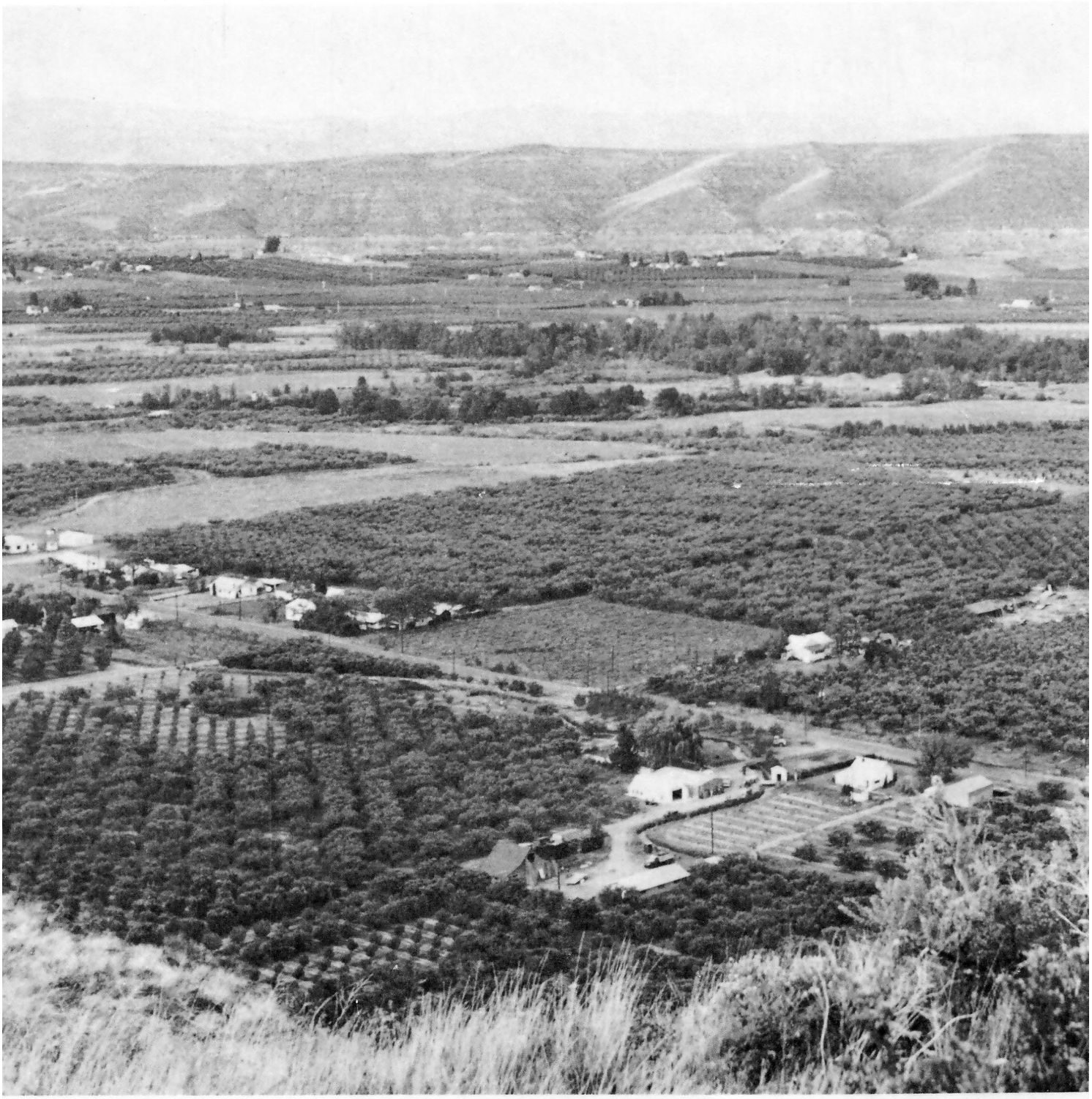
United States Department of Agriculture

Soil Conservation Service

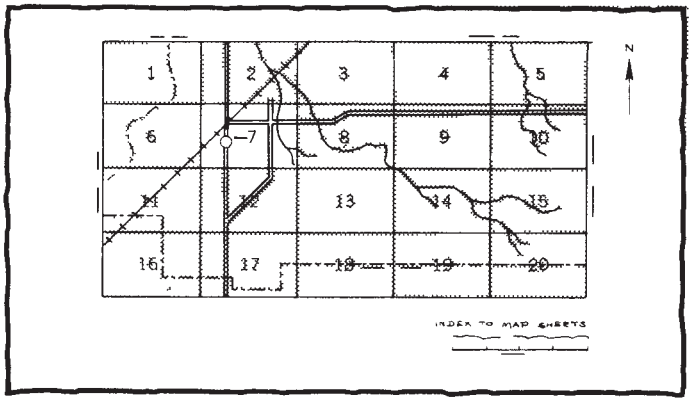
In Cooperation with Washington State Department of Natural Resources Washington State University, Agriculture Research