hazard of erosion is moderate.

A high percentage of this soil is in grass, brackenfern, and sedges. Where trees have been established, noble fir is on this soil, and it is often mixed with hemlock and Douglas-fir.

This soil is in site class V.

Equipment limitations are slight to moderate. Trafficability is good, except during very wet periods when this soil is compacted in places. This soil is usually covered with snow in winter and spring.

Roads and landings need to be carefully laid out and protected from erosion.

Plant competition is moderate. Nonstocked areas present special problems of competition from grass and fern in places.

Seedling mortality is moderate. Natural regeneration is not adequate, and some supplemental site preparation and planting is needed in places.

The hazard of windthrow is moderate.

This soil has marginal suitability for timber, but it is suited to watershed and to some recreational uses. The existing timber stands should be protected from fire, insects, and disease. Excessive soil disturbance should be avoided.

Wildlife [4]

This section describes the potential of the soils of the Benton County Area for wildlife production. The principal species of game in the Area are ring-necked pheasant, ruffed grouse, blue grouse, valley quail, bobwhite quail, mountain quail, band-tailed pigeon, mourning dove, duck, geese, and black-tailed deer. Also, many kinds of songbirds and insectivorous birds, small animals, and other nongame species are throughout the Area. They are valuable for the pleasure they give to persons who live and travel in the Area. Some birds damage fruit crops. Squirrels do a considerable amount of damage to grain fields that are intermingled with brushy areas. Gophers are common in many of the well-drained soils.

The population of some species of wildlife is related to kinds of soils. Many of the relationships are indirect and are mainly influenced by land use, the kinds of plants, and topography. Wildlife generally is more abundant, the individual animals larger, and the rate of production higher on fertile soils than on soils of poor quality.

[4] JAMES HEINZ, State game agent, Oregon State Game Commission, helped to prepare this section.

The suitability of a soil for a species of wildlife is strongly influenced by the present stage of plant succession and the stage of succession in which man tends to keep the land. A burned-over woodland area, for instance, goes through many successional changes before it has a full stand of trees again. During each of these changes, it is fair or good habitat for some species and poor habitat for others. Some species thrive through several changes. Use of an area may depend upon how much an adjacent area is opened by fire or logging in relation to the areas that are not opened up.

Most of the land in the Area is privately owned, so access is controlled by the landowners. Most of the farms, tree farms, and publicly owned lands are open to hunting in season. Hunting on private land is by permission of the landowner. Some of the land is in parks, wildlife refuges, and private and public shooting preserves. The landowner can obtain information from the Soil Conservation Service, Oregon State Game Commission, and Extension Service about trees, shrubs, vines, and crops that help to encourage wildlife. Local soil conservationists and wildlife technicians can also help determine the practices most suited to establishing wildlife on a particular farm.

In table 4 each wildlife group in the Benton County Area has been rated according to its suitability for food and cover for several game birds and for deer. The group for each mapping unit can be found in the "Guide to Mapping Units." The ratings given—good, fair, and poor—take into account the characteristics and productivity of the soils, the topography, the land use, and the kind of food and cover preferred by the species concerned.

Soil groupings, as well as information given in other sections and the soil maps, will assist in planning wildlife developments. Detailed onsite investigations are needed for planning many developments.

WILDLIFE GROUP 1

This group consists of excessively drained to moderately well drained, shallow to deep silt loams, silty clay loams, loams, gravelly loams, gravelly sandy loams, and fine sandy loams on terraces and bottom lands and small areas of Riverwash and Mixed alluvial land. Slopes are 0 to 12 percent. The hazard of erosion generally is slight to moderate, but it is high in the steeper areas and in overflow areas. Permeability is very rapid to moderately slow. Elevation is 190 to 700 feet, and the average frost-free period is 160 to 210 days. Average annual precipitation is 40 to 90 inches. This group covers about 20 percent of the Benton County Area.

TABLE 4.—*Suitability of wildlife groups for wildlife*

Wildlife group	Ring-necked pheasant	Ruffed grouse	Blue grouse	Valley quail	Bobwhite quail	Mountain quail	Band-tailed pigeon	Mourning dove	Ducks and geese	Black-tailed deer
1	Good	Poor	Poor	Good	Good	Poor	Poor	Good	Good	Good.
2	Fair	Fair	Poor	Fair	Fair	Poor	Poor	Fair	Good	Good.
3	Fair	Good	Good	Fair	Fair	Good	Good	Fair	Poor	Good.
4	Poor	Good	Good	Poor	Poor	Good	Good	Poor	Poor	Good.
5	Poor	Fair	Good	Poor	Poor	Fair	Fair	Poor	Poor	Good.

These soils are used for grain, grasses, legumes, orchards, and vegetable crops, as well as for fence rows, shrubs, and woodlots of oak, ash, cottonwood, Douglas-fir, and grass, which furnish good food and cover for ring-necked pheasant, valley quail, bobwhite quail, and mourning doves. Black-tailed deer are permanent inhabitants. Ducks and geese feed in areas that are close to water. Grouse, bandtailed pigeons, and mountain quail are uncommon in this area. Gophers, ground squirrels, moles, nutria, and opossum are commonly considered pests.

Planting along streambanks and roadways, grassing waterways, and preserving fence rows, woodlots, and brush areas improve cover and food for wildlife. Improved drainage of the soils increases plant growth and production. The soils on terraces have numerous drainageways that in many places are suitable for small ponds, many of which can be managed for game fish. Water from streams is available most of the year, but most of the small ditches and streams are dry late in summer. Protecting fields and fence rows from burning enhances cover and food supplies for wildlife.

WILDLIFE GROUP 2

This group consists of somewhat poorly drained and poorly drained, shallow to deep silt loams, silty clay loams, and clays on bottom lands and terraces. Slopes are 0 to 7 percent. Permeability is moderately slow to very slow. The hazard of erosion is slight or moderate, and some areas are subject to flooding. Elevation is 190 to 700 feet, and the frost-free period is 160 to 210 days. Average annual precipitation is 40 to 90 inches. This group covers about 14 percent of the Benton County Area.

Most areas of these soils are cleared and are used for grain, seed crops, hay, and pasture. Areas that have not been cleared are in ash, willow, sedges, and grass. A high water table, flooding, and ponding limit the use of these soils to ducks and geese late in fall, in winter, and early in spring. Waterfowl use seeds and tubers from water plants and crop residue on the well-drained soils adjacent to this area. Ring-necked pheasant, valley quail, bobwhite quail, mourning doves, and black-tailed deer use this area for food and cover the rest of the year. This group of soils is used by fur-bearing animals that have little commercial value and commonly become pests. Grouse and band-tailed pigeons are uncommon in this area.

Water-control structures, such as dikes, small dams, drain ditches, and tile systems, improve the habitat for ducks and geese in winter and for other game species the rest of the year. Cover and food supplies are also improved by planting along streambanks, ditchbanks, and roadways, by grassing waterways, and by maintaining fence rows, wood lots, and brush areas. Springs, streams, and wet areas furnish water throughout the year. Protecting fields and fence rows from burning enhances food supplies and cover for wildlife.

WILDLIFE GROUP 3

This group consists mainly of well-drained to somewhat poorly drained, moderately deep and deep silt loams, silty clay loams, loams, gravelly loams, and silty clays on low hills in the Coast Range. Also in this group are small areas of poorly drained soils. Slopes are 0 to 20 percent. Permeability is moderate to slow. Soil tilth is good to fair. The hazard of erosion is slight to high. Elevation is 190 to 1,800 feet, and the average frost-free period is 165 to 210 days. Average annual precipitation is 40 to 60 inches. This group covers about 12 percent of the Benton County Area.

These soils are used for orchards, grain, hay and pasture, and grass and legume seed, which furnish food and cover for ring-necked pheasants, valley quail, and bobwhite quail. Oak, Douglas-fir, hazel, bigleaf maple, and other trees, shrubs, and grasses are important food and cover plants. Ruffed grouse, mountain quail, and band-tailed pigeons use the fruit and seeds of the Pacific dogwood, madrone, elderberry, cascara, and other plants for food. Band-tailed pigeons are most numerous around the mineral springs late in summer and early in fall. Large populations of black-tailed deer use both cultivated and uncultivated areas for food and cover. Gophers, squirrels, and other burrowing animals are commonly considered pests.

Planting Douglas-fir, grassing waterways, planting along roadways, and preserving fence rows and brushy areas improve cover and food for wildlife. Numerous draws and drainageways are available for small ponds. Except for a few major creeks and springs, the drainageways are dry late in summer. Coyotes, fox, and bobcats are often found in these areas. Protecting fields and fence rows from burning enhances food supplies and cover for wildlife.

WILDLIFE GROUP 4

This group consists of well drained and moderately well drained, shallow to deep loams, silty clay loams, gravelly silty clay loams, and silty clays on uplands in the Coast Range. Slopes are 3 to 75 percent. The hazard of erosion is moderate to high. Elevation is 300 to 1,800 feet, and the frost-free period is 160 to 210 days. Average annual precipitation is 40 to 90 inches. This group covers about 43 percent of the Benton County Area.

Most areas of these soils are used for timber or native pasture. Many areas are too steep to be cultivated, and they commonly are close to cultivated areas. If they are intermingled with cultivated areas, ring-necked pheasant, valley quail, and bobwhite quail are in places. Douglas-fir, oak, hazlenut, bigleaf maple, alder, and other trees and shrubs are important food and cover plants. Ruffed grouse, mountain quail, and band-tailed pigeons use the leaves, buds, nuts, fruit, and seed from Pacific dogwood, madrone, elderberry, cascara, and other plants for food. Black-tailed deer use this area for food and cover.

Numerous draws and drainageways are available for small ponds. Except for a few major creeks and springs, the drainageways are dry late in summer.

WILDLIFE GROUP 5

This group consists of well drained to moderately well drained, shallow to deep loams, silty clay loams, gravelly loams, gravelly clay loams, and very cobbly loams in the Coast Range. Slopes are 3 to 100 percent. Permeability is moderately rapid to moderately slow. The hazard of erosion is moderate or high. Elevation is 500 to 4,000 feet, and the frost-free period is 120 to 200 days. Average annual precipitation is 40 to 120 inches. This group covers about 11 percent of the Benton County Area.

The vegetation is Douglas-fir, hemlock, cedar, alder, vine maple, swordfern, salal, and other trees and shrubs. Blue grouse, ruffed grouse, and black-tailed deer are numerous in this area. A small herd of Roosevelt elk is in the

extreme western part of this area. This area is often closed to entry in summer and early in fall because of the low humidity and the high danger of fire. Except for a few major creeks and springs, the drainageways are dry in July, August, and September. Cool breezes and fog often add moisture during this dry period. Numerous draws and drainageways are available for small ponds.

Engineering Uses of the Soils [5]

This section describes the soil properties important to engineering. Soils are natural materials that differ greatly in properties from one location to another, even within the same area. Soil properties are of special interest to engineers because they affect the construction and maintenance and roads, airports, pipelines, foundations, structures for controlling erosion, facilities for storing and transporting water, systems for draining and irrigating soils, and leaching fields for sewage tanks. Among the properties most important to the engineer are permeability, shear strength, compaction characteristics, shrink-swell potential, soil drainage, grain size, plasticity, and soil reaction (pH). Topography and depth to water table, to bedrock, or to sand and gravel are also important.

This survey contains information about the soils of the Benton County Area helpful to engineers. Special emphasis has been placed on engineering properties that affect irrigation, ponds, and structures to control and conserve soil and water. The information in this survey can be used to—

1. Make soil and land-use studies that will aid in selecting and developing sites for industrial, business, residential, and recreational uses.
2. Make preliminary estimates of the engineering properties of soils used in planning artificial drainage systems, ponds, irrigation systems, terraces and diversions, waterways, and other structures for conserving soil and water.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways, airports, pipelines, cables, and sewage disposal fields and in planning detailed surveys of the soils at selected locations.
4. Locate probable sources of sand and other material for use in construction.
5. Correlate performance of engineering structures with the soil mapping units and thus develop information that will be useful in designing and maintaining certain engineering practices and structures.
6. Determine the suitability of soils for movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps, reports, and aerial photographs for the purpose of making reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

Most of the information in this section is presented in tables 5 and 6, which show, respectively, several estimated soil properties significant to engineering and interpretations for various engineering uses. This information, however, does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally more than 5 or 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given soil mapping unit may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Soil samples from nearby counties were tested in accordance with standard procedures to help evaluate the soils for estimated properties significant to engineering (table 5). The sample for each series was taken at different locations from a depth of 100 inches or less. The data, therefore, may not be adequate for estimating the properties of soils at greater depths. These samples were tested for grain-size distribution, liquid limit, and plasticity index.

No engineering test data are available for the soils in the Benton County Area; however, data are available for Apt, Blachly, Bohannon, Honeygrove, Marty, and Slickrock soils from the adjoining Alsea Area; Dixonville, Malabon, and Veneta soils from the adjacent Lane County; Amity, Dayton, and Willamette soils from the adjacent Linn County; Bashaw, Concord, and Woodburn soils from Marion County; and Cloquato soils from Yamhill County. These laboratory data have been used to estimate properties for some of the soils listed in table 6.

Some of the terms used by the soil scientist may be unfamiliar to the engineer, and some words—for example, soil, clay, silt, and sand—have special meanings in soil science. These and other special terms used are defined in the Glossary.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*23*), used by SCS engineers, the Department of Defense, and others, and the AASHO system (*2*), adopted by the American Association of State Highway Officials.

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

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7, are clayey soils that have low strength when wet, the poorest soils for subgrade.

Estimated Unified and AASHO classifications for the soils in the survey area are given in table 5.

[5] Roy L. Fox, State conservation engineer, Soil Conservation Service, helped to prepare this section.

TABLE 5.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in that series contains more than one kind of soil. The soils in such
referring to other series that appear in the first column of this

Soil name and map symbols	Hydrologic group	Depth to bedrock	Depth to seasonal high water table	Depth from surface of typical profile	Classification			Coarse fraction greater than 3 inches
					Dominant USDA texture	Unified	AASHO	
		In.	*In.*	*In.*				*Pct.*
Abiqua: AbA, AbB	C	>40	>40	0–17	Silty clay loam	CL or ML	A–6	0
				17–60	Silty clay and clay	MH	A–7	0
Amity: Am	C	>72	12–24	0–22	Silt loam	ML	A–4	0
				22–60	Silty clay loam	CL or ML	A–7	0
Apt: ApC, ASD, ASF, ATD	C	>60	(1)	0–10	Silty clay loam	CL or ML	A–6	0
				10–60	Clay	MH	A–7	0
Bashaw:								
Ba	D	>60	0–6	0–15	Silty clay loam	CL or ML	A–6	0
				15–60	Clay	CH	A–7	0
Bc	D	>60	0–6	0–60	Clay	CH	A–7	0
Bellpine: BeC, BeD, BeE, BeF	C	20–40	(1)	0–10	Silty clay loam	CL	A–6	0
				10–26	Clay and silty clay	MH	A–7	0
				26	Partially weathered sandstone.			
Blachly: BLE, BLF	C	>60	(1)	0–6	Silty clay loam	MH	A–5	0
				6–60	Silty clay	MH	A–7	0
Bohannon: BOF, BOG	C	20–40	(1)	0–35	Gravelly loam	SM	A–4 or A–2	0–30
				35	Partially weathered sandstone.			
Brenner: Bp	C/D	>60	0–6	0–17	Silt loam	ML	A–4	0
				17–60	Silty clay and heavy silty clay loam.	MH	A–7	0
Briedwell: BrB, BrD	B	>40	>72	0–17	Gravelly loam to gravelly silty clay loam.	GM or ML	A–4 or A–2	0
				17–60	Very gravelly clay loam.	GM or GC	A–2 or A–6	0
Camas: Ca	A	>72	>60	0–7	Gravelly sandy loam	GM or SM	A–1	0–25
				7–60	Very gravelly sand	GW	A–1	5–25
Chehalis: Ch	B	>72	>60	0–60	Silty clay loam	CL or ML	A–6	0
Cloquato: Cm	B	>72	>60	0–60	Silt loam	ML	A–4 or A–6	0
Coburg: Cn	C	>72	20–36	0–43	Silty clay loam and silty clay.	CL	A–7	0
				43–60	Clay loam and sandy clay loam.	ML or SM	A–6 or A–4	0
Concord: Co	D	>72	0–6	0–26	Silt loam	CL or ML	A–4	0
				26–38	Silty clay loam and silty clay.	CL or ML	A–7	0
				38–60	Silt loam	ML	A–4	0
Conser: Cs	C/D	>72	0–6	0–17	Silty clay loam	CL	A–6	0
				17–60	Clay	CH	A–7	0
Dayton: Da	D	>72	0–6	0–15	Silt loam and silty clay loam.	ML	A–4	0
				15–45	Clay	CH	A–7	0
				45–60	Silty clay loam	CL	A–6	0
Dixonville: DnC, DnD, DnE, DnF	C	20–40	(1)	0–5	Silty clay loam	CL	A–6	0–10
				5–37	Clay or silty clay	CH	A–7	0–30
				37	Weathered basalt.			

See footnotes at end of table.

significant to engineering

mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for table. The sign < means less than, the sign > means more than]

Percentage passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)							Uncoated steel	Concrete
						In. per hour	*In. per in. of soil*	*pH*			
100	100	95–100	85–95	35–40	10–20	0. 6–2. 0	0. 19–0. 21	5. 6–6. 0	Moderate	Moderate	Moderate.
80–100	75–100	70–100	55–95	60–70	20–30	0. 2–0. 6	0. 12–0. 17	5. 6–6. 0	High	High	Moderate.
100	100	90–100	70–95	30–40	5–10	0. 6–2. 0	0. 19–0. 21	5. 6–6. 5	Moderate	High	Moderate.
100	100	95–100	85–95	40–50	10–20	0. 2–0. 6	0. 19–0. 21	5. 6–6. 5	Moderate	High	Low.
100	100	95–100	85–95	35–40	10–20	0. 6–2. 0	0. 19–0. 21	4. 5–5. 0	Moderate	Moderate	High.
100	100	90–100	75–95	50–60	10–20	0. 2–0. 6	0. 14–0. 16	4. 5–5. 0	High	High	High.
100	100	95–100	85–95	35–40	10–20	0. 6–2. 0	0. 19–0. 21	5. 6–6. 5	Moderate	High	Moderate.
100	100	95–100	85–95	70–90	40–60	<0. 06	0. 14–0. 16	6. 1–7. 3	High	High	Moderate.
100	100	95–100	85–95	70–90	40–60	<0. 06	0. 14–0. 16	5. 6–7. 3	High	High	Moderate.
90–100	90–100	85–100	75–95	35–40	15–20	0. 6–2. 0	0. 19–0. 21	5. 6–6. 0	Low	High	Moderate.
100	100	90–100	75–95	50–65	20–25	0. 06–0. 2	0. 14–0. 16	5. 1–5. 5	Moderate	High	Moderate.
100	100	95–100	85–95	50–65	5–10	0. 6–2. 0	0. 17–0. 21	4. 5–5. 0	Low	High	High.
70–100	70–100	65–100	50–85	50–65	10–20	0. 2–0. 6	0. 11–0. 13	4. 5–5. 0	Moderate	High	High.
70–95	60–90	50–85	30–50	(2)	(2)	2. 0–6. 0	0. 09–0. 15	4. 5–5. 0	Low	High	High.
100	100	90–100	70–90	25–35	3–10	0. 6–2. 0	0. 19–0. 21	4. 5–5. 5	Low	High	High.
100	100	95–100	90–95	50–60	15–20	0. 06–0. 2	0. 15–0. 17	4. 5–5. 0	Moderate	High	High.
60–80	50–70	40–70	30–65	25–40	5–10	2. 0–6. 0	0. 12–0. 18	5. 1–6. 0	Low	Low to moderate.	Moderate.
35–60	25–50	20–50	20–40	30–40	10–15	0. 6–2. 0	0. 08–0. 15	5. 6–6. 0	Low	Low to moderate.	Moderate.
50–65	45–60	25–40	15–25	(2)	(2)	2. 0–6. 0	0. 07–0. 09	5. 6–6. 0	Low	Low	Moderate.
25–50	20–35	10–25	0–5	(2)	(2)	>20. 0	0. 03–0. 05	5. 6–6. 0	Low	Low	Moderate.
100	100	95–100	85–95	35–40	10–15	0. 6–2. 0	0. 19–0. 21	6. 6–7. 3	Moderate	Moderate	Low.
100	100	95–100	80–90	34–40	5–15	0. 6–2. 0	0. 20–0. 23	6. 1–6. 5	Low	Low	Moderate.
100	100	95–100	85–95	40–50	20–25	0. 2–0. 6	0. 15–0. 21	5. 6–6. 5	High	High	Moderate.
100	100	80–95	35–75	30–40	5–15	0. 6–2. 0	0. 14–0. 21	6. 1–7. 3	Moderate	Moderate	Low.
100	100	95–100	85–95	30–40	5–10	0. 6–2. 0	0. 19–0. 21	5. 6–6. 0	Low	High	Moderate.
100	100	95–100	80–90	40–50	10–20	0. 06–0. 2	0. 15–0. 21	6. 1–6. 5	High	High	Low.
100	100	95–100	80–90	(2)	(2)	0. 2–0. 6	0. 19–0. 21	6. 1–6. 5	Low	High	Low.
100	95–100	95–100	85–95	35–40	15–20	0. 6–2. 0	0. 19–0. 21	6. 1–6. 5	Moderate	High	Moderate.
100	100	90–100	75–95	50–65	30–40	0. 06–0. 2	0. 14–0. 16	5. 6–6. 5	High	High	Moderate.
100	100	95–100	90–100	30–40	5–10	0. 2–0. 6	0. 23–0. 25	5. 6–6. 0	Low	High	Moderate.
100	100	95–100	90–100	60–80	40–50	<0. 06	0. 03–0. 05	5. 6–6. 0	High	High	Moderate.
100	100	95–100	90–95	30–40	10–20	0. 2–0. 6	0. 20–0. 23	6. 1–6. 5	Moderate	High	Low.
90–100	90–100	85–100	75–95	30–40	10–20	0. 6–2. 0	0. 19–0. 21	6. 1–6. 5	Moderate	High	Low.
65–100	70–100	65–100	50–95	50–80	30–50	0. 06–0. 2	0. 14–0. 17	5. 6–6. 0	High	High	Moderate.