Center and United States Department of the Interior Bureau of Indian Affairs

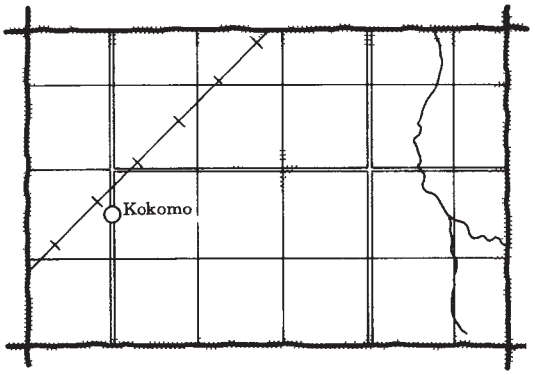
Soil Survey of Yakima County Area Washington



HOW TO USE

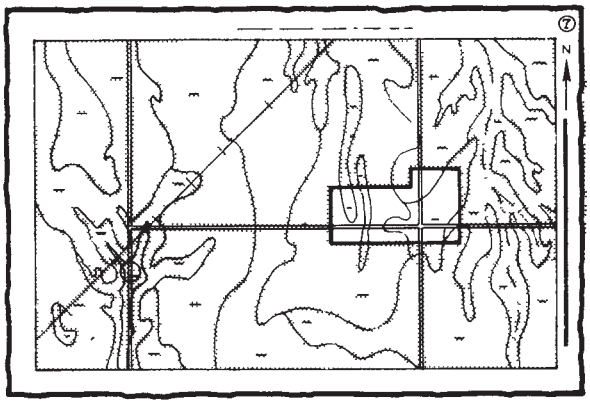
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

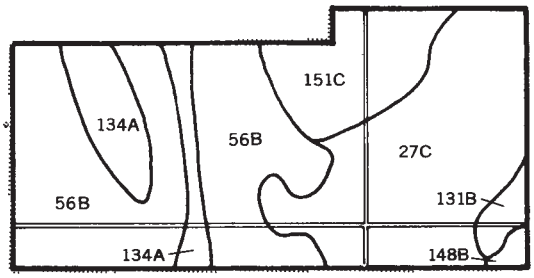




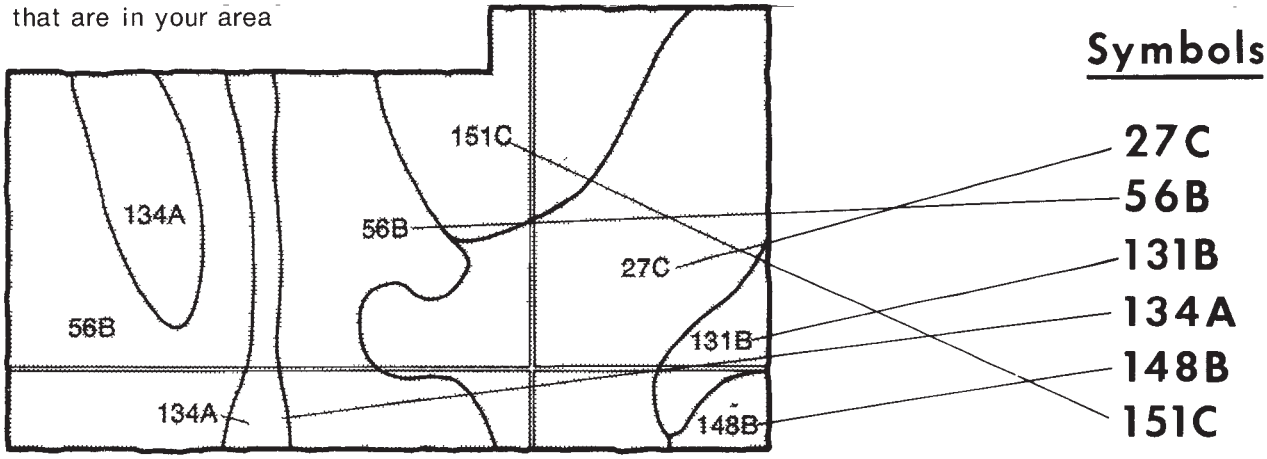
2. Note the number of the map sheet and turn to that sheet.

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



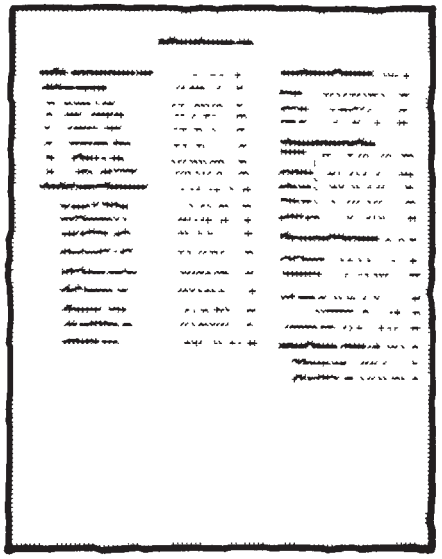


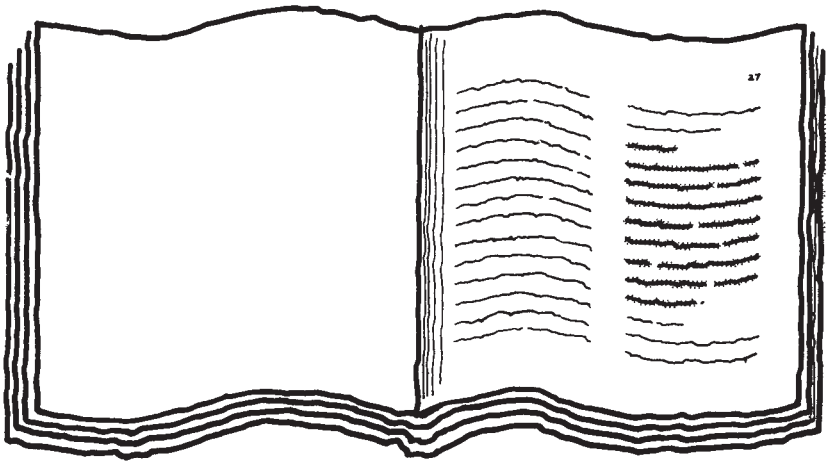
4. List the map unit symbols that are in your area