TABLE 5.—*Estimated soil properties*

Soil name and map symbols	Hydrologic group	Depth to bedrock	Depth to seasonal high water table	Depth from surface of typical profile	Classification			Coarse fraction greater than 3 inches
					Dominant USDA texture	Unified	AASHO	
		In.	*In.*	*In.*				*Pct.*
Dupee: DuC	C	40–>60	20–26	0–14	Silt loam	ML	A–6 or A–4	0
				14–60	Clay and heavy silty clay loam.	CL	A–7	0
*Hazelair: HaC, HeC, HeD—For Hazelair, well-drained variant part of HeC and HeD, see Hazelair, well-drained variant.	D	20–40	12–30	0–23	Silt loam and silty clay loam.	CL	A–6	0
				23–33	Clay	CH	A–7	0
				33	Fragmented siltstone.			
Hazelair, well-drained variant. Mapped only in complex with Hazelair.	D	20–40	(1)	0–19	Silty clay loam and light silty clay.	CL	A–6	0
				19–24	Clay	CH	A–7	0
				24	Weathered siltstone.			
Honeygrove: HgC, HND, HNF, HOD.	C	>60	(1)	0–8	Silty clay loam	ML	A–4	0
				8–60	Clay	MH	A–7	0
Jory: JoC, JoD, JoE, JRE, JRF.	C	>40	(1)	0–15	Silty clay loam	ML	A–6	0
				15–60	Clay or silty clay	CL or ML	A–7	0
Kilchis: KHG	D	12–20	(1)	0–19	Very cobbly loam	GM or GC	A–2 or A–4	50–55
				19	Fractured diorite.			
Klickitat: KKF, KKG	C	40–50	(1)	0–48	Gravelly clay loam and very cobbly clay loam.	GC or GM	A–2 or A–6	30–55
				48	Fractured basalt.			
Malabon: Ma	C	>72	>60	0–65	Silty clay loam and silty clay.	ML	A–7	----------
Marty: MGD, MGF	B	>60	(1)	0–65	Gravelly loam and clay loam.	ML, MH, or SM	A–7 and A–5	----------
McAlpin: Mn	C	>40	18–36	0–14	Silty clay loam	ML	A–6	0
				14–60	Silty clay	ML or CL	A–7	0
McBee: Ms	B	>72	24–36	0–60	Silty clay loam and silt loam.	ML or CL	A–6	0
Mixed alluvial land: MX. Too variable to estimate; onsite investigation needed.								
Mulkey: MYD	C	20–40	(1)	0–11	Loam	OL	A–4	0
				11–28	Cobbly and gravelly loam.	SM or ML	A–4	15–45
Nehalem: Ne	B	>72	24–40	0–60	Silty clay loam	ML or CL	A–6	0
Newberg: Ng, Nm	B	>72	60	0–60	Fine sandy loam and loam.	SM or ML	A–4	0
Peavine: PEE, PEF	C	30–40	(1)	0–6	Silty clay loam	CL or ML	A–7	0
				6–40	Clay	MH or CH	A–7	0
				40	Shale.			
Philomath: PhC, PhE	D	12–20	(1)	0–18	Clay or silty clay	CH	A–7	0
				18	Weathered basalt.			
Pilchuck: Pk	A	>72	>72	0–60	Fine sand	SM	A–2	0

See footnotes at end of table.

significant to engineering—Continued

Percentage passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 0.42 mm.)	No. 200 (0.074 mm.)							Uncoated steel	Concrete
						In. per hour	*In. per in. of soil*	*pH*			
100	100	90–100	70–90	30–40	5–15	0. 6–2. 0	0. 19–0. 23	5. 1–6. 0	Low	High	Moderate.
100	100	90–100	75–95	40–50	25–30	0. 2–0. 6	0. 16–0. 23	4. 5–5. 5	Moderate	High	High.
100	100	90–100	70–95	30–40	10–20	0. 6–2. 0	0. 19–0. 21	5. 6–6. 0	Moderate	High	Moderate.
100	100	90–100	75–95	60–80	40–50	<0. 06	0. 14–0. 16	5. 6–6. 0	High	High	Moderate.
100	100	95–100	85–95	30–40	10–20	0. 6–2. 0	0. 19–0. 21	5. 1–6. 0	Moderate	High	Moderate.
100	100	90–100	75–95	50–70	35–45	0. 06–0. 2	0. 14–0. 16	5. 1–5. 5	High	High	Moderate.
100	100	95–100	85–95	30–40	5–10	0. 6–2. 0	0. 19–0. 21	5. 1–5. 5	Low	High	Moderate.
75–100	75–100	70–100	50–95	55–70	10–15	0. 2–0. 6	0. 14–0. 16	4. 5–5. 0	Moderate	High	High.
100	100	95–100	85–95	40–50	10–15	0. 6–2. 0	0. 19–0. 21	4. 5–5. 0	Low	High	Moderate.
75–100	75–100	70–100	55–95	40–50	15–25	0. 2–0. 6	0. 14–0. 16	4. 5–5. 0	Moderate	High	High.
45–50	35–50	30–45	20–40	25–35	5–10	2. 0–6. 0	0. 04–0. 09	4. 5–5. 0	Low	High	High.
45–65	35–60	30–60	25–50	30–40	10–15	0. 6–2. 0	0. 06–0. 10	4. 5–5. 0	Low	High	High.
75–100	75–100	70–100	65–95	40–50	15–20	0. 2–0. 6	0. 15–0. 21	5. 6–6. 5	Moderate	High	Moderate.
70–90	70–90	60–85	40–70	45–55	7–15	0. 2–0. 6	0. 14–0. 20	4. 5–5. 0	Low	High	High.
100	100	95–100	85–95	35–40	10–15	0. 6–0. 2	0. 19–0. 21	5. 1–6. 0	Moderate	High	Moderate.
100	100	95–100	90–95	40–50	15–25	0. 2–0. 6	0. 15–0. 17	5. 6–6. 0	High	High	Moderate.
100	100	95–100	85–95	30–40	10–15	0. 6–2. 0	0. 19–0. 21	6. 1–7. 3	Moderate	High	Low.
80–100	90–100	75–95	55–75	30–40	5–10	2. 0–6. 0	0. 16–0. 18	<4. 5	Low	High	High.
55–85	50–75	45–70	35–55	30–40	5–10	2. 0–6. 0	0. 12–0. 15	4. 5–5. 0	Low	High	High.
100	100	95–100	85–95	30–40	10–15	0. 6–2. 0	0. 19–0. 21	4. 5–5. 5	Low	High	Moderate to high.
100	100	70–85	40–55	(2)	(2)	2. 0–6. 0	0. 13–0. 15	5. 6–6. 5	Low	Low	Moderate.
100	100	85–95	75–90	45–55	15–20	0. 6–2. 0	0. 18–0. 20	4. 5–5. 0	Low	High	Moderate.
100	100	85–95	75–95	60–85	30–45	0. 2–0. 6	0. 13–0. 16	4. 5–5. 0	Moderate	High	High.
65–100	70–100	65–100	50–95	60–80	40–55	0. 06–0. 2	0. 14–0. 16	6. 1–7. 3	High	High	Low.
100	100	65–80	20–35	(2)	(2)	6. 0–20. 0	0. 05–0. 10	6. 6–7. 3	Low	Low	Low to moderate.

TABLE 5.—*Estimated soil properties*

Soil name and map symbols	Hydrologic group	Depth to bedrock	Depth to seasonal high water table	Depth from surface of typical profile	Classification			Coarse fraction greater than 3 inches
					Dominant USDA texture	Unified	AASHO	
		In.	*In.*	*In.*				*Pct.*
*Price: PrC, PrD, PTE, PTF.	C	40–60	(1)	0–20	Silty clay loam and light silty clay.	ML	A–7	0–10
				20–50	Gravelly clay	MH	A–7	15–25
For Ritner part of PTE and PTF, see Ritner series.				50	Weathered basalt.			
*Ritner: RPE, RPG	C	30–40	(1)	0–15	Gravelly silty clay loam.	GM or ML	A–6	0–15
For Price part of RPE and RPG, see Price series.				15–40	Very cobbly silty clay.	GM or GC, CL, CL–ML	A–7 or A–2	30–55
				40	Fractured basalt.			
Riverwash: Rw. Too variable to estimate; onsite investigation needed.								
Salem: Sa	B	>72	>72	0–24	Gravelly loam and gravelly clay loam.	GM or ML	A–7	0
				24–60	Very gravelly sand	GP	A–1	0
Slickrock: SLD, SLF	B	>40	(1)	0–60	Gravelly loam	SM	A–4	0–15
Veneta: VeB, VeD	C	40–>60	(1)	0–27	Silty clay loam	ML	A–4	0
				27–60	Clay and silty clay	CH	A–7	0
Veneta, loamy subsoil variant: VnB, VnD, VnE.	C	30–40	(1)	0–11	Loam	ML	A–4	0
				11–40	Clay loam	ML	A–6	0
				40	Weathered sandstone.			
Waldo: Wa	D	>60	0–6	0–11	Silty clay loam and silty clay.	CL	A–7	0
				11–60	Clay	MH	A–7	0
Wapato: Wc	C/D	>72	0–6	0–60	Silty clay loam	CL or ML	A–6	0
Willamette: WeA, WeC	B	>72	>72	0–15	Silt loam	ML	A–4	0
				15–57	Silty clay loam	ML or CL	A–7	0
				57–60	Silt loam	ML or CL	A–6	0
Winchuck, silty subsoil variant: WhB.	B	>72	>72	0–11	Silt loam	ML	A–4	0
				11–44	Silty clay loam	ML	A–6	0
				44–60	Loam and silt loam	ML	A–4	0
Witham: WkB	D	40	12–30	0–60	Silty clay and clay	CH	A–7	0
Witzel: WLG	D	12–20	(1)	0–15	Very cobbly clay loam.	GC or CL	A–6	40–50
				15	Fractured basalt.			
Woodburn: WoA, WoC	C	>72	18–36	0–24	Silt loam	ML	A–4	0
				24–48	Silty clay loam	ML or CL	A–4	0
				48–60	Silt loam	ML or CL	A–6	0

[1] Seasonal high water table at a depth of less than 60 inches does not occur in these soils.

significant to engineering—Continued

Percentage passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.(	No, 200 (0.074 mm.)							Uncoated steel	Concrete
						In. per hour	*In. per in. of soil*	*pH*			
80–100	80–100	75–100	70–95	40–50	15–20	0. 6–2. 0	0. 14–0. 19	5. 1–6. 0	Low	High	Moderate.
70–85	60–85	55–85	50–80	50–60	20–30	0. 2–0. 6	0. 10–0. 14	5. 1–5. 5	Moderate	High	Moderate.
60–90	50–85	40–85	40–80	35–40	10–15	0. 6–2. 0	0. 12–0. 19	5. 6–6. 0	Low	High	Moderate.
35–75	25–70	25–65	20–65	40–50	15–25	0. 2–0. 6	0. 06–0. 13	5. 1–5. 5	Moderate	High	Moderate.
60–75	50–70	45–60	35–55	40–50	10–15	0. 6–2. 0	0. 12–0. 17	6. 1–6. 5	Low	Moderate	Low.
25–40	15–35	5–25	0–5	(2)	(2)	20. 0	0. 03–0. 05	6. 1–6. 5	Low	Low	Moderate.
65–85	55–75	40–70	35–50	30–40	5–10	0. 6–2. 0	0. 12–0. 16	4. 5–5. 0	Low	High	High.
100	100	95–100	80–95	25–30	3–8	0. 6–2. 0	0. 19–0. 21	5. 1–5. 5	Low	High	Moderate.
100	100	90–100	85–95	50–80	35–50	0. 06–0. 2	0. 14–0. 17	5. 6–6. 0	High	High	Moderate.
100	100	85–95	60–75	25–35	5–10	0. 6–2. 0	0. 16–0. 18	6. 1–6. 5	Low	Moderate	Low.
100	100	90–100	70–80	35–40	10–15	0. 2–0. 6	0. 19–0. 21	5. 6–6. 0	Low	Moderate	Moderate.
100	100	95–100	85–95	40–50	15–20	0. 2–0. 6	0. 17–0. 21	5. 1–5. 5	Moderate	High	Moderate.
100	100	90–100	75–95	55–70	20–30	0. 06–0. 2	0. 14–0. 16	5. 1–6. 0	High	High	Moderate.
100	100	95–100	85–95	35–40	10–15	0. 2–0. 6	0. 19–0. 21	5. 6–6. 5	Moderate	High	Low.
100	100	95–100	95–100	35–40	5–10	0. 6–2. 0	0. 19–0. 21	5. 6–6. 0	Low	Moderate	Moderate.
100	100	95–100	95–100	40–50	15–25	0. 6–2. 0	0. 19–0. 21	5. 6–6. 5	Moderate	Moderate	Low to moderate.
100	100	90–100	95–100	35–40	10–15	0. 6–2. 0	0. 19–0. 21	6. 1–6. 5	Low	Low	Low.
100	100	100	70–90	25–35	5–10	6. 0–2. 0	0. 19–0. 21	4. 5–5. 0	Low	High	High.
100	100	95–100	85–95	35–40	10–15	0. 6–2. 0	0. 19–0. 21	<4. 5–5. 0	Low	High	High.
100	100	85–95	60–75	25–35	5–10	0. 6–2. 0	0. 16–0. 18	<4. 5	Low	High	High.
100	100	90–100	75–95	60–80	35–55	0. 06	0. 14–0. 16	5. 1–6. 0	High	High	Moderate.
50–60	50–60	50–60	40–55	35–40	15–20	0. 2–0. 6	0. 08–0. 10	5. 6–6. 0	Low	Moderate	Moderate.
100	100	85–95	70–80	25–30	2–5	0. 6–2. 0	0. 19–0. 21	5. 6–6. 0	Low	Moderate	Moderate.
100	100	95–100	70–80	25–30	5–10	0. 06–0. 2	0. 19–0. 21	5. 6–6. 5	Moderate	High	Moderate.
100	100	95–100	80–90	35–40	11–15	0. 6–2. 0	0. 19–0. 21	6. 1–6. 5	Low	High	Moderate.

[2] Nonplastic.

TABLE 6.—*Interpretations of*

[An asterisk in the first column indicates that at least one mapping unit in that series contains more than one kind of soil. The soils in to other series in the

Soil series and map symbol	Suitability as source of—			Degree and kind of limitation for local roads and streets	Soil features affecting—
	Topsoil	Sand and gravel	Road fill		Farm ponds Reservoir area
Abiqua: AbA, AbB	Fair: silty clay loam.	Not suitable: thick overburden.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Moderately slow permeability; gravel below depth of 40 inches in places.
Amity: Am	Good	Not suitable: thick overburden.	Fair: somewhat poorly drained; moderate shrink-swell potential.	Moderate to severe: seasonal high water table.	Moderately slow permeability; seasonal high water table.
Apt: ApC, ASD, ASF ATD.	Fair to poor: slopes of 3 to 50 percent; silty clay loam surface layer.	Not suitable: sedimentary bedrock.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential; slopes of 3 to 50 percent.	Moderately slow permeability; slopes of 3 to 50 percent.
Bashaw: Ba, Bc	Poor: poorly drained.	Not suitable: excessive fines.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Very slow permeability; perched water table.
Bellpine: BeC, BeD, BeE, BeF.	Fair to poor: slopes of 3 to 50 percent; silty clay loam.	Not suitable: bedrock below depth of 20 to 40 inches.	Fair to poor: slopes of 3 to 50 percent.	Moderate to severe: slopes of 3 to 50 percent.	Slow permeability; slopes of 3 to 50 percent; bedrock below depth of 20 to 40 inches.
Blachly: BLE, BLF	Fair to poor: silty clay loam and silty clay; slopes of 3 to 50 percent.	Not suitable: excessive fines; bedrock below depth of 60 inches.	Fair to poor: slopes of 3 to 50 percent.	Moderate to severe: moderate shrink-swell potential; slopes of 3 to 50 percent.	Moderately slow permeability; slopes of 3 to 50 percent; bedrock at depth of more than 60 inches.
Bohannon: BOF, BOG	Poor: gravelly; slopes of 25 to 75 percent.	Not suitable: bedrock below depth of 20 to 40 inches.	Poor: slopes of 25 to 75 percent.	Severe: slopes of 25 to 75 percent.	Moderately rapid permeability; bedrock below depth of 20 to 40 inches; slopes of 25 to 75 percent.

engineering properties of the soils

such mapping units may have different properties, and limitations, and for this reason it is necessary to follow carefully the instructions for referring first column of this table]

Soil features affecting—Continued					
Farm ponds—Con. Embankments, dikes, and levees	Artificial drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading
Low shear strength; low permeability where compacted; high compressibility; good to fair resistance to piping.	Well drained; ditchbanks stable.	Moderate intake rate; high available water capacity.	Not applicable	High available water capacity; vegetation easy to establish.	Plastic when wet; difficult to excavate.
Moderate to low permeability where compacted; medium to high compressibility; moderate shrink-swell potential; fair to poor resistance to piping.	Somewhat poorly drained; natural drainageways inadequate; moderately slow permeability; ditchbanks stable.	Moderate intake rate; high available water capacity.	Not applicable	High available water capacity; vegetation easy to establish.	Seasonal high water table.
Low permeability where compacted; very high compressibility; fair to poor resistance to piping.	Well drained; moderately slow permeability.	Moderate intake rate; high available water capacity; slopes of 3 to 50 percent.	High available water capacity; moderately slow permeability.	High available water capacity; vegetation fairly easy to establish.	Plastic when wet; difficult to excavate.
Low permeability where compacted; high compressibility; good resistance to piping.	Poorly drained; very slow permeability; perched water table; ditchbanks unstable.	Moderate or slow intake rate; high available water capacity; perched water table; poor root penetration; slopes of 0 to 3 percent.	Very slow permeability; high available water capacity.	High available water capacity; vegetation fairly difficult to establish.	Seasonal high water table; plastic subsoil.
Low permeability where compacted; very high compressibility; fair to poor resistance to piping.	Well drained; slow permeability.	Moderate intake rate; moderate available water capacity; bedrock below depth of 20 to 40 inches; slopes of 3 to 50 percent.	Moderate available water capacity; slow permeability.	Moderate available water capacity; vegetation easy to establish.	Plastic when wet; difficult to excavate.
Low permeability where compacted; very high compressibility; fair to poor resistance to piping.	Well drained; moderately slow permeability.	Moderate intake rate; high available water capacity; slopes of 3 to 50 percent.	High available water capacity; moderately slow permeability.	High available water capacity; vegetation fairly easy to establish.	Plastic when wet; difficult to excavate.
Moderate permeability where compacted; slight compressibility; poor resistance to piping; common pebbles and few cobblestones.	Well drained; moderately rapid permeability.	Moderate intake rate; moderate available water capacity; slopes of 25 to 75 percent.	Not applicable	Not applicable	Few to common pebbles and cobblestones; slopes of 25 to 75 percent.

TABLE 6.—*Interpretations of*

Soil series and map symbol	Suitability as source of—			Degree and kind of limitation for local roads and streets	Soil features affecting—
	Topsoil	Sand and gravel	Road fill		Farm ponds: Reservoir area
Brenner: Bp	Poor: poorly drained.	Not suitable: thick overburden.	Poor: poorly drained.	Severe: seasonal high water table; subject to overflow; poorly drained.	Slow permeability; subject to overflow.
Briedwell: BrB, BrD	Poor: gravelly	Fair to poor for gravel.	Good	Slight to severe: slopes of 0 to 20 percent.	Moderate permeability; gravel below depth of 40 to 60 inches; slopes of 0 to 20 percent.
Camas: Ca	Poor: gravelly	Good for gravel	Good	Severe: subject to overflow.	Very rapid permeability; very gravelly below surface layer; subject to overflow.
Chehalis: Ch	Fair: silty clay loam.	Good, but thick overburden.	Fair: moderate shrink-swell potential.	Severe: subject to overflow.	Moderate permeability; gravel or sandy strata below depth of 60 inches in places; subject to overflow.
Cloquato: Cm	Good	Good, but thick overburden.	Fair: 80 to 90 percent fines.	Severe: subject to overflow.	Moderate permeability; gravel or sandy strata below depth of 60 inches in places; subject to overflow.
Coburg: Cn	Fair: silty clay loam.	Poor: excessive fines.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Moderately slow permeability; seasonal high water table.
Concord: Co	Poor: poorly drained.	Not suitable: no sand or gravel.	Poor: poorly drained.	Severe: poorly drained.	Slow permeability; seasonal high water table.
Conser: Cs	Poor: poorly drained.	Not suitable: no sand or gravel.	Poor: poorly drained.	Severe: poorly drained.	Slow permeability; seasonal high water table at depth of 0 to 6 inches.

engineering properties of the soils—Continued

Soil features affecting—Continued					
Farm ponds—Con. Embankments, dikes, and levees	Artificial drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading
Moderate to low permeability where compacted; medium to high compressibility; poor to fair resistance to piping.	Poorly drained; slow permeability; seasonal high water table.	Moderate intake rate; high available water capacity.	Not applicable	High available water capacity; vegetation fairly easy to establish.	Seasonal high water table.
Moderate permeability where compacted; slight compressibility; fair to good resistance to piping.	Well drained; moderate permeability.	Moderate intake rate; moderate available water capacity; slopes of 0 to 20 percent.	Moderate available water capacity; moderate permeability.	Moderate available water capacity; vegetation fairly difficult to establish.	Gravelly.
Moderate permeability where compacted; slight compressibility; good resistance to piping.	Excessively drained; subject to overflow.	Very rapid intake rate; low available water capacity; subject to overflow.	Not applicable	Low available water capacity; vegetation difficult to establish.	Gravelly; subject to overflow.
Low permeability where compacted; medium to high compressibility; moderate shrink-swell potential; fair to good resistance to piping.	Well drained	Moderate intake rate; high available water capacity.	Not applicable	High available water capacity; vegetation easy to establish.	Plastic when wet; difficult to excavate; subject to overflow.
Moderate permeability where compacted; medium compressibility; low shrink-swell potential; poor resistance to piping.	Well drained	Moderate intake rate; high available water capacity.	Not applicable	High available water capacity; vegetation easy to establish.	Silty soil material; subject to overflow.
Low permeability where compacted; medium to high compressibility; good to fair resistance to piping.	Moderately well drained; moderately slow permeability; seasonal high water table.	Moderate intake rate; high available water capacity; seasonal high water table.	Not applicable	High available water capacity; vegetation easy to establish.	Plastic when wet; difficult to excavate.
Moderate to low permeability where compacted; medium to high compressibility; fair to poor resistance to piping.	Poorly drained; slow permeability; seasonal high water table.	Moderate intake rate; high available water capacity; seasonal high water table.	Not applicable	High available water capacity; vegetation fairly difficult to establish.	Seasonal high water table; plastic when wet; difficult to excavate.
Low permeability where compacted; high compressibility; good resistance to piping.	Poorly drained; slow permeability.	Moderate intake rate; high available water capacity; seasonal high water table.	Not applicable	High available water capacity; vegetation fairly difficult to establish.	Seasonal high water table; plastic when wet; difficult to excavate.

TABLE 6.—*Interpretations of*

Soil series and map symbol	Suitability as source of—			Degree and kind of limitation for local roads and streets	Soil features affecting—
	Topsoil	Sand and gravel	Road fill		Farm ponds Reservoir area
Dayton: Da	Poor: poorly drained.	Not suitable: no sand or gravel.	Poor: poorly drained.	Severe: high shrink-swell potential; poorly drained.	Very slow permeability; seasonal high water table.
Dixonville: DnC, DnD, DnE, DnF.	Poor: silty clay below depth of 5 inches.	Not suitable: saprolite below depth of 20 to 40 inches.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Slow permeability; slopes of 3 to 50 percent; soil to depth of 20 to 40 inches.
Dupee: DuC	Fair: clay below depth of 14 inches.	Not suitable: bedrock at depth of 40 to more than 60 inches.	Fair: moderate shrink-swell potential.	Severe: seasonal high water table.	Moderately slow permeability; seasonal high water table; bedrock at depth of 40 to more than 60 inches.
*Hazelair: HaC, HeC, HeD. For Hazelair, well-drained variant part of HeC and HeD, see Hazelair well-drained variant.	Fair: silty clay loam.	Not suitable: sedimentary bedrock.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential; hazard of seepage.	Very slow permeability; perched water table; bedrock below depth of 20 to 40 inches.
Hazelair, well drained variant. Mapped only in complex with Hazelair.	Fair to poor: silty clay loam; 3 to 20 percent slopes.	Not suitable: sedimentary bedrock.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Slow permeability; bedrock below depth of 20 to 40 inches.
Honeygrove: HgC, HND, HNF, HOD.	Fair to poor: silty clay loam; slopes of 3 to 50 percent.	Not suitable: sedimentary bedrock.	Fair to poor: slopes of 3 to 50 percent; moderate shrink-swell potential.	Moderate to severe: moderate shrink-swell potential; slopes of 3 to 50 percent.	Moderately slow permeability; slopes of 3 to 50 percent; bedrock at depth of more than 60 inches.

engineering properties of the soils—Continued

Soil features affecting—Continued					
Farm ponds—Con. Embankments, dikes, and levees	Artificial drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading
Low permeability where compacted; high compressibility; good resistance to piping.	Poorly drained; very slow permeability; seasonal high water table; ditchbanks unstable.	Slow intake rate; low to moderate available water capacity; seasonal high water table; rooting depth limited by clay layer below depth of 12 to 18 inches.	Not applicable	Low to moderate available water capacity; vegetation fairly difficult to establish.	Seasonal high water table; plastic clay subsoil.
Low permeability where compacted; high compressibility; good resistance to piping.	Well drained; slow permeability.	Moderate intake rate; moderate available water capacity; slopes of 3 to 50 percent; soil to depth of 20 to 40 inches.	Moderate available water capacity; slow permeability.	Moderate available water capacity; vegetation easy to establish.	Plastic when wet; difficult to excavate.
Low permeability where compacted; high compressibility; moderate shrink-swell potential; fair resistance to piping.	Moderately well drained to somewhat poorly drained; moderately slow permeability; seasonal high water table; ditchbanks stable.	High available water capacity; moderate intake rate; seasonal high water table; slopes of 3 to 12 percent.	Moderately slow permeability; high available water capacity.	High available water capacity; vegetation fairly easy to establish.	Plastic when wet; difficult to excavate.
Low permeability where compacted; high compressibility; good resistance to piping.	Moderately well drained and somewhat poorly drained; very slow permeability; hazard of seepage; perched water table; ditchbanks unstable.	Moderate intake rate; moderate available water capacity; perched water table; rooting depth limited by clay layer below depth of 12 to 24 inches.	Very slow permeability; moderate available water capacity.	Moderate available water capacity; vegetation fairly difficult to establish.	Seasonal high water table; plastic subsoil.
Low permeability where compacted; high compressibility; good resistance to piping.	Well drained; slow permeability.	Moderate intake rate; moderate available water capacity; bedrock below depth of 20 to 40 inches; slopes of 3 to 20 percent.	Slow permeability; moderate available water capacity.	Moderate available water capacity; vegetation fairly difficult to establish.	Silty clay loam; slopes of 3 to 20 percent.
Low permeability where compacted; very high compressibility; fair to poor resistance to piping.	Well drained; moderately slow permeability.	Moderate intake rate; high available water capacity; slopes of 3 to 50 percent; weathered bedrock at depth of more than 60 inches.	Moderately slow permeability; high available water capacity.	Not applicable	Plastic when wet; difficult to excavate.

TABLE 6.—*Interpretations of*

Soil series and map symbol	Suitability as source of—			Degree and kind of limitation for local roads and streets	Soil features affecting—
	Topsoil	Sand and gravel	Road fill		Farm ponds: Reservoir area
Jory: JoC, JoD, JoE, JRE, JRF.	Fair: silty clay loam.	Not suitable: bedrock.	Fair to poor: slopes of 2 to 50 percent; moderate shrink-swell potential.	Moderate to severe: moderate shrink-swell potential; slopes of 2 to 50 percent.	Moderately slow permeability; slopes of 2 to 50 percent; bedrock at depth of 40 to more than 60 inches.
Kilchis: KHG	Poor: very cobbly loam.	Not suitable: possible source of rock for crushing.	Poor: slopes of 50 to 100 percent.	Severe: slopes of 50 to 100 percent.	Moderately rapid permeability; bedrock at depth of less than 20 inches; slopes of 50 to 100 percent.
Klickitat: KKF, KKG	Poor: gravelly clay loam.	Not suitable: possible source of rock for crushing.	Poor: slopes of 30 to 75 percent.	Severe: slopes of 30 to 75 percent.	Moderate permeability; bedrock below depth of 40 to 50 inches; slopes of 30 to 75 percent.
Malabon: Ma	Fair: silty clay loam.	Not suitable: thick overburden.	Fair: 65 to 95 percent fines; moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Moderately slow permeability.
Marty: MGD, MGF	Poor: slopes of 3 to 60 percent; gravelly and cobbly.	Not suitable: excessive fines.	Fair to poor: slopes of 3 to 60 percent; 40 to 70 percent fines.	Moderate to severe: slopes of 3 to 60 percent.	Moderately slow permeability; slopes of 3 to 60 percent; bedrock at depth of more than 60 inches.
McAlpin: Mn	Fair: silty clay loam.	Good, but thick overburden.	Poor: high shrink-swell potential.	Severe: seasonal high water table; high shrink-swell potential.	Moderately slow permeability; seasonal high water table; gravel below depth of 40 inches in places.
McBee: Ms	Fair: silty clay loam.	Good, but thick overburden.	Fair: moderate shrink-swell potential.	Moderate: seasonal high water table; subject to overflow.	Moderate permeability; seasonal high water table; subject to overflow.
Mixed alluvial land: MX. Too variable to estimate; onsite investigation needed.					

engineering properties of the soils—Continued

Soil features affecting—Continued					
Farm ponds—Con.					
Embankments, dikes, and levees	Artificial drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading
Low permeability where compacted; medium to high compressibility; fair to poor resistance to piping.	Well drained; moderately slow permeability.	Moderate intake rate; high available water capacity; slopes of 2 to 50 percent; weathered bedrock at depth of 40 to more than 60 inches.	Moderately slow permeability; high available water capacity.	High available water capacity; vegetation fairly easy to establish.	Plastic when wet; difficult to excavate.
Moderate permeability where compacted; slight compressibility; fair resistance to piping; many cobblestones.	Well drained to excessively drained; moderately rapid permeability.	Not applicable	Not applicable	Not applicable	Many cobblestones.
Low permeability where compacted; slight to medium compressibility; good resistance to piping; many cobblestones.	Well drained; moderate permeability.	Not applicable	Not applicable	Not applicable	Many cobblestones.
Moderate permeability where compacted; medium compressibility; poor resistance to piping.	Well drained	Moderate intake rate; high available water capacity.	Not applicable	High available water capacity; vegetation easy to establish.	Plastic when wet; difficult to excavate.
Low to moderate permeability where compacted; medium compressibility; fair to poor resistance to piping.	Well drained; moderately slow permeability.	Moderate intake rate; high available water capacity; slopes of 3 to 60 percent.	High available water capacity; moderately slow permeability.	Not applicable	Clay loam; plastic when wet.
Low permeability where compacted; medium to high compressibility; fair to poor resistance to piping.	Moderately well drained; moderately slow permeabillity; seasonal high water table.	Moderate intake rate; high available water capacity; seasonal high water table.	Not applicable	High available water capacity; vegetation easy to establish.	Plastic when wet; difficult to excavate.
Low to moderate permeability where compacted; medium to high compressibility; poor to fair resistance to piping.	Moderately well drained; moderate permeability; seasonal high water table; subject to overflow.	Moderate intake rate: high available water capacity; seasonal high water table.	Not applicable	High available water capacity; vegetation easy to establish.	Plastic when wet; difficult to excavate.

TABLE 6.—*Interpretations of*

Soil series and map symbol	Suitability as source of—			Degree and kind of limitation for local roads and streets	Soil features affecting—
	Topsoil	Sand and gravel	Road fill		Farm ponds Reservoir area
Mulkey: MYD	Fair to poor: cobbly and gravelly below depth of 11 inches.	Not suitable: bedrock.	Poor to fair: high organic-matter content in surface layer; slopes of 5 to 25 percent.	Poor to fair: high organic-matter content in surface layer; slopes of 5 to 25 percent.	Moderately rapid permeability; bedrock below depth of 20 to 40 inches; slopes of 5 to 25 percent.
Nehalem: Ne	Fair: silty clay loam.	Not suitable: excessive fines; thick overburden.	Fair: 85 to 95 percent fines.	Moderate: subject to overflow.	Moderate permeability; subject to overflow.
Newberg: Ng, Nm	Good	Fair to poor: thick overburden.	Good	Moderate: subject to overflow.	Moderately rapid permeability; gravel below depth of 40 inches in places.
Peavine: PEE, PEF	Fair to poor: silty clay loam; slopes of 3 to 60 percent.	Not suitable: sedimentary bedrock.	Fair to poor: slopes of 3 to 60 percent; moderate shrink-swell potential.	Moderate to severe: slopes of 3 to 60 percent; moderate shrink-swell potential.	Moderately slow permeability; slopes of 3 to 60 percent; bedrock below depth of 30 to 40 inches.
Philomath: PhC, PhE	Poor: silty clay or clay.	Not suitable: basalt bedrock at depth of less than 20 inches.	Poor: slopes of 3 to 45 percent; high shrink-swell potential.	Severe: high shrink-swell potential; slopes of 3 to 45 percent.	Slow permeability; slopes of 3 to 45 percent; bedrock at depth of less than 20 inches.
Philchuck: Pk	Poor: fine sand	Good to fair: thick overburden.	Good	Severe: subject to overflow.	Rapid permeability; gravel below depth of 40 inches in places.
*Price: PrC, PrD, PTE, PTF. For Ritner part of PTE and PTF, see Ritner series.	Poor: silty clay and gravelly clay.	Not suitable: basalt bedrock below depth of 40 to 60 inches.	Fair to poor: slopes of 3 to 60 percent; moderate shrink-swell potential.	Fair to poor: slopes of 3 to 60 percent; moderate shrink-swell potential.	Moderately slow permeability; slopes of 3 to 60 percent; bedrock below depth of 40 to 60 inches.
*Ritner: RPE, RPG. For Price part of RPE and RPG, see Price series.	Poor: gravelly	Not suitable: possible source of rock for crushing.	Fair to poor: slopes of 12 to 75 percent.	Poor: slopes of 12 to 75 percent.	Moderately slow permeability; bedrock below depth of 30 to 40 inches; slopes of 12 to 75 percent.

engineering properties of the soils—Continued

Soil features affecting—Continued					
Farm ponds—Con. Embankments, dikes, and levees	Artificial drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading
High organic-matter content.	Well drained; moderately rapid permeability.	Not applicable	Not applicable	Not applicable	Hazard of prolonged snow cover.
Low to moderate permeability where compacted; medium compressibility; poor to fair resistance to piping.	Well drained; moderate permeability.	Moderate intake rate; high available water capacity.	Not applicable	Not applicable	Silty clay loam.
Moderate permeability where compacted; slight compressibility; poor resistance to piping.	Somewhat excessively drained; moderately rapid permeability.	Rapid to moderate intake rate; high available water capacity.	Not applicable	High available water capacity; vegetation easy to establish.	Fine sandy loam or loam.
Low permeability where compacted; very high compressibility; fair to poor resistance to piping.	Well drained; moderately slow permeability.	Not applicable	Not applicable	Not applicable	Plastic when wet; difficult to excavate.
Low permeability where compacted; high compressibility; good resistance to piping.	Well drained; slow permeability.	Moderate intake rate; low available water capacity; slopes of 3 to 45 percent; bedrock at depth of less than 20 inches.	Low available water capacity; slow permeability.	Low available water capacity; vegetation fairly easy to establish.	Very plastic when wet; difficult to excavate.
Moderate permeability where compacted; slight compressibility; fair to poor resistance to piping.	Excessively drained; rapid permeability.	Rapid intake rate; moderate available water capacity.	Not applicable	Not applicable	Sandy.
Low permeability where compacted; very high compressibility; fair to poor resistance to piping.	Well drained; moderately slow permeability.	Moderate intake rate; moderate to high available water capacity; bedrock below depth of 40 to 60 inches; slopes of 3 to 60 percent.	Moderate to high available water capacity; moderately slow permeability.	Moderate to high available water capacity; vegetation easy to establish.	Plastic when wet; difficult to excavate.
Low permeability where compacted; medium compressibility; fair resistance to piping; many cobblestones.	Moderately slow permeability; well drained.	Not applicable	Not applicable	Not applicable	Gravelly; slopes of 12 to 75 percent.

TABLE 6.—*Interpretations of*

Soil series and map symbol	Suitability as source of—			Degree and kind of limitation for local roads and streets	Soil features affecting—
	Topsoil	Sand and gravel	Road fill		Farm ponds: Reservoir area
Riverwash: Rw	Not suitable	Good for gravel	Good: high shear strength.	Not suited	Not suited
Salem: Sa	Poor: gravelly	Good below depth of 20 to 30 inches.	Good below depth of 20 to 30 inches.	Slight	Very rapid permeability; very gravelly sand below depth of 20 to 30 inches.
Slickrock: SLD, SLF	Poor: gravelly	Not suitable: sedimentary bedrock.	Good to poor: slopes of 3 to 50 percent.	Slight to severe: slopes of 3 to 50 percent.	Moderate permeability; bedrock below depth of 40 to 60 inches; slopes of 3 to 50 percent.
Veneta: VeB, VeD	Fair to poor: silty clay loam below depth of 8 inches; slopes of 2 to 20 percent.	Not suitable: excessive fines.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Slow permeability; slopes of 2 to 20 percent; bedrock at depth of 40 to more than 50 inches.
Veneta loamy subsoil variant: VnB, VnD, VnE.	Fair: clay loam	Not suitable: excessive fines.	Fair to poor: slopes of 2 to 30 percent; 60 to 75 percent fines.	Moderate to severe: slopes of 2 to 30 percent; 60 to 75 percent fines.	Moderately slow permeability; slopes of 2 to 30 percent; weathered bedrock below depth of 30 to 40 inches.
Waldo: Wa	Poor: poorly drained.	Not suitable: excessive fines.	Poor: poorly drained.	Severe: high shrink-swell potential; seasonal high water table; poorly drained.	Slow permeability.
Wapato: Wc	Poor: poorly drained.	Not suitable to good: thick overburden.	Poor: poorly drained.	Severe: seasonal high water table; subject to overflow; poorly drained.	Moderately slow permeability; subject to overflow; sand or gravel below depth of 4 feet in places.
Willamette: WeA, WeC	Good to fair: slopes of 0 to 12 percent.	Not suitable: excessive fines.	Fair to poor: moderate shrink-swell potential; 95 to 100 percent fines.	Moderate to severe: slopes of 0 to 12 percent; moderate shrink-swell potential; 95 to 100 percent fines.	Moderate permeability; slopes of 0 to 12 percent.

engineering properties of the soils—Continued

Soil features affecting—Continued					
Farm ponds—Con. Embankments, dikes, and levees	Artificial drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading
Not suited	Not applicable	Not suited	Not suited	Not suited	Not suited.
Material below depth of 20 to 30 inches: high permeability where compacted; very slight compressibility; good resistance to piping.	Well drained; very rapid permeability.	Moderate intake rare; moderate available water capacity.	Not applicable	Not applicable	Gravelly.
Moderate permeability where compacted; slight compressibility; poor resistance to to piping.	Well drained; moderate permeability.	Not applicable	Not applicable	Not applicable	Gravelly; slopes of 3 to 50 percent.
Low to moderate permeability where compacted; medium to high compressibility; poor to good resistance to piping.	Well drained to moderately well drained; slow permeability.	Moderate intake rate; high available water capacity; slopes of 2 to 20 percent.	High available water acpacity; slow permeability.	High available water capacity; vegetation fairly easy to establish	Plastic when wet; difficult to excavate.
Moderate permeability where compacted; medium compressibility; poor resistance to piping.	Well drained; moderately slow permeability.	Moderate intake rate; moderate available water capacity; slopes of 2 to 30 percent.	Moderate available water capacity; moderately slow permeability.	Moderate available water capacity; vegetation fairly easy to establish.	Slopes of 2 to 30 percent.
Low permeability where compacted; high compressibility; fair resistance to piping.	Poorly drained; slow permeability; ditchbanks unstable.	Moderate intake rate; high available water capacity; seasonal high water table.	Not applicable	High available water capacity; vegetation fairly difficult to establish.	Seasonal high water table; plastic when wet; difficult to excavate; poor surface drainage.
Low to moderate permeability where compacted; medium to high compressibility; fair to poor resistance to piping.	Poorly drained; moderately slow permeability; seasonal high water table; ditchbanks moderately stable.	Moderate intake rate; high available water capacity; seasonal high water table.	Not applicable	High available water capacity; vegetation fairly easy to establish.	Seasonal high water table; plastic when wet; difficult to excavate.
Low to moderate permeability where compacted; medium to high compressibility; fair to poor resistance to piping.	Well drained; moderate permeability.	Moderate intake rate; high available water capacity; slopes of 0 to 12 percent.	High available water capacity; moderate permeability.	High available water capacity; vegetation easy to establish.	Plastic when wet; difficult to excavate.