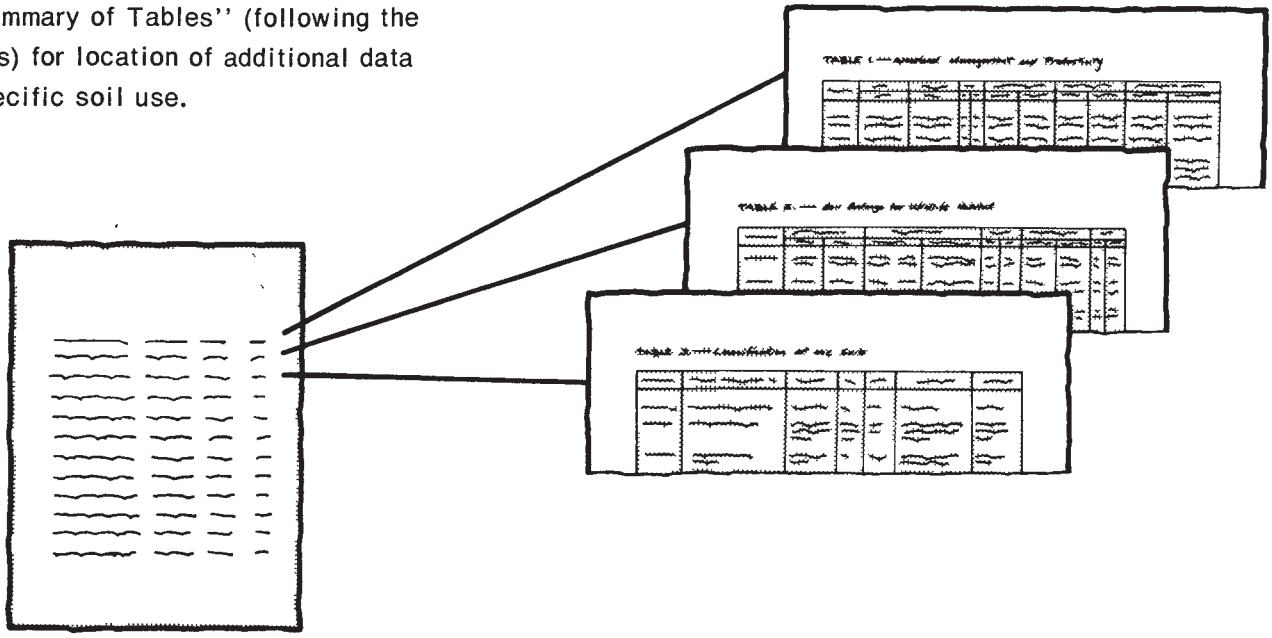
THIS SOIL SURVEY

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





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



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

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

Major fieldwork for this soil survey was performed in the period 1969-79. Soil names and descriptions were approved in 1979. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1979. This survey was made cooperatively by the Soil Conservation Service; the Washington State Department of Natural Resources; the Washington State University, Agriculture Research Center; and the United States Department of the Interior, Bureau of Indian Affairs. It is part of the technical assistance furnished to the South Yakima, Ahtanum-Moxee, Wenas Valley, and Hi-land Conservation Districts.

Cover: An area of Weirman-Ashue general map unit in Naches Valley.