TABLE 6.—*Interpretations of*

Soil series and map symbol	Suitability as source of—			Degree and kind of limitation for local roads and streets	Soil features affecting—
	Topsoil	Sand and gravel	Road fill		Farm ponds Reservoir area
Winchuck, silty subsoil variant: WhB	Good to fair: silty clay loam below depth of 8 to 15 inches.	Fair: gravel below depth of 40 inches in places.	Fair: 60 to 90 percent fines.	Fair: 60 to 90 percent fines.	Moderate permeability; slopes of 2 to 7 percent.
Witham: WkB	Poor: clay or silty clay.	Not suitable: excessive fines; thick overburden.	Poor: high shrink-swell potential.	Severe: high shrink-swell potential.	Very slow permeability; perched water table; slopes of 2 to 7 percent.
Witzel: WLG	Poor: cobbly	Not suitable: possible source of rock for crushing.	Poor: bedrock below depth of 12 to 20 inches.	Severe: bedrock below depth of 12 to 20 inches; slopes of 30 to 75 percent.	Moderately slow permeability; bedrock below depth of 12 to 20 inches; slopes of 30 to 75 percent; many cobblestones.
Woodburn: WoA, WoC	Good	Not suitable: excessive fines.	Fair: moderate shrink-swell potential.	Moderate: moderate shrink-swell potential.	Slow permeability; bedrock at depth of more than 72 inches.

Soil properties significant to engineering

Several estimated soil properties significant to engineering are given in table 5. These estimates are made from typical soil profiles, for each layer sufficiently different to have a different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for similar soils, and on experience with the same kinds of soil in other counties. Following are explanations of some of the columns in table 5.

The hydrologic groupings in table 5 are used in estimating the total volume and peak runoff that can be expected from storms of a given amount and intensity. They are useful in planning measures to control runoff. In group A are coarse textured and moderately coarse textured soils that transmit water through their profile at a rapid rate. These soils can absorb the precipitation that results from most storms and have the highest rate of infiltration, even when they are thoroughly wet, and the lowest runoff potential of any of the soils in the survey area. In group B are the moderately coarse textured to moderately fine textured, deep or very deep soils that transmit water through their profile at a moderate rate. These soils have a moderate runoff potential. In group C are the moderately coarse textured to fine textured, deep to shallow soils that transmit water through their profile at a slow rate. These soils have a high runoff potential. In group D are the medium textured, moderately fine textured, and fine textured soils. Some soils in this group have a high water table, some have a thin mantle of soil over impervious material, some have a surface layer consisting of impervious material, and some are very deep. Soils in group D have the highest runoff potential of any soils in the survey area.

Depth to bedrock is the distance from the surface of the soil to the upper surface of the rock layer.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Soil texture is described in table 5 in the standard terms used by the U.S. Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser

engineering properties of the soils—Continued

Soil features affecting—Continued					
Farm ponds—Con. Embankments, dikes, and levees	Artificial drainage	Irrigation	Terraces and diversions	Grassed waterways	Winter grading
Moderate permeability where compacted; medium compressibility; poor stability; poor resistance to piping.	Well drained; moderate permeability.	Moderate intake rate; high available water capacity; slopes of 2 to 7 percent.	High available water capacity; moderate permeability.	High available water capacity; vegetation easy to establish.	Silt loam; slightly difficult to excavate.
Low permeability where compacted; high compressibility; good resistance to piping.	Somewhat poorly drained; very slow permeability; seepage; perched water table; ditchbanks unstable.	Moderate to low intake rate; moderate to high available water capacity; perched water table; poor root penetration; slopes of 2 to 7 percent.	Moderate to high available water capacity.	Moderate to high available water capacity; vegetation fairly difficult to establish.	Seasonal high water table; plastic subsoil.
Low permeability where compacted; slight compressibility; good resistance to piping; many cobblestones.	Well drained; moderately slow permeability.	Not applicable	Not applicable	Not applicable	Very cobbly.
Low to moderate permeability where compacted; medium to high compressibility; fair to poor resistance to piping.	Moderately well drained; slow permeability; seasonal high water table; ditchbanks stable.	Moderate intake rate; high available water capacity; slopes of 0 to 12 percent.	Slow permeability; high available water capacity.	High available water capacity; vegetation easy to establish.	Plastic when wet; difficult to excavate.

than sand, an appropriate modifier is added, for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary.

The tests to determine liquid limit and plastic limit measure the effect of water on consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The plastic limit is the moisture content at which the soil material passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the soil material passes from a plastic to a liquid state. The plasticity index is the numerical difference between liquid limit and plastic limit. It indicates the range in moisture content within which a soil material is in a plastic condition.

Permeability is the rate at which water moves downward through undisturbed soils. The estimates are based on undisturbed cores of saturated soils.

The available water capacity is the capacity of soils to store water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Reaction is the intensity of the acidity or alkalinity of the soil, expressed in pH values. A pH notation of 7.0 is neutral. A lower value indicates acidity, and a higher value indicates alkalinity.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. The extent of shrinking and swelling is influenced by the amount and kinds of clay in the soil. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built on, in, or with material having this rating.

Corrosivity pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete (*17*). The rate of corrosion of uncoated steel is related to such soil properties as drainage, texture, total acidity, and electrical conductivity of the soil material. Corrosivity for concrete is influenced mainly by the content of sodium or magnesium sulfate, but also by soil texture and acidity. In-

stallations of uncoated steel that intersect soil boundaries or soil horizons are more susceptible to corrosion than installations entirely in one kind of soil or in one soil horizon. A corrosivity rating of *low* means that the probability of soil-induced corrosion damage is low. A rating of *high* means that the probability of damage is high, and protective measures for steel and more resistant concrete should be used to avoid or minimize damage.

Engineering interpretations of the soils

The estimated interpretations in table 6 are based on the engineering properties of soils shown in table 5, on test data for soils in nearby or adjoining survey areas, and on the experience of engineers and soil scientists with the soils of the Benton County Area. In table 6 ratings are used to summarize the degree and kind of limitation or the suitability of the soils for all listed purposes other than for drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, winter grading, grassed waterways, and terraces and diversions. For these particular uses, table 6 lists soil features not to be overlooked in planning, installation, and maintenance.

Following are explanations of some of the columns in table 6. Soil suitability is rated by the terms *good*, *fair*, and *poor*, ratings which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as in preparin a seedbed; by natural fertility of the material or the response of plants to it when fertilizer is applied; and by absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are also characteristics that affect suitability. In addition, ratings consider what damage will result at the area from which topsoil is taken.

Sand and gravel are used in great quantities in many kinds of construction. The ratings provide guidance about probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect the mining of the materials. The ratings also do not indicate the quality of the deposit. A detailed investigation at the site of a probable source is needed to determine the suitability of the sandy or gravelly material for a special use.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

The suitability of the soil material for road fill depends in part on the texture and plasticity of the soil material, its water content and compaction characteristics, the hazard of erosion, and presence of rock within the normal depth of the road excavation. Highly plastic soil materials having a high water content generally are unsuitable for road fill. The same features that apply to road fill generally apply to the location of highways. Also considered are the presence of a high water table and the hazard of flooding.

Local roads and streets have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHO classification, the Unified classification, and the shrink-swell potential indicate the traffic-supporting capacity of the soil material. Wetness and flooding affect the stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means that soil properties generally are favorable for the rated use; that is, limitations are minor and can be easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means that soil properties are so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material. the features shown in the table are those of an undisturbed soil.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Unfavorable factors include the presence of stones and organic material. Features shown in the table are those of soil material that has been disturbed.

Drainage of cropland and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence the rate of water movement; depth to the water table; slope and stability in ditchbanks; susceptibility to stream overflow; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow or water erosion; soil texture; content of stones; depth of root zone; rate of water intake at the surface; permeability of the soil below the surface layer; and layers that restrict the movement of water. Other important features are available water capacity, the need for drainage, and the depth to water table or bedrock.

Terraces and diversions are embankments, or ridges, that are constructed across a slope to intercept runoff and make it soak into the soil or flow slowly to a prepared outlet. Features that affect the suitability of a soil for terraces and diversions are uniformity and steepness of slope, depth to bedrock or other unfavorable material, presence of stones, permeability, and resistance to water erosion and soil slipping. A soil suitable for these structures provides an outlet for runoff and is not difficult to vegetate.

The suitability of a soil for establishing and maintain-

ing vegetation in a waterway are the hazard of erosion, reaction, and natural fertility. For soils that are level or nearly level, and for soils that do not require waterways, "not applicable" is shown in the column giving features that affect suitability for grassed waterways.

Soil features that affect winter grading are depth to seasonal water table, slope, and soil textures that include the coarse fragment content. These features reflect the difficulty with which the soil material can be excavated in winter.

In the upland sections of the Area, some weathered soil materials are unstable, highly plastic clays subject to land movement. Even small pockets less than 10 feet wide can slump where they are exposed in road cuts and cause serious road maintenance problems. Larger areas of this weathered sediment require extensive remedial practices. In contrast, the soil material weathered from volcanic rock (in other parts of the Coast Range) is more stable. Highly plastic clays seldom occur in these areas. In either area, the removal of soil material from the base of a slope may start landslides.

Town and Country Planning [6]

This section was prepared mainly for community planners, developers, landscape architects, builders, zoning officials, realtors, private and potential landowners, and others interested in the use of soils in the Benton County Area. Population is increasing rapidly, and community development is steadily expanding into areas formerly used for farming. The demand for housing, shopping centers, schools, parks, golf courses, and other community developments is increasing.

In selecting a site for a home, a highway, an industry, recreational use, or other purposes, the suitability of the soils in each site for such use should be determined. Some of the more common properties affecting the use of the soils for these purposes are soil texture, shrink-swell potential, steepness of slope, permeability, depth to bedrock and to the water table, and the hazard of flooding. On the basis of these and other related characteristics, soil scientists and engineers have rated the soils of the Benton County Area for specific land uses. The ratings and the nature of the soil limitations that influenced the ratings are shown in table 7.

The ratings used in this table are *slight*, *moderate*, and *severe*, and they are applied as the soils occur naturally. If the rating is *slight*, little or no adjustments are needed in use and no limitations are shown. A *moderate* rating means that the soil has limitations that can be overcome. A *severe* rating means that the soil has serious limitations that are costly to overcome and that the use of the soil for the intended purpose is questionable. Where a rating of moderate or severe is given, the chief limiting features are identified.

In the paragraphs that follow, each use is defined, and the properties important in rating the limitations of the soils for such purpose are given. This information can be used along with that in table 7, information in other parts of the survey, and the soil map at the back of the survey as a guide in planning the use of the soils. Before beginning most construction projects, however, an investigation should be made at the site being considered.

Dwellings without basements are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock (*7*), and the content of stones and rocks.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material from a depth of about 18 inches to about 6 feet is evaluated. The soil properties considered are those that affect the absorption of effluent and the construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction. Slope also affects the risk of soil erosion, lateral seepage, and the downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids (*8*). A lagoon has a nearly level floor and has sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density, and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic matter, and slope; and if the floor needs to be leveled, depth to bedrock becomes important. The soil properties that affect the embankment are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the amounts of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Among the recreational facilities considered are playgrounds, camp areas, picnic areas, and paths and trails. Important soil properties considered for such uses are wetness and depth to water table, the hazard of flooding, slope, depth to bedrock, permeability, and the amount of stones, rocks, and cobblestones.

Playgrounds and camp areas have similar limitations for use. Playgrounds are used intensively for baseball, football, tennis, badminton, and other organized games. Camp areas are sites available for tents and small camp trailers and for outdoor dining for periods up to 14 days. Both kinds of areas are used frequently and intensively and should withstand heavy foot traffic.

The requirements for playgrounds are similar to those for camp areas. If the rating is *severe*, limitations for the two uses are similar. Soils that have *slight* limitations for playgrounds should have slopes of not more than 3 percent, the surface should be free of coarse fragments, and hard rock should be at a depth of 40 inches or more. Soils with *moderate* limitations for this use may have one or more of the following features: slopes of 3 to 7 percent, bedrock at a depth between 20 and 40 inches, somewhat poor drainage, moderately slow or slow permeability, or a surface texture of silty clay loam or clay loam.

[6] RICHARD C. HERRIMAN, soil scientist, Soil Conservation Service, helped to prepare this section.

TABLE 7.—*Degree and kinds of limitations*

[An asterisk in the first column indicates that a mapping unit contains more than one kind of soil. The properties of the soils in such column of

Soil	Residential and commercial applications		
	Dwellings without basements	Septic tank absorption fields	Sewage lagoons
Abiqua:			
AbA	Severe: high shrink-swell potential.	Severe: moderately slow permeability.	Moderate: gravel below depth of 40 inches in places.
AbB	Severe: high shrink-swell potential.	Severe: moderately slow permeability.	Moderate: slopes of 3 to 5 percent; gravel below depth of 40 inches.
Amity: Am	Severe: seasonal high water table at depth of 12 to 24 inches.	Severe: moderately slow permeability; seasonal high water table at depth of 12 to 24 inches.	Severe: seasonal high water table at depth of 12 to 24 inches.
Apt:			
ApC	Severe: high shrink-swell potential.	Severe: moderately slow permeability.	Moderate to severe: slopes of 3 to 12 percent.
ASD, ATD	Severe: high shrink-swell potential.	Severe: slopes of 5 to 25 percent; moderately slow permeability.	Severe: excessive slope
ASF	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
Bashaw: Ba, Bc	Severe: seasonal high water table at depth of 0 to 6 inches; high shrink-swell potential.	Severe: very slow permeability.	Severe: seasonal high water table at depth of 0 to 6 inches.
Bellpine:			
BeC	Moderate: slopes of 3 to 12 percent; moderate shrink-swell potential.	Severe: bedrock below depth of 20 to 40 inches; slow permeability.	Severe: bedrock below depth of 20 to 40 inches.
BeD	Moderate to severe: slopes of 12 to 20 percent.	Severe: bedrock below depth of 20 to 40 inches.	Severe: excessive slope
BeE	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
BeF	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
Blachly:			
BLE	Moderate to severe: slopes of 3 to 30 percent.	Severe: moderately slow permeability; slopes of 3 to 30 percent.	Severe: slopes of 3 to 30 percent.
BLF	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
Bohannon: BOF, BOG	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
Brenner: Bp	Severe: seasonal high water table at depth of 0 to 6 inches.	Severe: seasonal high water table at depth of 0 to 6 inches; slow permeability.	Severe: occasional flooding; seasonal high water table at depth of 0 to 6 inches.
Briedwell:			
BrB	Slight	Moderate to severe: bedrock below depth of 40 to 60 inches.	Severe: Moderately rapid permeability in upper 17 inches, moderate permeability below.
BrD	Moderate to severe: slopes of 7 to 20 percent.	Moderate to severe: slopes of 7 to 20 percent; very gravelly substratum.	Severe: excessive slope
Camas: Ca	Severe: subject to flooding	Severe: subject to flooding	Severe: subject to flooding
Chehalis: Ch	Severe: subject to flooding	Severe: subject to flooding	Severe: subject to flooding

for town and country planning

mapping units may differ, and for this reason it is necessary to follow carefully the instructions for referring to other series in the first this table]

Recreational facilities			
Playgrounds	Camp areas	Picnic areas	Paths and trails
Moderate: silty clay loam----	Moderate: silty clay loam-----	Moderate: silty clay loam-----	Moderate: silty clay loam.
Moderate: silty clay loam; slopes of 3 to 5 percent.	Moderate: silty clay loam-----	Moderate: silty clay loam-----	Moderate: silty clay loam.
Severe: seasonal high water table at depth of 12 to 24 inches; moderately slow permeability.	Moderate: seasonal high water table; moderately slow permeability.	Moderate: seasonal high water table.	Moderate: somewhat poorly drained.
Moderate to severe: slopes of 3 to 12 percent.	Moderate: silty clay loam; slopes of 3 to 12 percent.	Moderate: silty clay loam; slopes of 3 to 12 percent.	Moderate: silty clay loam.
Severe: excessive slope-------	Moderate to severe: silty clay loam; slopes of 5 to 25 percent.	Moderate to severe: silty clay loam; slopes of 5 to 25 percent.	Moderate: silty clay loam.
Severe: excessive slope-------	Severe: excessive slope--------	Severe: excessive slope--------	Severe: excessive slope.
Severe: poorly drained-------	Severe: poorly drained--------	Severe: poorly drained--------	Severe: poorly drained.
Moderate to severe: slopes of 3 to 12 percent; silty clay loam.	Moderate: slopes of 3 to 12 percent; silty clay loam.	Moderate: slopes of 3 to 12 percent; silty clay loam.	Moderate: silty clay loam.
Severe: excessive slope-------	Severe: slopes of 12 to 20 percent.	Severe: slopes of 12 to 20 percent.	Moderate: silty clay loam; slopes of 12 to 20 percent.
Severe: excessive slope-------	Severe: excessive slope--------	Severe: excessive slope--------	Moderate: silty clay loam; slopes of 20 to 30 percent.
Severe: excessive slope-------	Severe: excessive slope--------	Severe: excessive slope--------	Severe: excessive slope.
Moderate to severe: slopes of 3 to 30 percent.	Moderate to severe: slopes of 3 to 30 percent.	Moderate to severe: slopes of 3 to 30 percent.	Moderate: slopes of 3 to 30 percent.
Severe: excessive slope-------	Severe: excessive slope--------	Severe: excessive slope--------	Severe: excessive slope.
Severe: excessive slope-------	Severe: excessive slope--------	Severe: excessive slope--------	Severe: excessive slope.
Severe: poorly drained-------	Severe: poorly drained--------	Severe: poorly drained--------	Severe: poorly drained.
Moderate to severe: gravelly--	Moderate: gravelly-----------	Moderate: gravelly-----------	Moderate: gravelly.
Severe: excessive slope-------	Moderate to severe: slopes of 7 to 20 percent.	Moderate to severe: slopes of 7 to 20 percent.	Moderate: slopes of 7 to 20 percent; gravelly.
Severe: gravelly------------	Severe: gravelly; subject to flooding.	Moderate: gravelly-----------	Moderate: gravelly.
Severe: silty clay loam; subject to flooding.	Severe: silty clay loam; subject to flooding.	Moderate: silty clay loam-----	Moderate: silty clay loam.