contents

soil series

Issued May 1985

index to map units

summary of tables

foreword

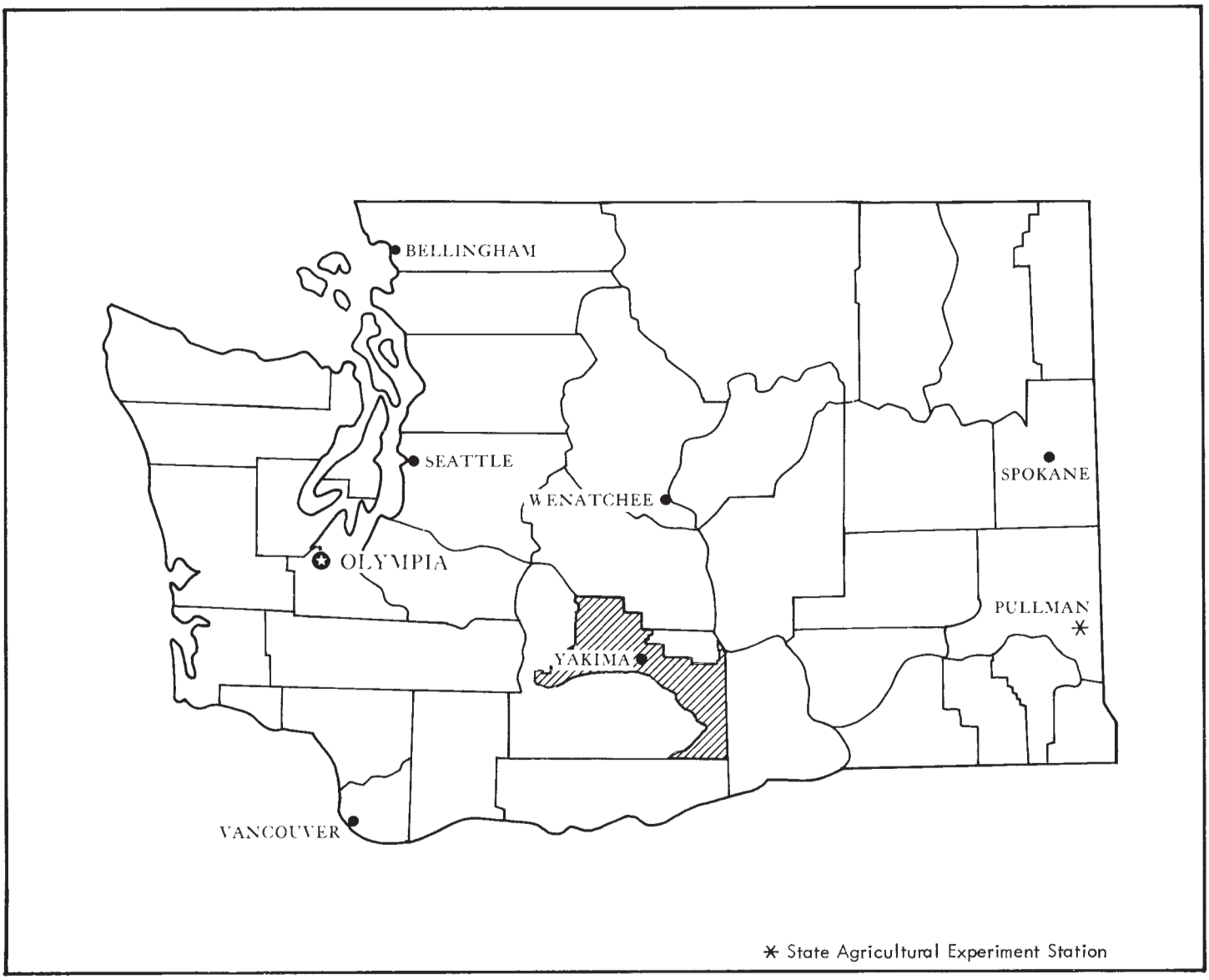
This soil survey contains information that can be used in land-planning programs in Yakima County Area. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact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

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

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

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

Lynn A. Brown
State Conservationist
Soil Conservation Service



Location of Yakima County Area in Washington

soil survey of
Yakima County Area, Washington

By Charles D. Lenfesty and Thomas E. Reedy, Soil Conservation Service

Fieldwork by Charles D. Lenfesty, Thomas E. Reedy, Jonathan P. Edwards,
James T. Bayer, Phillip S. Gale, Jack J. Rasmussen, Ronald A. Peyton, and Richard A. Pudney,
Soil Conservation Service; and Thomas J John,
Washington State Department of Natural Resources

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
Washington State Department of Natural Resources,
Washington State University, Agriculture Research Center; and
United States Department of the Interior, Bureau of Indian Affairs

YAKIMA COUNTY AREA is in the south-central part of Washington. It consists of privately owned land; land managed by the Forest Service, Bureau of Land Management, the Washington State Department of Game, and the Washington State Department of Natural Resources; and some Yakima Indian Reservation land.

The survey area has a total land area of about 1,394 square miles, or 892,136 acres. About 268,880 acres is irrigated cropland, 64,000 acres is nonirrigated cropland, 425,456 acres is rangeland, 133,800 acres is grazable woodland. Irrigated farming is the main economic enterprise in the area. The major crops include apples, cherries, hops, asparagus, corn, and grass and legumes grown for hay and pasture.

About 65 different kinds of soil are in the survey area The soils formed in alluvium, eolian sand, lake sediment, loess, and residuum derived from basalt and sandstone. Most of the soils are well drained; however, in some of the lower lying areas drainage is impeded and some of the soils are affected by excessive salts or alkali, or both The soils are sandy to clayey in texture and are very shallow to very deep. In irrigated areas the soils are dominantly nearly level to strongly sloping. In nonirrigated areas the soils are dominantly moderately steep to steep.

An older survey of Yakima County was published in 1958 (*19*). It included most of the present survey area. The present survey updates the older survey and provides additional information and orthophoto maps that show the soils in greater detail.

Descriptions, names, and delineations of soils in this soil survey do not fully agree with those on soil maps for adjacent counties. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, or the extent of soils within the survey area.

general nature of the survey area

This section gives general information about the survey area. It discusses the history and development, physiography, geology, drainage and water supply, and climate.

history and development

Before the arrival of white settlers, the survey area was occupied by the seminomadic Yakima Indians (*26*). The land was used for camping, hunting, fishing, and gathering of food. As the area became settled, a Roman

Catholic mission was established in the Ahtanum Valley in 1852 and irrigated farming was introduced.

Yakima County was established in 1865. Raising livestock was the main economic activity until the Northern Pacific Transcontinental Railroad was extended into the area in 1886. Large investments were then made in irrigation to attract settlers. By 1900, with construction of the Sunnyside and Congdon Canal systems, Yakima Valley contained the largest irrigated acreage in Washington. The population in the county was centered around the market towns of Yakima, Union Gap, and Sunnyside.

At present Yakima County is among the leading agricultural counties in the United States. It ranks first in the nation in the production of hops, apples, mint, peas for processing, honey, and several kinds of tree fruit. It is also a major center for the production of beef cattle. Also within the survey area are sheep operations, turkey farms, and dairy farms.

physiography

The central and eastern parts of the survey area are in the Walla Walla section of the Columbia Plateau physiographic province (*10*). These parts of the area are composed of five east-trending ridges formally named Umptanum, Yakima, and Rattlesnake Ridges; Cleman Mountain; and Horse Heaven Hills. In general, the ridges have even crests and smooth sides. Most are not forested and are used primarily as rangeland. The Horse Heaven Hills, in the southeastern part of the area, are predominantly used for nonirrigated crops, mainly winter wheat. Between the ridges are basin valleys that are tributary to the Yakima Valley. These include the Wenas, Naches, Moxee, and Ahtanum Valleys. These valleys are quite extensive and are the main areas used for irrigated crops.

The place where the Yakima River flows between Ahtanum Ridge and Rattlesnake Ridge is known as Union Gap. It serves as a natural divide between the upper and the lower parts of Yakima Valley. The ridges and valleys, along with the lower lying foothills in the western part of the survey area, flank forested foothills and mountains in the far western part of the area. This part of the area is in the middle section of the Cascade Range.

geology

The geology of the survey area is quite varied. The mountainous areas in the western part consist of many different types of rock, including basalt and andesite. Representative soils that formed in loess mixed with material derived from basalt and in residuum and colluvium in these areas are those of the Jumpe, Sutkin, Sapkin, and Naxing series. The principal rock in the central and eastern parts is Yakima Basalt, which is the younger flow of Columbia River Basalt (*7*). This basalt originated from large fissures or rifts along which the fluid lava swelled to the surface and spread in all directions. Soils such as those in the Ritzville, Starbuck, Shano, and Bickleton series formed in areas where loess is underlain by basalt. Soils such as those in the Bakeoven, Lickskillet, Kiona, McDaniel, and Rock Creek series formed in colluvium and residuum derived from basalt.

Overlying the Yakima Basalt in many areas that flank foothills and ridges are the light-colored tuffaceous sandstone, siltstone, and conglomerate of the Ellensburg Formation. This old stream-deposited sediment was derived from volcanic material ejected during the early development of the Cascade Range. The Formation occurs extensively in the Wenas Valley, in the lower reaches of the Naches Valley, in areas west of Yakima, and along the southern part of Rattlesnake Ridge. The Formation is more than 1,800 feet thick in places. Soils that formed in loess mixed with material derived from the Ellensburg Formation are those of the Harwood, Gorst, Cowiche, and Taneum series.