TABLE 7.—*Degree and kinds of limitations*

Soil	Residential and commercial applications		
	Dwellings without basements	Septic tank absorption fields	Sewage lagoons
Cloquato: Cm	Severe: subject to flooding	Severe: subject to flooding	Severe: subject to flooding
Coburg: Cn	Severe: seasonal high water table; high shrink-swell potential.	Severe: moderately slow permeability; seasonal high water table.	Severe: seasonal high water table.
Concord: Co	Severe: seasonal high water table.	Severe: slow permeability; seasonal high water table.	Severe: seasonal high water table.
Conser: Cs	Severe: seasonal high water table; poorly drained.	Severe: seasonal high water table.	Severe: seasonal high water table; subject to flooding.
Dayton: Da	Severe: seasonal high water table; poorly drained.	Severe: seasonal high water table; very slow permeability.	Severe: seasonal high water table.
Dixonville:			
DnC	Severe: basalt bedrock below depth of 20 to 40 inches.	Severe: slow permeability; bedrock below depth of 20 to 40 inches.	Severe: bedrock below depth of 20 to 40 inches.
DnD	Severe: bedrock below depth of 20 to 40 inches; slopes of 12 to 20 percent.	Severe: excessive slope; bedrock below depth of 20 to 40 inches; slow permeability.	Severe: excessive slope
DnE	Severe: excessive slope	Severe: excessive slope; slow permeability.	Severe: excessive slope
DnF	Severe: excessive slope	Severe: excessive slope; slow permeability.	Severe: excessive slope
Dupee: DuC	Moderate: seasonal high water table below depth of 20 to 26 inches.	Severe: moderately slow permeability; seasonal high water table.	Severe: seasonal high water table below depth of 20 to 26 inches.
Hazelair:			
HaC	Severe: seasonal high water table.	Severe: very slow permeability	Severe: seasonal high water table below depth of 12 to 30 inches.
*HeC:			
Hazelair part	Severe: seasonal high water table.	Severe: very slow permeability	Severe: seasonal high water table below depth of 12 to 30 inches.
Hazelair, well-drained variant part.	Moderate: bedrock below depth of 20 to 40 inches.	Severe: bedrock below depth of 20 to 40 inches; slow permeability.	Severe: bedrock below depth of 20 to 40 inches; slopes of 3 to 12 percent.
*HeD:			
Hazelair part	Severe: seasonal high water table.	Severe: very slow permeability	Severe: seasonal high water table below depth of 12 to 30 inches.
Hazelair, well-drained variant part.	Moderate to severe: slopes of 12 to 20 percent.	Severe: bedrock below depth of 20 to 40 inches; slow permeability; slopes of 12 to 20 percent.	Severe: bedrock below a depth of 20 to 40 inches; slopes of 12 to 20 percent.
Honeygrove:			
HgC	Moderate: moderate shrink-swell potential.	Severe: moderately slow permeability.	Moderate to severe: slopes of 3 to 12 percent.
HND	Moderate to severe: slopes of 3 to 25 percent; moderate shrink-swell potential.	Severe: moderately slow permeability; slopes of 3 to 25 percent.	Moderate to severe: excessive slope.
HNF	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
HOD	Severe: high susceptibility to sliding; slopes of 5 to 25 percent.	Severe: moderately slow permeability; slopes of 5 to 25 percent.	Moderate to severe: excessive slope.

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Recreational facilities			
Playgrounds	Camp areas	Picnic areas	Paths and trails
Severe: subject to flooding	Severe: subject to flooding	Slight	Slight.
Moderate: silty clay loam	Moderate: silty clay loam	Moderate: silty clay loam	Moderate: silty clay loam.
Severe: poorly drained	Severe: poorly drained	Severe: poorly drained	Severe: poorly drained.
Severe: poorly drained	Severe: poorly drained	Severe: poorly drained	Severe: poorly drained.
Severe: poorly drained	Severe: poorly drained	Severe: poorly drained	Severe: poorly drained.
Moderate to severe: silty clay loam; slopes of 3 to 12 percent.	Moderate: silty clay loam; slopes of 3 to 12 percent.	Moderate: silty clay loam; slopes of 3 to 12 percent.	Moderate: silty clay loam.
Severe: excessive slope	Severe: slopes of 12 to 20 percent.	Severe: slopes of 12 to 20 percent.	Moderate: slopes of 12 to 20 percent; silty clay loam.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Moderate: slopes of 20 to 30 percent; silty clay loam.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope.
Moderate to severe: slopes of 3 to 12 percent.	Moderate: moderately slow permeability.	Moderate: slopes of 3 to 12 percent.	Slight to moderate: moderately well drained to somewhat poorly drained.
Severe: slopes of 3 to 12 percent; very slow permeability.	Severe: very slow permeability.	Moderate: moderately well drained and somewhat poorly drained.	Moderate: moderately well drained and somewhat poorly drained.
Severe: slopes of 3 to 12 percent; very slow permeability.	Severe: very slow permeability.	Moderate: moderately well drained and somewhat poorly drained.	Moderate: moderately well drained and somewhat poorly drained.
Moderate to severe: slopes of 3 to 12 percent.	Moderate: silty clay loam	Moderate: silty clay loam	Moderate: silty clay loam.
Severe: slopes of 3 to 12 percent; very slow permeability.	Severe: very slow permeability.	Moderate: moderately well drained and somewhat poorly drained.	Moderate: moderately well drained and somewhat poorly drained.
Severe: slopes of 12 to 20 percent.	Severe: slopes of 12 to 20 percent.	Severe: slopes of 12 to 20 percent.	Moderate: silty clay loam; slopes of 12 to 20 percent.
Moderate to severe: slopes of 3 to 12 percent.	Moderate: slopes of 3 to 12 percent.	Moderate: silty clay loam	Moderate: silty clay loam.
Moderate to severe: slopes of 3 to 25 percent.	Moderate to severe: slopes of 3 to 25 percent.	Moderate to severe: slopes of 3 to 25 percent.	Moderate: silty clay loam; slopes of 3 to 25 percent.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope.
Moderate to severe: slopes of 5 to 25 percent.	Moderate to severe: slopes of 5 to 25 percent.	Moderate to severe: slopes of 5 to 25 percent.	Moderate: slopes of 5 to 25 percent; silty clay loam.

TABLE 7.—*Degree and kinds of limitations*

Soil	Residential and commercial applications		
	Dwellings without basements	Septic tank absorption fields	Sewage lagoons
Jory:			
JoC	Moderate: moderate shrink-swell potential.	Severe: moderately slow permeability.	Moderate to severe: slopes of 2 to 12 percent.
JoD	Moderate to severe: slopes of 12 to 20 percent.	Severe: slopes of 12 to 20 percent.	Severe: excessive slope
JoE	Severe: slopes of 20 to 30 percent.	Severe: slopes of 20 to 30 percent.	Severe: excessive slope
JRE	Moderate to severe: slopes of 2 to 30 percent; moderate shrink-swell potential.	Severe: moderately slow permeability; slopes of 2 to 30 percent.	Moderate to severe: slopes of 2 to 30 percent.
JRF	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
Kilchis: KHG	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
Klickitat: KKF, KKG	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
Malabon: Ma	Moderate: moderate shrink-swell potential.	Severe: moderately slow permeability.	Moderate: slopes of 0 to 3 percent.
Marty:			
MGD	Slight to severe: slopes of 3 to 25 percent.	Severe: moderately slow permeability.	Moderate to severe: slopes of 3 to 25 percent.
MGF	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
McAlpin: Mn	Severe: seasonal high water table at depth of 18 to 36 inches; high shrink-swell potential.	Severe: moderately slow permeability; seasonal high water table.	Severe: gravel below depth of 40 inches in places; seasonal high water table.
McBee: Ms	Severe: subject to flooding	Severe: subject to flooding	Severe: subject to flooding
Mixed alluvial land: MX. Too variable to be rated. Onsite investigation needed.			
Mulkey: MYD	Severe: slopes of 5 to 25 percent; high frost-action potential.	Severe: bedrock below depth of 20 to 40 inches; slopes of 5 to 25 percent.	Severe: moderately rapid permeability; slopes of 5 to 25 percent.
Nehalem: Ne	Severe: subject to flooding	Severe: subject to flooding	Severe: subject to flooding
Newberg: Ng, Nm	Severe: subject to flooding	Severe: subject to flooding	Severe: subject to flooding
Peavine:			
PEE	Moderate to severe: bedrock below depth of 30 to 40 inches; slopes of 3 to 30 percent.	Severe: bedrock below depth of 30 to 40 inches; slopes of 3 to 30 percent; moderately slow permeability.	Severe: slopes of 3 to 30 percent; bedrock below depth of 30 to 40 inches.
PEF	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
Philomath: PhC, PhE	Severe: bedrock below depth of less than 20 inches.	Severe: bedrock below depth of less than 20 inches; high shrink-swell potential.	Severe: bedrock below depth of less than 20 inches.
Pilchuck: Pk	Severe: subject to flooding	Severe: subject to flooding	Severe: subject to flooding

or town and country planning—Continued

Recreational facilities			
Playgrounds	Camp areas	Picnic areas	Paths and trails
Moderate to severe: slopes of 2 to 12 percent.	Moderate: silty clay loam	Moderate: silty clay loam	Moderate: silty clay loam.
Severe: excessive slope	Severe: slopes of 12 to 20 percent.	Severe: slopes of 12 to 20 percent.	Moderate: slopes of 12 to 20 percent; silty clay loam.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Moderate: slopes of 20 to 30 percent; silty clay loam.
Moderate to severe: slopes of 2 to 30 percent.	Moderate to severe: slopes of 2 to 30 percent.	Moderate to severe: slopes of 2 to 30 percent.	Slight to moderate: slopes of 2 to 30 percent; silty clay loam.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope.
Moderate: silty clay loam	Moderate: silty clay loam	Moderate: silty clay loam	Moderate: silty clay loam.
Moderate to severe: slopes of 3 to 25 percent.	Moderate to severe: slopes of 3 to 25 percent.	Moderate to severe: slopes of 3 to 25 percent.	Slight to moderate: slopes of 3 to 25 percent.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope.
Moderate: seasonal high water table: moderately slow permeability.	Moderate: seasonal high water table; moderately slow permeability.	Moderate: seasonal high water table.	Moderate: silty clay loam.
Severe: subject to flooding	Severe: subject to flooding	Moderate: subject to flooding	Moderate: silty clay loam.
Severe: slopes of 5 to 25 percent.	Moderate to severe: slopes of 5 to 25 percent.	Moderate to severe: slopes of 5 to 25 percent.	Slight to moderate: slopes of 5 to 25 percent.
Severe: subject to flooding	Moderate: subject to flooding	Moderate: subject to flooding	Moderate: subject to flooding.
Severe: subject to flooding	Moderate: subject to flooding	Moderate: subject to flooding	Moderate: subject to flooding.
Moderate to severe: slopes of 3 to 30 percent.	Moderate to severe: slopes of 3 to 30 percent.	Moderate to severe: slopes of 3 to 30 percent.	Moderate: slopes of 13 to 30 percent.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope.
Severe: bedrock below depth of less than 20 inches.	Severe: silty clay	Severe: silty clay	Severe: silty clay.
Severe: subject to flooding	Severe: subject to flooding	Moderate: subject to flooding	Moderate: subject to flooding.

TABLE 7.—*Degree and kinds of limitations*

Soil	Residential and commercial applications		
	Dwellings without basements	Septic tank absorption fields	Sewage lagoons
*Price:			
PrC	Moderate: slopes of 3 to 12 percent; moderate shrink-swell potential.	Severe: moderately slow permeability.	Moderate to severe: slopes of 3 to 12 percent.
PrD	Moderate to severe: slopes of 12 to 20 percent.	Severe: slopes of 12 to 20 percent; moderately slow permeability.	Severe: slopes of 12 to 20 percent.
PTE For limitations of Ritner part, see Ritner series.	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
PTF For limitations of Ritner pa t, see Ritner series.	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
*Ritner:			
RPE For Price part, see Price soils.	Moderate to severe: basalt bedrock below depth of 30 to 40 inches; slopes of 12 to 30 percent.	Severe: basalt bedrock below depth of 30 to 40 inches; slopes of 12 to 30 percent.	Severe: excessive slope
RPG For Price part, see Price soils.	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
Riverwash: Rw. Not suited to the selected applications or facilities.			
Salem: Sa	Slight	Slight: very gravelly sand below depth of 20 to 30 inches; hazard of polluting water supplies.	Severe: very rapid permeability.
Slickrock:			
SLD	Slight to severe: slopes of 3 to 25 percent.	Moderate to severe: slopes of 3 to 25 percent; moderate permeability.	Moderate to severe: slopes of 3 to 25 percent; moderate permeability.
SLF	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
Veneta:			
VeB	Severe: high shrink-swell potential.	Severe: slow permeability	Moderate: slopes of 2 to 7 percent.
VeD	Severe: slopes of 7 to 20 percent; high shrink-swell potential.	Severe: slow permeability; slopes of 7 to 20 percent.	Severe: slopes of 7 to 20 percent.
VnB	Moderate: bedrock below depth of 30 to 40 inches.	Severe: bedrock below depth of 30 to 40 inches.	Severe: bedrock below depth of 30 to 40 inches.
VnD	Moderate to severe: slopes of 7 to 20 percent; bedrock below depth of 30 to 40 inches.	Severe: slopes of 7 to 20 percent; bedrock below depth of 30 to 40 inches.	Severe: excessive slope
VnE	Severe: slopes of 20 to 30 percent.	Severe: slopes of 20 to 30 percent.	Severe: excessive slope
Waldo: Wa	Severe: seasonal high water table; poorly drained.	Severe: seasonal high water table; slow permeability.	Severe: seasonal high water table at depth of 0 to 6 inches.
Wapato: Wc	Severe: seasonal high water table.	Severe: seasonal high water table.	Severe: subject to flooding

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Recreational facilities			
Playgrounds	Camp areas	Picnic areas	Paths and trails
Moderate to severe: slopes of 3 to 12 percent.	Moderate to severe: silty clay loam.	Moderate: silty clay loam	Moderate: silty clay loam.
Severe: slopes of 12 to 20 percent.	Severe: slopes of 12 to 20 percent.	Severe: slopes of 12 to 20 percent.	Moderate: slopes of 12 to 20 percent.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Moderate to severe: excessive slope.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Moderate to severe: silty clay loam; slopes of 12 to 30 percent.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope.
Severe: gravelly	Slight	Slight	Slight.
Severe: slopes of 3 to 25 percent; gravelly.	Moderate to severe: slopes of 3 to 25 percent.	Moderate to severe: slopes of 3 to 25 percent.	Slight to moderate: slopes of 3 to 25 percent.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope.
Moderate: slopes of 2 to 7 percent.	Moderate: slow permeability	Slight	Slight.
Severe: slopes of 7 to 20 percent.	Moderate to severe: slopes of 7 to 20 percent.	Moderate to severe: slopes of 7 to 20 percent.	Slight to moderate: slopes of 7 to 20 percent.
Moderate: slopes of 2 to 7 percent.	Slight	Slight	Slight.
Severe: excessive slope	Moderate to severe: slopes of 7 to 20 percent.	Moderate to severe: slopes of 7 to 20 percent.	Slight to moderate: slopes of 7 to 20 percent.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Moderate: slopes of 20 to 30 percent.
Severe: poorly drained	Severe: poorly drained	Severe: poorly drained	Severe: poorly drained.
Severe: poorly drained	Severe: poorly drained	Severe: poorly drained	Severe: poorly drained.

TABLE 7.—*Degree and kinds of limitations*

Soil	Residential and commercial applications		
	Dwellings without basements	Septic tank absorption fields	Sewage lagoons
Willamette: WeA	Moderate: moderate shrink-swell potential.	Slight	Moderate: moderate permeability.
WeC	Moderate: moderate shrink-swell potential.	Slight to moderate: slopes of 3 to 12 percent.	Moderate to severe: slopes of 3 to 12 percent; moderate permeability.
Winchuck, silty subsoil variant: WhB.	Slight	Slight	Moderate: slopes of 2 to 7 percent; moderate permeability.
Witham: WkB	Severe: high shrink-swell potential.	Severe: very slow permeability; seasonal high water table.	Severe: seasonal high water table at depth of 12 to 30 inches.
Witzel: WLG	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope
Woodburn: WoA	Moderate to severe: seasonal high water table at depth of 18 to 36 inches.	Severe: seasonal high water table; slow permeability.	Severe: seasonal high water table at depth of 18 to 36 inches.
WoC	Moderate to severe: seasonal high water table at depth of 18 to 36 inches.	Severe: seasonal high water table; slopes of 3 to 12 percent; slow permeability.	Severe: slopes of 3 to 12 percent; seasonal high water table at depth of 18 to 36 inches.

Camp areas require little site preparation other than that required in areas used for tents or for parking. The soils must be able to support heavy foot and vehicular traffic. Soils rated *slight* for this use are well drained, are free of flooding, and have rapid to moderate permeability. They also have slopes of less than 7 percent, a surface layer that is friable and has less than about 15 percent coarse fragments larger than 10 inches. Soils rated *moderate* for this use have slopes of 7 to 12 percent, occasional flooding during periods of use, moderately slow or slow permeability, a silty clay loam or clay loam surface layer, or are somewhat poorly drained. Soils rated *severe* for camp areas are wet, or water ponds during periods of use. In addition, flooding is a hazard, slopes are more than 12 percent, and the surface layer is loose and sandy or clayey or has 50 percent or more coarse fragments larger than 10 inches.

Picnic areas should be suitable for pleasure outings where meals are eaten outdoors. Such facilities as tables and fireplaces generally are furnished. The chief requirements are good drainage and gentle slopes. It is assumed that little site preparation is needed. Soils that have *slight* limitation for use as picnic grounds are well drained, somewhat excessively drained, or moderately well drained. free of flooding during the season of use, have slopes of less than 7 percent, are over 40 inches to bedrock, and have a surface layer that is relatively free of coarse fragments larger than 10 inches. Soils with *moderate* limitations for this use have slopes of 7 to 12 percent, are somewhat poorly drained, or have silty clay loam or clay loam surface texture. Soils that have *severe* limitations for this use are wet, are subject to flooding more than once in 2 years during the season of use, have slopes of more than 12 percent, or have a clay surface texture.

Paths and trails are areas used for cross-country hiking, bridle paths, and other nonintensive use. The areas are assumed to be for use as they occur in nature and need little soil excavation. Soils are rated *slight* if they are excessively drained, somewhat excessively drained, well drained, moderately well drained and have a seasonal water table below a depth of 20 inches during the season of use. Also, such soils are free of flooding and have slopes of less than 12 percent and a surface layer that is friable and mostly free of coarse fragments larger than 10 inches. Soils rated *moderate* have slopes of 12 to 30 percent, somewhat poor drainage, or a surface layer of silty clay loam or clay loam. Soils are rated *severe* if they are wet or are flooded during periods of use, if slopes are more than 30 percent, or if the surface layer is sticky and plastic when wet or otherwise restricts foot traffic.

Formation and Classification of the Soils

Soils of the Benton County Area differ in fertility, in physical and chemical properties, and in productivity. These differences are the result of differences in parent material and of local differences in the environment under which the soils formed. This section describes some factors in the environment and the major processes that have affected the formation of soils in the Benton County Area. It also describes the system for classifying soils and gives the classification of the soil series by higher categories.

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Recreational facilities			
Playgrounds	Camp areas	Picnic areas	Paths and trails
Slight	Slight	Slight	Slight.
Moderate to severe: slopes of 3 to 12 percent.	Slight to moderate: slopes of 3 to 12 percent.	Slight to moderate: slopes of 3 to 12 percent.	Slight.
Moderate: slopes of 2 to 7 percent.	Slight	Slight	Slight.
Moderate: silty clay loam	Moderate: silty clay loam	Moderate: silty clay loam	Moderate: silty clay loam.
Severe: excessive slope	Severe: excessive slope	Severe: excessive slope	Severe: excessive slope.
Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.	Moderate: seasonal high water table.
Moderate to severe: seasonal high water table; slopes of 3 to 12 percent.	Moderate: seasonal high water table; slopes of 3 to 12 percent.	Moderate: slopes of 3 to 12 percent; seasonal high water table.	Moderate: seasonal high water table.

Formation of Soils

Soil is a more or less continuous body covering that part of the land surface upon which plants grow. Soil forms when the environmental factors of climate, relief, biological forces, and time interact with the parent material. The formation of each soil and its characteristics are affected by these five factors. Soil formation is a complex process in which these five factors, or agents, are interdependent. Their influence on the kind and degree of soil formation varies from place to place. These five factors, or forces, interact with different intensities and combinations from one area to another. In some places, one or two factors may dominate. An example is climate, which affects the type of plants and the amount of water available for weathering the parent rock material. In other areas, relief is the dominant factor, and its influence on erosion, surface runoff, and internal soil drainage is reflected in the kinds of soil that form. The influence of the factors of soil formation on the soils in the Benton County Area are discussed in the paragraphs that follow.

Parent material

Parent material is an unconsolidated layer on the earth's surface from which soils form. Parent materials commonly are identified and described by their geologic origin and mineral composition. Soils of the Benton County Area formed mainly in recent alluvium, terrace sediments, old gravelly alluvium, and materials weathered from sandstone, basalt, and other rocks (fig. 22) (*1, 3, 4, 5, 6, 13, 14, 15, 24*).

Recent alluvium is the main kind of parent material along river and stream bottoms. These sediments were derived from material of mixed mineralogy. Some of this material is from local alluvium that has been transported only a short distance. The alluvium along major streams and rivers has been moved for a considerable distance. The alluvium has a wide range of texture. Some of the soils that formed in these materials are those of the Bashaw, Brenner, Camas, Chehalis, and Newberg series.

Terrace sediments are on the main valley floor and consist of thick deposits of stratified sediments that range in texture from silt to clay. These materials were deposited by water during the Late Pleistocene epoch. The differences in texture and mineralogy of these materials are reflected in the chemical and physical characteristics of the soils. The Amity, Dayton, Willamette, and Woodburn soils formed in these sediments. The Malabon and Coburg soils formed in sediments of younger terraces.

Old gravelly alluvium composed of well-weathered gravel of mixed sedimentary and volcanic rocks occurs as terrace remnants along the lower slopes of the foothills. This material has been covered by a more recent deposit of silt that is 2 to 3 feet thick. The Veneta soils formed in this material.

Sandstone formations consist of thick, bedded sandstone and sandy siltstone and are throughout the Survey Area. These formations extend from the valley foothills into the deeply dissected Coast Range. The sandstones are composed of micaceous, arkosic, and basaltic materials that have a matrix of clay minerals. The rock is approximately 20 to 30 percent quartz minerals, 30 to 40 percent plagioclase, and 10 percent mica and fragments of volcanic

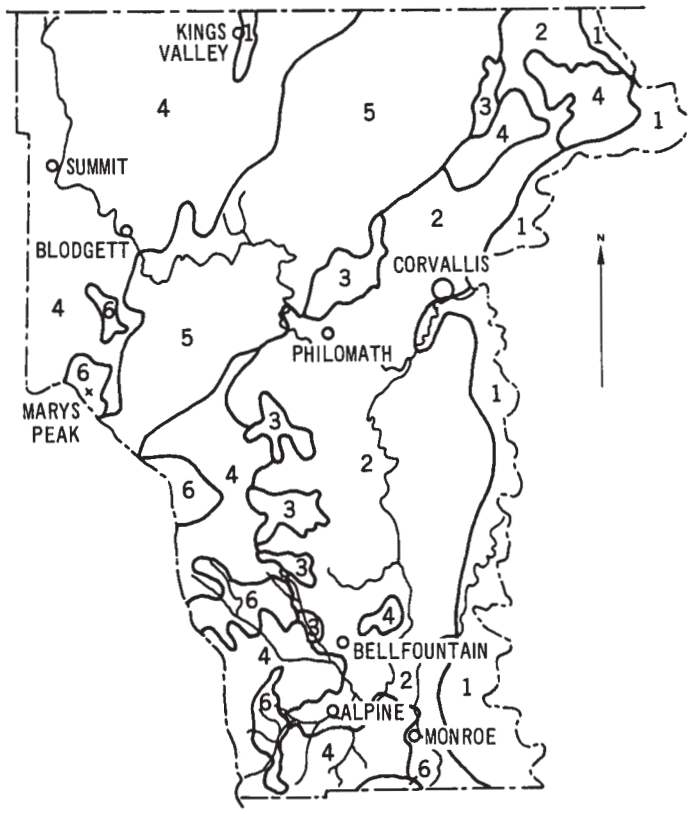

Figure 22.—**Parent materials in Benton County Area: 1, recent alluvium: 2, terrace sediments; 3, old gravelly alluvium; 4, sandstone; 5, basalt flows; 6, intrusive rocks.**

rock. These soft sedimentary rocks weather rapidly, and the effect of the parent material is reflected in the soil characteristics. The morphology of the soils indicates that many of the parent materials are colluvial. The Bohannon, Apt, Bellpine soils, and Veneta soils, loamy subsoil variant, formed in these materials.

Basalt flows are the oldest rock exposed in the survey area. They consist of a thick sequence of basalt flows composed of pillow lavas and flow breccias. The tuffaceous siltstone is a member of this formation, although the dominant rock type is basalt. The partially weathered basalt saprolite is brownish to yellowish gray. The basalt ranges from hard unweathered rock to almost completely weathered soft saprolite. These materials occur in the low foothills and extend into the steep mountainous area of the Coast Range. Many of the soils associated with this formation formed in alluvial and colluvial materials produced by active erosion on steeper slopes. Dixonville, Jory, and Price soils are some of the soils that formed in basaltic materials.

The intrusive rocks consist of dikes and sills of gabbro and diorite that cut the sedimentary rock formations. Nearly all of the higher peaks are capped by sills of these rocks. Many dikes of intrusive rock occur in the southern part of the survey area. Plagioclase feldspar is the most common mineral and makes up to 40 to 60 percent of most of the rocks. The Marty soils formed in colluvium or locally transported material derived dominantly from quartz diorite.

Climate

Climate has a strong influence on soil formation. Temperature and precipitation affect the rate at which rocks weather, parent material is transformed, and organic matter is decomposed.

The Benton County Area has a modified marine climate that varies considerably within the area. The three climate zones are the Willamette Valley floor, the lower foothills. and the steep uplands of the Coast Range.

In the Benton County Area, approximately 70 percent of the annual precipitation falls from November through March. Less than 5 percent of the annual precipitation falls from June through August. In the farming areas nearly all the precipitation falls as rain. Only on the highest peaks of the steep uplands of the Coast Range can any significant amount of snow regularly be expected each year. The summers are moderately warm and moderately dry. The winters are cool and wet. Enough precipitation occurs annually to saturate the soils and recharge the deep water table.

In the Willamette Valley plant growth is rapid on deep soils late in spring, continues at a reduced rate in summer, and increases with the fall rains that begin in September. The shallow soils, however, are usually dry by the middle of July, and the moderately deep soils, by August. Decomposition of organic matter is favored by adequate moisture, mild winters, and warm springs. The oxidation or loss of organic matter is offset by the long growing season, lush vegetative growth, lack of moisture, and cool nights in summer and fall. The latter factors result in a moderate accumulation of organic matter in the soils of the Benton County Area.

Precipitation increases gradually from the valley floor west into the low foothills. It ranges from about 40 to 45 inches on the valley floor, from 40 inches along the foot slopes of the foothills to 60 inches on the upper slopes, and from 60 to 120 inches in the steep uplands.

The soils that formed under the mild, subhumid climate of the valley are less leached and have a higher base saturation than the soils on the low foothills and mountainous uplands, which are strongly acid to very strongly acid.

In the foothills and steep uplands of the Coast Range in the western part of the Benton County Area, the elevation increases from about 350 feet in the east to about 1,500 feet in the west. Some mountain peaks have an elevation of 2,500 to 4,000 feet. As the elevation increases, the annual precipitation increases from about 40 to 120 inches; and the average annual temperature decreases from about 54° to 43° F. at the higher elevations.

Vegetation, climate, and soils have a close relationship, and the effects of the higher precipitation and lower temperatures are reflected in the kind of vegetation and soils that formed. Vegetation changes from prairie-type plants in the valley to coniferous forests in the uplands. The organic-matter content of the soils in the upper part of the A1 horizon is greater at higher elevations because lower temperatures and higher precipitation combine to produce dense stands of vegetation.

Upland soils that formed in a zone of high precipitation

have been leached of many of the soluble bases (*10*) and are consequently strongly acid to very strongly acid.

Biological forces

Man, plants, and animals have affected the kinds of soil that formed in the Benton County Area. The soil-forming factors of parent material, relief, time, and climate have influenced the kinds of plants and animals that live on a soil.

The soils of the Benton County Area formed under several distinct types of vegetative cover (*9*). Those on the main valley floor and the adjacent flood plain formed under a cover of grass, sedges, and intermittent clumps of trees. Their thick, dark surface layer is high in organic matter and has a high base saturation. The influence of grassland vegetation is reflected in the Williamette, Woodburn, Malabon, and Chehalis soils.

In the foothills the native vegetation is mixed stands of Douglas-fir, grand fir, and oak interspersed with openings of brush and grass. The soils in the foothills have a thinner and lighter colored surface layer and a lower base saturation. They are more strongly acid than the soils that formed under grass. These soils commonly have more organic matter than Williamette soils and other Mollisols that occupy the main valley floor. Examples of such soils are the Bellpine and Price soils and the Veneta soils, loamy subsoil variant.

In the steep uplands the native vegetation was dense stands of Douglas-fir, alder, and bigleaf maple. The soils that formed under this cover have a thin surface layer and a low base saturation and are strongly acid or very strongly acid. Examples of these soils are the Blachly, Klickitat, and Marty soils.

The stems, leaves, roots, and twigs from many different kinds of plants that fall to the soil surface are decomposed by soil organisms, such as bacteria and fungi. This decomposed organic residue is mixed into the soil by worms, insects, and small animals.

Organic matter helps to maintain soil structure and increases the water intake and the available water capacity of a soil. It is also an important source of plant nutrients. The biochemical action of the organic soil solutions that contain organic acids is important in the weathering of rock minerals into parent material.

The native vegetation in the Benton County Area originally provided a protective cover on the land surface. After the soils were cleared and tilled by man, however, the cycle of soil formation under this natural cover was disrupted and the influence of man began to be reflected in the soil. Many times he improved the soil by drainage, fertilization, and cultivation: at other times he drastically altered the soil by some of his land-use practices, causing a decrease in organic-matter content and severe soil erosion.

Relief

Relief is the difference in elevation within an area. Its influence on soil formation is strong. Features of relief that can modify the forces of climate are slope gradient, slope shape, and slope exposure, or aspect. These features affect the rate of runoff, evaporation, and internal drainage. In nearly level or depressional areas, water is ponded or runs off very slowly, allowing more moisture to enter and percolate through the soil. In steeper areas of the same parent material, water runs off more rapidly and less enters the soil. This relationship directly affects the kinds of soil that form and the type and amount of vegetation that grows.

The recent flood plains in the Benton County Area have low relief and are subject to frequent flooding. The flooding removes and redeposits material and results in the abandonment of old channels and the cutting of new ones. The topography on the flood plains is undulating, mainly because of channeling during overflow. The relief is about 10 feet.

The main valley floor generally is nearly level and has little relief. Differences in elevation commonly do not exceed 2 or 3 feet. The surface drainage pattern is not well developed, and surface runoff is often very slow or ponded. The soils, therefore, are moderately well drained to poorly drained (*5*).

The low foothills and old high terraces adjacent to the valley floor have gently sloping to moderately sloping broad tops and ridges that break into steep side slopes. The surface runoff varies with the slope gradient. The soils are shallow to deep. Alluvial fans, footslopes, and pediments from these hills gradually merge with the valley floor.

The steep, dissected uplands rise abruptly above the low foothills. They have a pronounced local relief, very steep side slopes, and narrow to broad moderately sloping ridges. These areas have been incised by narrow tributary valleys. Many of the slopes are unstable because active erosion and mass movement occur in the steeper areas (*4, 6*). The soils range from shallow to deep.

Time

The effect of time on the formation of soils in the Benton County Area is striking and corresponds generally to the increasing age of the geomorphic surfaces and related parent material. The youngest soils, such as Camas, Cloquato, and Newberg soils, formed in recent stratified alluvium along rivers and streams. These soils do not have distinct horizons, especially below the surface layer. The accumulation of organic matter and weak expression of structure are the only evidences of horizon differences. Soils such as the Amity, Coburg, Willamette, and Woodburn soils formed in sediments on terraces. These soils have argillic horizons of clay accumulation (*16*).

The foothills have broad, rounded ridges and tops and stable surfaces. Soils that have moderate to strong structure and other distinct horizon features formed in these old intensively weathered residual and alluvial-colluvial materials. The Bellpine, Dixonville, and Jory soils are examples.

In the steep, dissected uplands, the surface layer is unstable and subject to active erosion. The soils that formed in these fresh alluvial-colluvial materials are weak to moderate in textural development. Examples are the Klickitat, Marty, and Slickrock soils.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and response to manipulation. First through classification, and then through use of soil maps, we can apply

our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison in large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965 (*21*). Readers interested in further details about the system should refer to the latest literature available (*18*).

This system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that can be observed in the field or that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are such that soils of similar genesis are grouped together.

In table 8 the soil series of Benton County Area are placed in categories of the current system. Classes of the current system are defined briefly in the following paragraphs.

ORDER: Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. Two exceptions, Entisols and Histosols, occur in many different climates. The six soil orders in Benton County Area are Mollisols, Ultisols, Vertisols, Inceptisols, Alfisols, and Entisols. Each order is named with a word of three or four syllables ending in *sol*, for example, Mollisol.

SUBORDER: Each order is subdivided into suborders based mainly on properties that influence soil genesis and that are important to plant growth or were selected to reflect what seemed to be the most important variables within the orders The names of suborders have exactly two syllables. The last syllable indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP: Soil suborders are divided into great groups on the basis of close similarity in the kind, arrangement, and degree of expression of pedogenic horizons, soil moisture, and temperature regimes, and in base status. The names of great groups have three or four syllables and end with the name of a suborder. A prefix added to the name suggests something about the properties and soil. An example is Argiaquoll (*Arg*, meaning argillic horizon, plus *aquoll*, the suborder of Millisols that have an aquic moisture regime).

SUBGROUPS: Great groups are subdivided into three kinds of subgroups—the central (typic) concept of the great groups (not necessarily the most extensive subgroup); the intergrades, or transitional forms to other orders, suborders, or great groups; and extragrade subgroups that have some properties that are representative of the great groups but that do not indicate transitions to any other known kind of soil. The names of subgroups are derived by placing one or more adjectives before the name of the great group, The adjective Typic is used for the subgroup that is thought to typify the great group. An example is Typic Argiaquoll.

FAMILY: Soil families group soils within a subgroup that have physical and chemical properties similar enough that responses to management and manipulation for use are nearly the same for comparable phases. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineralogy, temperature regime, thickness of the soil penetratable by roots, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for particle-size, mineralogy, reaction, and so on, that are used to differentiate families. An example is Typic Argiaquolls, fine, mixed, mesic.

SERIES: The series consists of a group of soils that formed from a particular kind of parent material and have horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition. The names are place names taken from the area where the soil was first defined. An example is the Dixonville series.

Laboratory Data

Table 9 shows the results of physical and chemical analyses of three soils and chemical data for two soils mapped in the Benton County Area. All the samples analyzed were taken from carefully selected pits. The soil material was rolled, crushed, and sieved by hand to remove fragments of rock more than 2 millimeters in diameter. Laboratory analyses were made on ovendry samples of the soil material less than 2 millimeters in diameter. The methods of analysis used are described in Soil Survey Investigations Report No. 1 (*22*). These methods were briefly described in the following paragraphs.

Particle-size distribution.—The percentage of various soil separates less than 2 millimeters in size was determined. After organic matter is destroyed, the sand fractions are determined by sieving and the silt and clay fractions are determined by sedimentation.

Reaction.—The pH (hydrogen-ion concentration) was measured with a glass electrode in a 1:1 soil-water suspension.

Organic carbon.—The carbon in organic matter was determined. Most organic matter contains about 68 percent carbon. Hence, the percentage of organic carbon multiplied by 1.7 gives the percentage of organic matter. Wet combustion was the method used.

Nitrogen.—The nitrogen content of the soil, mostly in organic matter, was determined by standard Kjeldahl procedures.

Carbon-nitrogen ratio.—This is the ratio of the percentage of organic carbon to the percentage of nitrogen.

Water content (15 bar).—This is the amount of water held by the soil against a pressure of 15 bars (220 lb./sq. in.). This water commonly cannot be used by crops; the growth of most crops is retarded, however, when the water content is much higher. Measurement of 15-bar water

TABLE 8.—*Classification of soil series*

Series	Family	Subgroup	Order
Abiqua	Fine, mixed, mesic	Cumulic Ultic Haploxerolls	Mollisols.
Amity	Fine-silty, mixed, mesic	Argiaquic Xeric Agialbolls	Mollisols.
Apt	Clayey, mixed, mesic	Typic Haplohumults	Ultisols.
Bashaw	Very fine, montmorillonitic, mesic	Typic Pelloxererts	Vertisols.
Bellpine	Clayey, mixed, mesic	Xeric Haplohumults	Ultisols.
Blachly	Fine, mixed, mesic	Typic Dystrochrepts	Inceptisols.
Bohannon	Fine-loamy, mixed, mesic	Typic Haplumbrepts	Inceptisols.
Brenner	Fine, mixed, acid, mesic	Fluvaquentic Humaquepts	Inceptisols.
Briedwell	Loamy-skeletal, mixed mesic	Ultic Haploxerolls	Mollisols.
Camas	Sandy-skeletal, mixed, mesic	Fluventic Haploxerolls	Mollisols.
Chehalis	Fine-silty, mixed, mesic	Cumulic Ultic Haploxerolls	Mollisols.
Cloquato	Coarse-silty, mixed, mesic	Cumulic Ultic Haploxerolls	Mollisols.
Coburg	Fine, mixed, mesic	Pachic Ultic Argixerolls	Mollisols.
Concord	Fine, montmorillonitic, mesic	Typic Ochraqualfs	Alfisols.
Conser	Fine, mixed, mesic	Typic Argiaquolls	Mollisols.
Dayton	Fine, montmorillonitic, mesic	Typic Albaqualfs	Alfisols.
Dixonville	Fine, mixed, mesic	Pachic Ultic Argixerolls	Mollisols.
Dupee	Fine, mixed, mesic	Aquultic Haploxeralfs	Alfisols.
Hazelair	Very fine, mixed, mesic	Aquultic Haploxerolls	Mollisols.
Hazelair, well-drained variant.	Fine, mixed, mesic	Ultic Haploxerolls	Mollisols.
Honeygrove	Clayey, mixed, mesic	Typic Haplohumults	Ultisols.
Jory	Clayey, mixed, mesic	Xeric Haplohumults	Ultisols.
Kilchis	Loamy-skeletal, mixed, mesic	Lithic Haplumbrepts	Inceptisols.
Klickitat	Loamy-skeletal, mixed, mesic	Typic Haplumbrepts	Inceptisols.
Malabon	Fine, mixed, mesic	Pachic Ultic Argixerolls	Mollisols.
Marty	Medial, mesic	Andic Dystrochrepts	Inceptisols.
McAlpin	Fine, mixed, mesic	Cumulic Ultic Haploxerolls	Mollisols.
McBee	Fine-silty, mixed, mesic	Cumulic Ultic Haploxerolls	Mollisols.
Mulkey	Medial, frigid	Typic Dystrandepts	Inceptisols.
Nehalem	Fine-silty, mixed, mesic	Fluventic Haplumbrepts	Inceptisols.
Newberg	Coarse-loamy, mixed, mesic	Fluventic Haploxerolls	Mollisols.
Peavine	Clayey, mixed, mesic	Typic Haplohumults	Ultisols.
Philomath	Clayey, montmorillonitic, mesic, shallow	Vertic Haploxerolls	Mollisols.
Philchuck	Mixed, mesic	Dystric Xeropsamments	Entisols.
Price	Fine, mixed, mesic	Dystric Xerochrepts	Inceptisols.
Ritner	Clayey-skeletal, mixed, mesic	Dystric Xerochrepts	Inceptisols.
Salem	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Pachic Ultic Argixerolls	Mollisols.
Slickrock	Fine-loamy, mixed, mesic	Pachic Haplumbrepts	Inceptisols.
Veneta	Fine, mixed, mesic	Ultic Haploxeralfs	Alfisols.
Veneta, loamy subsoil variant.	Fine-loamy, mixed, mesic	Ultic Haploxeralfs	Alfisols.
Waldo	Fine, mixed, mesic	Fluvaquentic Haplaquolls	Mollisols.
Wapato	Fine-silty, mixed, mesic	Fluvaquentic Haplaquolls	Mollisols.
Willamette	Fine-silty, mixed, mesic	Pachic Ultic Argixerolls	Mollisols.
Winchuck, silty subsoil variant.	Fine-silty, mixed, mesic	Typic Haplohumults	Ultisols.
Witham	Fine, montmorillonitic, mesic	Vertic Haploxerolls	Mollisols.
Witzel	Loamy-skeletal, mixed, mesic	Lithic Ultic Haploxerolls	Mollisols.
Woodburn	Fine-silty, mixed, mesic	Aquultic Argixerolls	Mollisols.

retention is on crushed samples in a pressure membrane apparatus.

Cation exchange capacity, NH_4OAc.—The ability of the soil to hold cations is expressed in milliequivalents per 100 grams of soil. It is determined by saturating the soil with an ammonium acetate (pH 7.0) solution and measuring the amount of ammonium retained.

Cation exchange capacity, sum.—This is similar to cation-exchange capacity, NH_4OAc, but it is determined by adding the extractable cations and extractable acidity. Cation-exchange capacity, sum, is usually slightly larger than that of cation-exchange capacity, NH_4OAc.