Subsequent folding of the basalt has formed the series of east-trending ridges. The Ellensburg Formation was deposited during the early stages of basalt folding; therefore, it is on highly dissected terraces. The uplifting of these folds was so slow that the Yakima River was able to downcut rapidly enough to maintain its course. The tributaries to the Yakima River formed as a result of the basalt folding. In a few areas of the Wenas Valley and near Pamona, the Ellensburg Formation is capped by a late lava flow.

The upper and lower parts of Yakima Valley have been filled with material that was deposited by normal stream activity and glacial outwash. These areas include low terraces and flood plains. Representative soils that formed in recent alluvium are those in the Esquatzel, Weirman, Ashue, Wenas, Toppenish, and Umapine series. Extensive areas in the lower part of Yakima Valley are mantled by loess underlain by lake sediment that was deposited during glacial flooding in the late Pleistocene. This sediment occurs at elevations of as much as 1,000 feet in the survey area. Warden soils are examples of soils that formed in loess overlying lake sediment. These are the most extensive soils in the survey area.

drainage and water supply

Almost all of the survey area drains into the Yakima River; however, the far northeastern and southeastern parts drain into the Columbia River.

The supply of irrigation water comes primarily from streams that receive snowmelt from the Cascade Range. These streams have more than ample flow early in the growing season, but the flow decreases during the season. To supplement the flow of the streams in summer and fall, three large mountain lakes have been

dammed to create storage reservoirs. These are the Cle Elum, Kachess, and Keechelus Lakes, which are in Kittitas County. Three other reservoirs, Tieton and Clear Lakes on the Tieton River and Bumping Lake on the Bumping River, are in Yakima County, and they greatly increase the flow of the Naches River. There is also a small reservoir in the Wenas Valley. Even with these reservoirs, there is frequently a shortage of water in tributaries of the Yakima River. Transmission losses and overirrigation aggravate the problems of water shortage, drainage, erosion, and alkali and salt accumulation.

All available surface water presently is allocated to irrigated land. Development of more irrigated land will require additional storage capacity, more underground sources of water, or use of water-saving measures within present allocations. There appears to be potential for developing more irrigated land above the Roza Canal in the Moxee Valley and the south flanks of Rattlesnake Ridge. Other areas have little or no potential for irrigation because of the limited productivity of the soils and the high cost of obtaining water.

climate

Prepared by the National Climatic Center, Asheville, North Carolina

The Rocky Mountains partly shield the Yakima County Area from strong arctic winds, so winters, though cold, generally are not too severe. In summer Pacific Ocean winds are partially blocked; the days are hot, but the nights are fairly cool. Precipitation, except in mountainous areas, is scant in summer. In many places, however, it is adequate during the cooler parts of the year for growing nonirrigated small grain and range plants. The snowpack accumulation at high elevations supplies irrigation water for intensive farming in some of the lowland areas.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Yakima and Sunnyside in the period 1951-78 and at Rimrock in the period 1951-77. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperatures at Yakima, Rimrock, and Sunnyside are 32, 29, and 35 degrees F, respectively. The average daily minimum temperature is 23 degrees at Yakima, 21 degrees at Rimrock, and 26 degrees at Sunnyside. The lowest temperature on record, which occurred at Yakima on February 1, 1956, at Rimrock on December 17, 1964, and at Sunnyside on January 26, 1957, is -20 degrees In summer the average temperature is 68 degrees at Yakima, 61 degrees at Rimrock, and 70 degrees at Sunnyside. The average daily maximum temperatue is about 82 degrees F. The highest recorded temperature, which occurred at Yakima on August 10, 1971, is 110 degrees

Growing degree days, shown in table 1, are equivalent to heat units. During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The temperature at which a crop ceases to grow varies, depending on the crop. A base temperature of 40 degrees has been arbitrarily chosen to typify the minimum temperature for some crops. The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 7 to 8 inches at Yakima and Sunnyside and 25 inches at Rimrock. Of this, 30 percent at Yakima and Sunnyside and 20 percent at Rimrock usually falls in April through September, which includes the growing season for most crops. The heaviest 1-day rainfall recorded was 2.75 inches at Rimrock on November 20, 1962 Thunderstorms occur on about 7 days each year, and most occur in summer.