Extractable cations.—These are the basic cations (Ca, Mg, Na, K) held by the soil, expressed in milliequivalents per 100 grams of soil. They are determined by measuring the amount of basic cations in the ammonium acetate solution used to saturate the soil in the cation exchange capacity determination.

Extractable acidity.—The acidity (mainly in acid aluminum compounds) of the soil is expressed in milliequivalents per 100 grams of soil and measured by extracting acidity with a triethanolamine solution of pH 8.2.

Base saturation.—This refers to the sum of bases expressed in percentage of the cation exchange capacity, as specified.

Profile descriptions for the tested soils from the Benton County Area follow. Laboratory data for other soils in the Benton County Area are available from the soil surveys of the Alsea Area and those of areas of Lane, Linn, Marion, and Yamhill Counties.

TABLE 9.—*Physical and chemical*

[Absence of an entry indicates that no determination was made; if the analysis has been

Soil name and sample number	Horizon	Depth	Particle-size distribution						
			Very coarse sand (2–1 mm.)	Coarse sand (1–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Silt (0.05–(0.002–mm.)	Clay (<0.002 mm.)
		In.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
Bellpine silty clay loam:									
Profile No. 1,[1] S68 Oreg.-2-1 (1–5).	A11	0–4							
	A12	4–12							
	B1	12–17							
	IIB2t	17–32							
	IIC	32–40							
Camas gravelly sandy loam:									
Profile No. 2,[3] S65 Oreg.-2-4 (1–3).	Ap	0–6	4.3	18.1	14.2	18.7	8.6	24.4	11.7
	A12	6–10	4.0	18.5	11.6	22.2	11.9	22.7	9.1
	IIC	10–52	18.4	41.0	15.7	12.5	4.3	5.7	2.4
Malabon silty clay loam:									
Profile No. 3,[3] S65 Oreg.-2-1 (1–5).	Ap	0–8	0	.3	.9	6.8	10.7	50.2	31.1
	A12	8–17	0	.2	.4	3.2	7.9	52.2	36.1
	B21t	17–31	0	.1	.2	3.0	7.7	51.2	37.8
	B22t	31–46	0	.4	.4	2.5	7.0	50.2	39.5
	IIB3t	46–63	0	.2	.3	1.5	5.1	48.8	44.1
Newberg sandy loam from an area of Newberg fine sandy loam:									
Profile No. 4,[3] S65 Oreg.-2-2 (1–4).	Ap	0–10	1.0	13.8	21.3	30.3	8.5	16.9	8.2
	AC	10–21	.1	1.8	9.0	43.5	17.5	19.8	8.3
	C1	21–34		.3	2.8	29.5	24.7	30.3	12.4
	C2	34–62		.2	3.6	39.5	21.8	23.5	11.4
Peavine silty clay loam:									
Profile No. 5,[1] S67 Oreg.-2-5 (1–7).	A11	0–3							
	A12	3–9							
	B1	9–17							
	B21t	17–24							
	B22t	24–29							
	B3t	29–38							
	C	38–44							

[1] Analyses by Roger Parsons, research soil scientist, Soil Conservation Service, in cooperation with the Oregon Agricultural Experiment Station (unpublished data).

[2] Value determined by sum method (5A3a) (*22*).

analyses of selected soils

made but nothing has been found, a dash is entered in the appropriate column]

Reaction in water 1:1	Organic carbon	Nitrogen	Carbon-nitrogen ratio	Water content (15 bar)	Cation-exchange capacity	Extractable cations				Extractable acidity	Base saturation
						Ca	Mg	Na	K		
pH	*Pct.*	*Pct.*		*Pct.*	*Pct.*					*Meg. per 100 g. of soil*	*Pct.*
----------	4.5	--------	----------	----------	[2] 32.6	9.2	4.1	0	1.5	17.8	45.4
----------	2.9	--------	----------	----------	[2] 30.1	3.3	2.8	0	1.0	23.0	23.6
----------	1.9	--------	----------	----------	[2] 26.6	1.6	2.1	0	.9	22.0	17.3
----------	.8	--------	----------	----------	[2] 31.3	.8	2.3	0	.9	27.3	12.8
----------	.6	--------	----------	----------	[2] 33.6	.3	2.2	0	.8	30.3	9.8
5.5	2.2	0.2	11.0	7.5	15.8	9.8	3.7	.1	1.1	----------	93.0
5.5	.7	.1	7.0	6.2	14.6	7.9	3.2	.1	.7	----------	81.5
6.6	.1	[4]	----------	3.1	8.0	4.6	1.9	.1	.3	----------	86.5
6.5	3.6	.2	18.0	17.0	31.2	19.0	7.0	.3	.4	----------	85.5
6.5	2.4	.2	12.0	19.3	36.8	15.6	8.9	.4	.2	----------	68.2
6.4	2.4	.1	24.0	19.4	30.8	15.3	10.0	.4	.2	----------	84.0
6.1	2.4	.1	24.0	20.2	31.4	15.0	16.0	.4	.2	----------	84.7
6.0	1.6	.1	16.0	22.1	33.3	13.0	12.2	.5	.2	----------	77.7
5.9	1.8	.1	18.0	6.9	18.4	9.2	3.7	.1	.7	----------	74.4
6.1	.4	[4]	----------	7.6	14.9	9.5	4.2	.1	.6	----------	96.6
6.1	.4	[4]	----------	9.6	18.6	11.1	6.2	.2	.2	----------	95.2
6.1	.4	.1	4.0	9.1	20.7	11.1	6.0	.3	----------	----------	85.0
----------	4.1	--------	----------	----------	[2] 32.0	5.8	5.3	0	1.1	19.8	38.1
----------	2.4	--------	----------	----------	[2] 27.4	2.6	3.5	0	.5	20.8	24.1
----------	1.6	--------	----------	----------	[2] 23.7	.6	2.2	0	.4	20.5	13.5
----------	1.0	--------	----------	----------	[2] 26.8	1.6	2.9	0	.5	21.8	18.7
----------	.2	--------	----------	----------	[2] 29.0	1.8	3.3	0	.4	23.5	19.0
----------	.5	--------	----------	----------	[2] 31.5	1.4	3.1	0	.6	26.4	16.2

[3] Analyses by the Oregon Soil Characterization Laboratory, Oregon State University, Corvallis, Oregon.
[4] Trace.

Bellpine silty clay loam (S68 Oreg. 2–1) SE¼NW¼ sec. 2, T. 15 S., R. 6 W.; 4 miles southwest of Monroe:

A11—0 to 4 inches, dark-brown (7.5YR 3/2) silty clay loam, brown (7.5YR 5/4) dry; strong, fine, granular structure; hard, friable, sticky and plastic; many fine and medium pores; many roots; pH 5.6; clear, smooth boundary.

A12—4 to 12 inches, dark reddish-brown (5YR 3/4) silty clay loam, brown (7.5YR 5/4) dry; moderate, fine, subangular blocky structure; hard, firm, sticky and plastic; many fine and very fine pores; pH 5.2; many roots; clear, smooth boundary.

B1—12 to 17 inches, reddish-brown (5YD 4/4) heavy silty clay loam, reddish brown (5YR 5/4) dry; moderate, fine and medium, subangular blocky structure; hard, firm, very sticky and very plastic; common roots; few basic igneous pebbles; pH 5.0; clear, smooth boundary.

IIB2t—17 to 32 inches, dark-red (2.5YR 3/6) clay, yellowish red (5YR 5/6) dry; strong, fine, subangular blocky structure; very hard, very firm, very sticky and very plastic; common moderately thick clay films; common roots; pH 5.0; abrupt, wavy boundary.

IIC—32 to 40 inches, partly weathered Tyee Siltstone; dark red (2.5YR 3/6) clay films along fractures.

Camas gravelly sandy loam (S65 Oreg. 2–4) SE¼SE¼ sec. 17, T. 11 S., R. 4 W.; 4 miles northeast of Corvallis:

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) gravelly sandy loam; weak, medium, subangular blocky structure; very friable, nonsticky and nonplastic: many roots; few medium interstitial pores; pH 5.5; 30 percent gravel; clear, smooth boundary.

A12—6 to 10 inches, dark-brown (10YR 3/3) gravelly sandy loam; weak, medium, subangular blocky structure; very friable, nonsticky and nonplastic; many roots; few medium interstitial pores; pH 5.5; 30 percent gravel; abrupt, wavy boundary.

IIC—10 to 52 inches, dark-brown (10YR 4/3) and very dark grayish-brown (10YR 3/2) variegated very gravelly coarse sand; single grain; loose, nonsticky and nonplastic; pH 6.6; 70 percent gravel; few, intermittent, thin lenses of dark-brown (10YR 3/3) loam or fine sandy loam; substratum extends to depth of many feet.

Malabon silty clay loam (S65 Oreg. 2–1) SW¼SW¼ sec. 10 T. 14 S., R. 5 W.; 3 miles north of Monroe on Crocker farm:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) silty clay loam; moderate, fine, subangular blocky structure breaking to moderate, fine, granular; friable, sticky and plastic; many roots; many, fine, interstitial pores; pH 6.5; gradual, smooth boundary.

A12—8 to 17 inches, dark-brown (10YR 3/3) silty clay loam; strong, fine, subangular blocky structure: friable, sticky and plastic; many roots; many medium and coarse pores; pH 6.5; gradual, smooth boundary.

B21t—17 to 31 inches, dark-brown (10YR 3/3) silty clay loam; strong, fine, subangular blocky structure; firm, sticky and plastic; common roots; common medium and large pores; common, moderately thick, very dark gray (10YR 3/1) clay films on ped surfaces and in root channels; pH 6.4; gradual, smooth boundary.

B22t—31 to 46 inches, very dark grayish-brown (10YR 3/2) heavy silty clay loam; moderate, medium, subangular blocky structure breaking to strong, fine, subangular blocky; firm, sticky and plastic; few roots; common medium and large pores; common, moderately thick, very dark gray (10YR 3/1) clay films on ped surfaces and in root channels; pH 6.1; gradual, smooth boundary.

IIB3t—46 to 63 inches, dark-brown (10YR 3/3) silty clay; moderate, medium, subangular blocky structure; firm, sticky and plastic; few roots; few medium and fine pores; few, moderately thick, very dark gray (10YR 3/1) clay films, pH 6.0.

Newberg fine sandy loam (S65 Oreg. 2–2) SW¼SE¼ sec. 17, T. 11 S., R. 4 W.; 3 miles northeast of Corvallis:

Ap—0 to 10 inches, very dark brown (10YR 2/2) fine sandy loam; weak, medium, moderate, subangular blocky structure and moderate, fine, subangular blocky; very friable, nonsticky and nonplastic; many roots; common fine and medium interstitial pores; pH 5.9; clear, smooth boundary.

AC—10 to 21 inches, dark-brown (10YR 3/3) fine sandy loam; weak, medium, prismatic structure; very friable, nonsticky and nonplastic; many roots; common fine and medium pores; pH 6.1; gradual, smooth boundary.

C1—21 to 34 inches, dark-brown (10YR 4/3) fine sandy loam; weak, coarse, prismatic structure; very friable, slightly sticky and slightly plastic; common roots; common fine and medium interstitial pores; pH 6.1; gradual, smooth boundary.

C2—34 to 62 inches, dark-brown (10YR 4/3) fine sandy loam; massive; very friable, nonsticky and nonplastic; few roots; few fine pores; pH 6.1.

Peavine silty clay loam (S67 Oreg. 2–5) NE¼NW¼ sec. 20, T. 14 S., R. 6 W.; 1½ miles southwest of Dawson:

A11—0 to 3 inches, brown (7.5YR 4/2) silty clay loam, light brown (7.5YR 6/4) dry; moderate, fine, granular structure; friable, slightly sticky and slightly plastic; common dark-brown (10YR 3/2) coatings; pH 5.0; clear, wavy boundary.

A12—3 to 9 inches, brown (7.5YR 4/3) fine silty clay loam, light brown (7.5YR 6/4) dry; moderate, fine, granular structure and subangular blocky structure; friable, sticky and slightly plastic; pH 4.8; clear, wavy boundary.

B1—9 to 17 inches, brown (7.5YR 4/4) silty clay, reddish yellow (7.5YR 6/6) dry; moderate, fine, subangular, blocky structure breaking to moderate, fine, granular; firm, sticky and plastic; pH 4.8; clear, wavy boundary.

B21t—17 to 24 inches, yellowish-red (5YR 4/6) clay, yellowish red (5 YR 5/6) dry; moderate, medium and fine, subangular blocky structure; firm, sticky and plastic; common thin clay films; pH 4.8; clear, wavy boundary.

B22t—24 to 29 inches, yellowish-red (5YR 4/6) clay, yellowish red (5YR 5/6) dry; moderate, medium, subangular blocky structure; firm, sticky and plastic; common thin clay films of slightly higher chroma than matrix; 20 percent coarse siltstone fragments as much as 10 millimeters in diameter; pH 4.6; clear, wavy boundary.

B3t—29 to 38 inches, yellowish-red (5YR 4/8) silty clay, yellowish red (5YR 5/8) dry; weak, medium, subangular blocky structure; firm, sticky and plastic; common moderately thick clay films; 20 percent coarse siltstone fragments as much as 20 millimeters in diameter; pH 4.6; abrupt, wavy boundary.

C—38 to 44 inches, weathered pale-brown (10YR 6/3) siltstone; thick dark reddish-brown (5YR 3/4) clay films along fractures.

General Nature of the Area

This section describes the climate of the Benton County Area. It also discusses the settlement and development of the Area and gives facts about transportation, industry, and farming.

Climate [7]

The climate described in this section extends from the west bank of the Willamette River to the crest of the Coast

[7] GILBERT L. STERNS, climatologist for Oregon, and LAWRENCE P. KIERLUFF, assistant climatologist for Oregon, National Weather Service, U.S. Department of Commerce, helped to prepare this section.

Range and includes all of the Benton County Area except the small part in the Alsea Basin. The western border for the part of the Benton County Area under discussion parallels the coast of the Pacific Ocean but is about 25 miles east of the Ocean. At this latitude practically all large airmasses move from west to east. Thus, most air crossing the Benton County Area has recently completed several days' travel over the Pacific Ocean. During that time it has become nearly saturated, and its temperature, at least in the lower several 1,000 feet, has closely approached that of the ocean. The effects of this marine air on both temperature and precipitation are described in the pages that follow.

The Coast Range exerts a major influence on the Area in several ways. It acts as a bulwark for all the Willamette area against the full violence of numerous ocean-spawned storms that move onto the Oregon coast late in fall, in winter, and early in spring. The marine air is greatly modified as it crosses these mountains, so that it arrives in the Willamette Valley significantly cooler in winter, warmer in summer, and drier in all seasons than when it arrives at the coast.

Within 75 miles of the Area's eastern border, the Cascade Mountains form a crest ridge 5,000 to 6,400 feet high, a number of peaks of which rise several thousand feet higher. The Cascades block the direct flow of the more extremely hot or cold continental air into the Willamette Valley near the Benton County Area.

About 70 miles to the north the Willamette River meets the Columbia River, which cuts a gorge through the Cascade Mountains. Occasionally continental air, usually confined to the east side of the Cascades, finds its way through this gorge and down the Willamette Valley as far south as the Benton County Area. The more severe winter temperatures are caused by such invasions of continental air.

Most of the survey area is between elevations of 200 feet on the valley floor and 1,500 feet along the crest of the Coast Range. The crest ridge of the Coast Range generally ranges from about 800 feet to nearly 2,000 feet; a number of peaks extend several hundred feet higher. Most of the climatic differences in the Area are associated with differences in elevation. In order to describe the climatic features quantitatively, the Area has been divided into two zones—the valley floor, and the eastern slopes of the Coast Range. In most of the tables in this section, averages and percentages for each zone are listed separately or variations within the Area are represented by a range of values. Less significant but still influential are the direction of the slope of a particular area and the possibility for air drainage.

The annual normal precipitation for the Benton County Area ranges from nearly 40 inches along the valley floor to more than 110 inches at higher elevations in the Coast Range. Approximately 70 percent of this total falls from November through March. This has two causes: (1) most of the major storms occur in this season; and (2) the ground is much colder than the water of the Pacific Ocean in this season. Thus, the nearly saturated marine air that moves onto the Oregon coast begins cooling immediately because it comes into contact with the much colder ground and because it is forced to rise as it moves over the Coast Range. This forced lifting decreases the air temperature 3 to 5 degrees for each 1,000-foot increase in elevation. In these cooling processes the wet airmasses lose a large part of their moisture on the western slopes of the Coast Range, and precipitation then decreases sharply with the decrease in elevation toward the valley floor in the Benton County Area (fig. 23).

Nearly all the precipitation falls as rain, the average annual snowfall being 8 inches on the valley floor. Accumulations seldom exceed 4 inches. On very rare occasions, accumulations up to 15 inches have occurred at the lower elevations, but even these heavier snowfalls commonly last only a few days. On the higher slopes of the Coast Range, an annual total of 11 inches is common and depths of 3 to 8 inches may last a week or more.

Measurable precipitation occurs on the average of 150 to 160 days a year.

Precipitation in summer is often the product of occasional thunderstorms. Usually these summer showers are light, lasting only an hour or two. Heavy winter storms occasionally cause major floods on the valley floor. Multiple purpose dams in much of the headwater area of the Willamette River have largely eliminated this problem along its main stem, but bottom lands of tributary streams sometimes are flooded. Generally, damage is confined to flooded pasture and limited erosion. It is wise for the newcomer, however, to determine the recent high water marks before investing large sums of money in constructing farm buildings in low-lying areas.

Table 10 gives precipitation data for the Benton County Area.

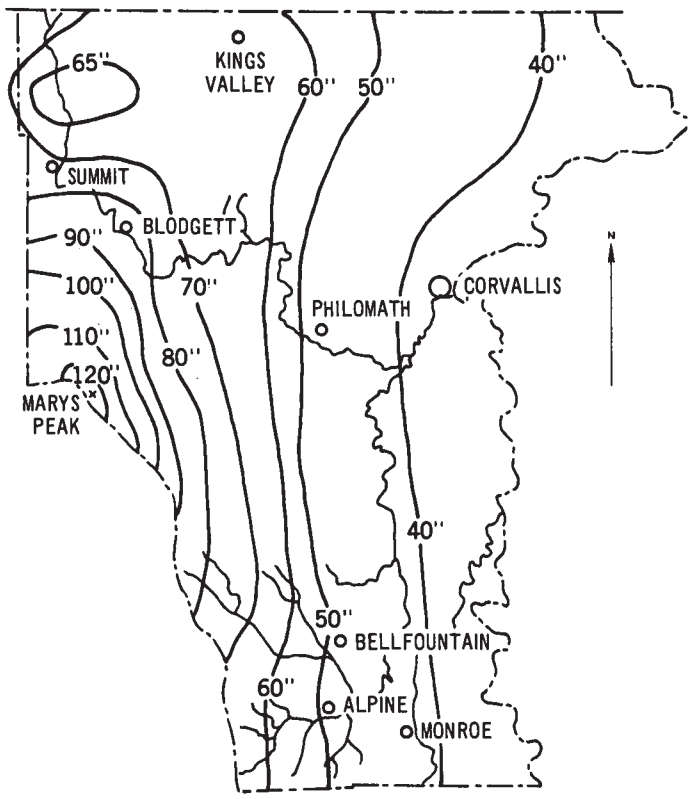

Figure 23.—**Average annual precipitation in Benton County Area.**

TABLE 10.—*Temperature and precipitation*

Month	Temperature				Precipitation							
	Average daily maximum	Average daily minimum	2 years in 10 will have at least 4 days with—		Average	1 year in 10 will have—		Average snowfall	Maximum depth of snow on ground	Average number of days with snow cover	Average depth of snow on days with snow cover	Average number of days with measurable precipitation
			Maximum equal to or higher than—	Minimum equal to or lower than—		Less than—	More than—					
	°F.	°F.	°F.	°F.	In.	In.	In.	In.	In.		In.	
VALLEY FLOOR												
January	45	32	58	21	6.5	2.9	11.7	4	14	2	4	19
February	50	34	60	24	5.2	2.1	8.5	1	15	1	4	17
March	55	36	67	29	4.5	2.0	7.2	1	3	(1)	3	18
April	62	40	76	32	2.2	.7	3.8	(1)	(1)	0	0	14
May	68	45	83	37	2.0	.5	3.9	0	(1)	0	0	12
June	73	49	88	42	1.4	.2	3.2	0	0	0	0	9
July	81	51	95	45	.4	.1	.7	0	0	0	0	3
August	81	51	93	44	.4	.1	1.4	0	0	0	0	3
September	76	48	91	39	1.4	.1	2.6	0	(1)	0	0	7
October	64	43	77	35	3.9	1.2	7.7	0	4	(1)	2	13
November	53	37	62	27	5.7	1.5	10.7	1	4	(1)	4	17
December	48	35	57	25	7.1	3.4	11.5	1	5	(1)	1	20
Year	63	42	[2] 99	[3] 17	40.7	29.4	50.0	8	15	3	4	152
UPPER LEVELS OF COAST RANGE												
January	45	31	56	16	20.2	7.9	32.9	6	25	7	8	19
February	49	33	60	23	16.8	8.7	30.6	2	36	4	8	17
March	53	34	67	26	15.3	7.9	23.9	2	26	2	9	18
April	59	36	75	29	7.8	3.9	13.0	(1)	1	(1)	1	15
May	66	40	83	31	4.5	1.6	9.6	0	(1)	0	0	12
June	71	44	89	36	2.7	.4	5.8	0	0	0	0	9
July	78	46	93	38	1.1	.1	2.9	0	0	0	0	5
August	76	46	90	38	1.8	.1	3.6	0	0	0	0	6
September	73	44	89	34	3.9	.4	9.4	0	0	0	0	8
October	62	41	79	30	12.0	4.6	27.7	(1)	3	(1)	3	14
November	52	36	63	24	18.4	6.1	29.4	(1)	5	(1)	3	18
December	46	34	56	23	21.6	10.1	32.7	1	26	2	5	21
Year	61	39	[2] 97	[3] 12	126.1	101.7	154.6	11	36	15	8	162

[1] Less than one-half.
[2] Average annual highest temperature.
[3] Average annual lowest temperature.

Because of the modified marine climate, there are few temperature extremes in western Oregon in either summer or winter, especially in the Willamette Valley. In the Benton County Area temperatures of 90° F. or more occur on an average of 10 to 15 days a year; those below 32° occur 60 to 70 days a year on the valley floors and from 100 to 110 days a year on the upper slopes. Temperatures of 100° occur about every other year, and temperatures below 0° occur about once every 20 years on an average. These low extremes mark the invasion of continental air either through the gorge and down the valley or over the top of the Cascade ridge. In table 11 are shown the probabilities for the occurrence of temperatures of 36°, 32°, 28°, 24°, 20°, and 16° after indicated dates in spring and before listed dates in fall. These dates should be considered as estimates and not as exact values.

On a clear morning a low-lying pocket is likely to be several degrees lower in temperature than are sloping hillsides or other areas that have better drainage only short distances away.

Evapotranspiration is a term used to identify the total moisture transferred from the soil to the atmosphere. It includes both that lost through evaporation and that lost through transpiration of plants. By relating evapotranspiration with the natural rainfall of the Area, the amount of supplemental moisture that may be needed for irrigating crops can be estimated.

Annual rainfall in the western part of Oregon far exceeds yearly total evapotranspiration, but the soil at any one time is capable of holding only a limited amount of moisture. This amount varies with the soil. The maximum evapotranspiration that would result, if 100 percent of the moisture required for plant use were available in the soils at all times, is known as the potential evapotrans-

piration. Actual evapotranspiration is that which takes place under normal rainfall in soils of a particular available water capacity. Table 12 presents the potential evapotranspiration; the actual evapotranspiration from soils that have available water capacity of 2 inches and 6 inches; and the monthly average pan evaporation, recorded near Corvallis.

Winds are of major importance to activities in Benton County Area in a number of ways. The growing use of airplanes to apply fertilizers, insecticides, and chemicals for weed control has greatly heightened interest in prevailing wind directions and probable periods of minimum speeds. In locating industrial plants, it is necessary to consider the prevailing wind directions so that the harmful effects of air-polluting emissions will be reduced. When constructing farm buildings, the local wind stress should be considered. High winds can become a hazard to ripening fruit. Tables 13 and 14 provide useful information about the winds from observations at the Salem Airport. Although this station is about 20 miles north of the Benton County Area, it should be fairly representative of the usual conditions in the valley floor areas of the Benton County Area. Occasional periods of strong easterly winds mark the invasion of continental airmasses from the other side of the Cascades.

The marine airmasses that usually move across the Benton County Area are high in relative humidity most of the year. Exceptions are the periods of either extremely low winter temperature or high summer temperature that mark the invasion of very dry continental airmasses. Under these conditions, humidity in summer can drop to 10 percent or 15 percent, which is not unusual during the warmest part of the day.

Nighttime relative humidity, particularly during the early morning hours, approaches 100 percent throughout the year. The 4 a.m. average in July, the driest month, is more than 85 percent. A heavy dew remains for several early morning hours and can be expected any time of the year. The nearest official humidity records representative of the valley floor in the Benton County Area are those for Salem. The annual average relative humidity is 89 percent at 4:00 a.m.; 74 percent at 10:00 a.m.; 60 percent at 4:00 p.m.; and 82 percent at 10:00 p.m.

Frequent storms move in from the Pacific Ocean, and the marine air cools as it is lifted over the Coast Range, which produces a considerable amount of cloudiness from mid-October to mid-March. Even during this period, however, bright sunny periods of several days can be expected intermittently throughout the winter.

A fairly reliable estimate of the cloudiness and solar radiation in at least the farming area of the Benton County Area is in table 15. The monthly average cloudiness is based on hourly observations made at Salem Airport. This, however, should be generally representative of the mid-Willamette Valley. Cloudiness is given as the tenths of sky covered with clouds. For example, in January an average of 8.3 tenths of a possible 10 tenths is covered. An average of 8.3 tenths means the same as 83 percent.

Solar radiation is given as the average number of Langleys per day. One Langley equals one calorie of solar energy per square centimeter per minute. The solar radiation averages in table 15 were determined from a very short record made at Corvallis, ranging from 2 years for some months to as much as 4 years for others.

Settlement and Development [8]

The Benton County Area was originally inhabited by the Klikitat Indians, who rented the area from the Calapooia Indians for use as a hunting ground. French-Canadian trappers visited the region at an early date and were followed by American settlers, who came south from Oregon City, the end of the Oregon Trail. The first settlers took out land claims in 1845. In the following years, the California Gold Rush lured a number of settlers to the Sacramento Valley. In the fifties more and more settlers arrived, and towns sprang up in many parts of the Area.

Benton County was officially created on December 23, 1847, by an act of the Provisional Government. It was the seventh county to be organized in the Oregon Territory. The county listed 2,479 residents at the time Oregon attained statehood. The 1860 census gave Benton County a population of more than 3,000, of which 748 were voters.

In 1900 the population was 6,706, of which 1,819 lived in the county seat. The population increased to 39,165 in 1960 and to 41,100 in 1965. A population of 48,900 was projected for 1970, and 73,600 for 1985.

The first road through the county was opened in 1852. For a time, Corvallis (then called Marysville) was considered the head of navigation on the Willamette River, and freighters made the town the northern end of a profitable pack-train and stage-line business, which extended south into California. After the Indian wars in the southern part of Oregon were concluded, more roads were built.

The stern-wheel steamers that moved freight along the Willamette River became obsolete in the county in 1879 as a result of the establishment of train service from Portland to Corvallis, which provided the impetus for growth and development.

In 1853 the Oregon Territorial Legislature tried to found a university at Marysville. Oregon State Agricultural College was established in 1868, when it was formed from a Methodist school, Corvallis College.

Transportation, Industries, and Markets

Two main east-west highways, State Route No. 34 and U.S. Highway No. 20, connect the Benton County Area with the Pacific Coast to the west and the Cascades to the east. U.S. Highway No. 99W, the main north-south highway, connects the Benton County Area with Portland and Salem to the north and Eugene to the south. State Route No. 223 extends from Wren, where it connects with U.S. Highway No. 20 north of the county line.

A network of improved county roads radiates from Corvallis and connects the towns of the Area. Practically all the homes and farms of the Area are connected to this network. Motor freight service is furnished by trucking companies for the entire Area. Passenger bus service is provided to most of the towns. The terminal for the Air West Airlines is at the Corvallis Municipal Airport. The airport also serves private aircraft.

[8] TED H. SIDOR, Extension Service, Oregon State University, assisted in preparing this section.

TABLE 11.—*Probability of given temperatures after*

VALLEY

Probability	Dates for given probability and temperature	
	16° F. or lower	20° F. or lower
Spring:		
1 year in 10 later than	(1)	February 10 to February 20
2 years in 10 later than	(1)	January 30 to February 5
5 years in 10 later than	(1)	January 10 to January 15
Fall:		
1 year in 10 earlier than	(1)	November 20 to November 25
2 years in 10 earlier than	(1)	November 29 to December 14
5 years in 10 earlier than	(1)	(1)

UPPER LEVELS OF

Spring:		
1 year in 10 later than	February 10 to February 20	March 5 to March 15
2 years in 10 later than	February 5 to February 15	February 25 to March 5
5 years in 10 later than	January 1 to January 10	January 10 to January 20
Fall:		
1 year in 10 earlier than	December 10 to December 20	November 20 to November 30
2 years in 10 earlier than	(1)	November 30 to December 10
5 years in 10 earlier than	(1)	December 20 to December 30

[1] No meaningful value can be determined for this probability.

TABLE 12.—*Potential evapotranspiration, actual evapotranspiration, and pan evaporation*

Month	Potential evapotranspiration		Actual evapotranspiration in soils having available water capacity of—				Pan evaporation near Corvallis
			2 inches		6 inches		
	Valley floor	Upper levels of Coast Range	Valley floor	Upper levels of Coast Range	Valley floor	Upper levels of Coast Range	
	In.	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
January	0.5	0.5	0.5	0.5	0.5	0.5	(1)
February	.7	.7	.7	.7	.7	.7	(1)
March	1.2	1.2	1.2	1.2	1.2	1.2	(1)
April	2.0	2.0	2.0	2.0	2.0	2.0	3.1
May	3.1	2.7	2.8	2.7	3.0	2.7	4.1
June	3.9	3.5	2.1	3.5	3.0	3.5	5.1
July	4.7	4.3	.6	2.5	2.0	3.5	6.9
August	4.3	3.6	.4	1.7	1.2	2.5	6.2
September	3.1	2.8	1.4	2.8	1.6	2.8	4.2
October	2.1	2.0	2.1	2.0	2.1	2.0	1.9
November	.9	.9	.9	.9	.9	.9	(1)
December	.5	.4	.5	.4	.5	.4	(1)
Year	27.0	24.6	15.2	20.9	18.7	22.7	

[1] Evaporation not measured in these months.

specified dates in spring and before specified dates in fall

FLOOR

Dates for given probability and temperature—Continued			
24° F. or lower	28° F. or lower	32° F. or lower	36° F. or lower
February 20 to March 15	March 25 to April 15	April 25 to May 5	May 15 to June 5
Febraury 10 to March 5	March 15 to April 5	April 16 to May 5	May 10 to May 30
January 25 to February 10	February 20 to March 15	March 30 to April 20	April 30 to May 15
October 25 to November 20	October 20 to October 30	September 30 to October 20	September 5 to October 5
November 21 to November 28	October 27 to November 6	October 15 to October 25	September 15 to October 8
December 10 to December 16	November 10 to December 5	October 30 to November 5	October 6 to October 20
COAST RANGE			
April 10 to April 20	May 5 to May 15	June 10 to June 20	(1)
March 25 to April 5	April 20 to April 30	May 30 to June 10	(1)
February 25 to March 5	March 25 to April 5	May 10 to May 20	(1)
October 30 to November 10	October 5 to October 15	September 5 to September 15	(1)
November 10 to November 20	October 15 to October 25	September 15 to September 25	(1)
December 1 to December 10	November 10 to November 20	October 10 to October 20	(1)

TABLE 13.—*Average annual windspeed and percentage of time from eight directions and calm*

[Recorded at Salem]

Direction	Percentage of time	Average speed
		M.p.h.
North	12. 6	6. 4
Northeast	7. 2	6. 2
East	1. 8	4. 2
Southeast	7. 5	5. 7
South	27. 3	8. 2
Southwest	12. 3	7. 5
West	8. 7	6. 1
Northwest	11. 3	5. 6
Calm	11. 3	

TABLE 14.—*Fastest 1-minute windspeed and direction from which wind is blowing*

[Recorded at Salem]

Month	Speed	Direction
	M.p.h.	
January	41	South.
February	46	South.
March	39	South.
April	44	South.
May	35	Southwest.
June	30	South-southwest.
July	28	West-southwest.
August	24	West-southwest.
September	32	West-northwest.
October	68	West.
November	44	South-southwest.
December	46	South-southwest.

TABLE 15.—*Average cloudiness and solar radiation*

Month	Cloudiness	Solar radiation
	Tenths of sky	*Langleys per day*
January	8. 3	115
February	8. 1	172
March	7. 9	288
April	7. 3	399
May	7. 0	530
June	6. 4	558
July	4. 0	612
August	4. 7	508
September	5. 1	411
October	7. 0	233
November	8. 0	118
December	8. 8	83
Year	6. 0	336

A branch freight line of the Southern Pacific Railroad is the only major railroad line in the area. It connects the Benton survey area with the Pacific Coast and with the main Southern Pacific Railroad line at Albany. Another branch freight line enters the county from the north and runs as far south as Monroe, where it terminates. A privately owned railroad line, the Valley and Siletz Railroad, is used for hauling logs and wood products. It is in the northwestern part of the county and connects with the Southern Pacific Railroad.

Benton County is chiefly a farming and logging area, Wood and wood products, such as hardboard, plywood, lumber, and wood by-products, are manufactured locally and are the major source of income.

Farming is diverse. Some farm products are processed locally and shipped for further handling and distribution. Local slaughterhouses process some of the livestock produced in the Area. Livestock and poultry that are not marketed locally are shipped to Portland and other market outlets. A major cannery and a frozen-food processing plant in Corvallis process many of the vegetable and fruit crops grown locally.

Oregon State University, in Corvallis, has 15,000 students. In recent years it greatly expanded its facilities, devoting much of its activity and research to forestry, farming, engineering, oceanography, and water-resource research.

Farming

In 1845 the early settlers of this region occupied the level, treeless valley floor above the flood plain, which provided grass and wild hay in abundance (*19*). Because of the lack of farm implements and available markets, only enough land was cultivated to supply home needs, and for a number of years cattle grazing was the major farm enterprise. The California Gold Rush, however, encouraged wheat production. By 1879, after markets and transportation had been developed, wheat and oats became important cash crops.

During the following decades fruit and nut crops and dairy products became more and more important and contributed much toward total farm income. Livestock consisted of hogs, sheep, goats, and beef and dairy cattle. Horses and mules provided the power for hauling, for farmwork, and for transportation. Neither fertilizers nor lime were used during the early days of farming. Barnyard manure was available on every farm, but very little was used as fertilizer.

Today farming in the Benton County Area is highly diversified, and a wide variety of crops is produced. Large quantities of commercial fertilizers are used.

The nearly level, gently sloping, deep soils that have no severe drainage limitation can produce all crops to which they are climatically suited if irrigaton water is available. The steeper, shallower, more poorly drained soils are suited to few crops.

The acreages of the principal crops are listed in table 16. Horticultural and truck crops are some of the principal cash crops in the Area, and in the past few years they have been increasing in acreage as additional land has been brought under irrigation. The acreage of cereal grain and grass seed crops has remained about the same in the past few years.

TABLE 16.—*Acreage of principal crops*

Crop	Year	
	1968	1964
Cereal grains:	*Acres*	*Acres*
Wheat	11, 500	5, 200
Barley	1, 200	3, 500
Oats	700	3, 000
Field corn	900	300
Hay and forage crops:		
Alfalfa	2, 100	3, 500
Clover and clover mix	3, 700	2, 600
Wild and other tame hay	3, 900	2, 500
Field and seed crops:		
Bentgrass	2, 100	1, 136
Crimson clover	400	2, 350
Fine fescue	1, 000	595
Bluegrass	900	413
Tall fescue	1, 900	1, 700
Annual ryegrass	3, 700	6, 045
Perennial ryegrass	2, 900	3, 006
Orchardgrass	2, 600	2, 411
Miscellaneous specialty and vegetable seed crops:		
Peppermint for oil	2, 000	800
Vegetable, flower seeds, bulbs, sugar beet seed, dill for oil	760	323
Horticultural and truck crops for processing and fresh market:		
Apples	180	170
Sweet cherries	105	125
Sour cherries	165	100
Prunes and plums	200	200
Filberts	475	480
Walnuts	400	315
Strawberries	250	175
Bush and pole beans	2, 100	675
Table beets	515	300
Processed sweet corn	2, 850	1, 000
Cultivated summer fallow	3, 400	(1)
Idle cropland	8, 573	(1)
Christmas trees	3, 900	(1)

[1] Not reported.

For many years, as the population of the Area increased, farms increased in number and decreased in size, but this trend has reversed since the introduction of modern farm machinery. The number of farms decreased from 845 in 1959 to 808 in 1964, whereas, during the same period, the average size of farms increased from 229 acres to 242 acres. Many small farms are being incorporated into larger units that can be operated more efficiently and economically.

The most significant change in farm organization in the past decade has been the shift from owner-operated to lessor-operated farms. Half of the cropland in the Area is now farmed under rental or lease arrangements. Prior to World War II, and shortly thereafter, many small farms in the hilly uplands were diverted to woodland use. Douglas-fir has now taken over many of these areas that were formerly in pasture or under cultivation, and in some places trees are large enough to be cut for poles and saw logs. Many farms in the Area are operated on a part-time basis, and part-time farming is increasing. A large number of the farm personnel are employed in industry, and many of the younger people leave the farms to work in cities.

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Glossary

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable basis), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Anaerobic bacteria. Bacteria that live in the absence of oxygen.

Available water capacity (also termed 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 capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Canopy. The covering of green leaves and branches formed by the crowns of individual trees in a forest.

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.

Clod. A soil aggregate, caused by plowing or digging, that breaks up from repeated wetting and drying.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found 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 and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Deciduous (botany). Refers to plants that lose their leaves at maturity, or at certain seasons. Contrasts with evergreen.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, 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 draining outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Drumlin (geology). A streamlined hill or ridge of glacial deposits with a long axis that is parallel to the direction of flow of a former glacier.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Esker (geology). A narrow, winding ridge or mound of stratified gravelly and sandy drift that was deposited by a subglacial stream.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Fragipan. A loamy, brittle, subsurface horizon that is very low in organic-matter content and clay but is rich in silt or very fine sand. The layer is seemingly cemented. When dry, it is hard or very hard and has a high bulk density in comparison with the horizon or horizons above it. When moist, the fragipan tends to rupture suddenly if pressure is applied, rather than to deform slowly. The layer is generally mottled, is slowly or very slowly permeable to water, and has few or many bleached fracture planes that form polygons. Fragipans are a few inches to several feet thick; they generally occur below the B horizon, 15 to 40 inches below the surface.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Kame (geology). An irregular short ridge or hill of stratified glacial drift.

Lacustrine deposit (geology). Material deposited from lake water and exposed by lowering of the water level or elevation of the land.

Loam. The textural class of soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of 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 these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimensions; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Glacial lake (geology). A lake whose basin was formed by glaciation, either drift depressions, ice-scoured rock depressions, or glaciated valleys. Also used for a water body held up by the damming action of a glacier.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

No-till planting (agronomy). The practice whereby a new crop is planted in last year's stubble or stalks without seedbed preparation. Usually fertilizer and herbicide are applied on the same trip through the field.

Organic soil. A general term applied to a soil or horizon that consists primarily of organic matter, such as peat soils, muck soils, and peaty soil layers. In chemistry, organic refers to the compounds of carbon.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Perched water table. A body of water that has been retarded in its downward movement by an impermeable or nearly impermeable layer to such an extent that it forms an upper zone of saturation overlying, but separated from, a lower zone.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow*, *slow*, *moderately slow*, *moderate*, *moderately rapid*, *rapid*, and *very rapid*.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline.	9.1 and higher

Rill. A steep-sided channel resulting from accelerated erosion. A rill normally is a few inches in depth and width and is not large enough to be an obstacle to farm machinery.

Roches moutonnees. A rounded hummock of rocklike whales' backs, smoothed and striated by glacial action. Also called sheepbacks or rock sheep.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Side-slope seepage. The lateral movement of internal soil water that surfaces some distance down the slope of a hillside.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes 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 other plant and animal life characteristic of the soil are largely confined to the solum.

Stoss (geology). Facing the direction from which a glacier moves. Contrasts with *lee*.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. 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 together without any regular cleavage, as in many claypans and hardpans).

Surface layer. The uppermost part of the soil, ordinarily moved in tillage, or its equivalent in uncultivated soils; roughly, the A horizon.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

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 loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Valley train (geology). The material deposited by the stream in the valley below a glacier.

Vesicular. Having small pores in the soil mass.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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