The average seasonal snowfall is 25 inches at Yakima, 107 inches at Rimrock, and 12 inches at Sunnyside. The greatest snow depth at any one time during the periods of record was 22 inches at Yakima, 71 inches at Rimrock, and 11 inches at Sunnyside On the average, 18 days at Yakima, 53 days at Rimrock, and 3 days at Sunnyside have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 40 percent. Humidity is higher at night, and the average at dawn is about 80 percent The sun shines 75 percent of the time possible in summer and 30 percent in winter. The prevailing wind is from the west-northwest Average windspeed is highest, 8 miles per hour, in spring.

how this survey was made

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

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

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

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

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

general soil map units

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

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

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

The general soil map at the back of this survey does not join, in all instances, with the general soil maps for adjacent survey areas. Differences in the maps have resulted from differences in the occurrence of soil patterns, differences in the publication scale of the maps, and the recent advances in classification

The 13 map units in this survey have been grouped into four general kinds of landscape for broad interpretive purposes. Each of the broad groups and the map units in each group are described in the following pages.

map unit descriptions

soils on flood plains and terraces

This group consists of four map units. It makes up about 24 percent of the survey area. The soils in this group are nearly level to moderately steep The native vegetation is mainly grasses, forbs, and shrubs

The soils in this group are very deep and somewhat excessively drained, well drained, somewhat poorly drained, and artificially drained. They formed in alluvium, eolian sand, and lacustrine sediment and have a mantle of loess or eolian sand

This group is used mainly for irrigated crops. It is also used for orchards, nonirrigated crops, rangeland, wildlife habitat, and homesites.

1. Umapine-Wenas

Very deep, somewhat poorly drained and artificially drained, nearly level and gently sloping soils; on flood plains

This map unit is in the north-central and eastern parts of the survey area, along the Wenas, Ahtanum, and Yakima Rivers. Slope is 0 to 5 percent The native vegetation is mainly water- and salt-tolerant grasses and forbs and salt-tolerant shrubs. Elevation is 650 to 1,800 feet. The average annual precipitation is 6 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 180 days.

This unit makes up about 3 percent of the survey area. It is about 40 percent Umapine soils and 10 percent Wenas soils. The remaining 50 percent is components of minor extent.

Umapine soils are very deep and somewhat poorly drained. They formed in alluvium These soils are silt loam throughout and are saline and alkaline.

Wenas soils are very deep and artificially drained. They formed in alluvium. The surface layer is silt loam The upper part of the subsoil is silt loam, and the lower part is silty clay loam. The upper part of the substratum is loam, and the lower part to a depth of 60 inches or more is loamy sand and gravelly loamy sand

Of minor extent in this unit are Fiander, Zillah, Toppenish, and Track soils and well drained Esquatzel soils.

This unit is used mainly for irrigated crops It is also used as rangeland, for wildlife habitat, and as homesites.

This unit is suited to irrigated crops. The main limitation of the Wenas soils is wetness, and the main limitations of the Umapine soils are alkalinity and wetness. Where the Umapine soils are drained, leached of excessive salts, and irrigated, they are suited to such crops as sweet corn, alfalfa, winter wheat, and asparagus.

The production of forage on this unit is limited by the salinity of the Umapine soils.

This unit is well suited to habitat for wildlife such as upland game birds, waterfowl, wading birds, and numerous other birds and mammals.

2. Weirman-Ashue

Very deep, somewhat excessively drained and well drained, nearly level and gently sloping soils; on flood plains and low terraces

This map unit is in the north-central part of the survey area, along the Yakima and Naches Rivers. Slope is 0 to 5 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 1,700 feet. The average annual precipitation is 7 to 14 inches, the average annual air temperature is about 51 degrees F, and the frost-free season is 130 to 180 days.

This unit makes up about 4 percent of the survey area. It is about 50 percent Weirman soils and about 15 percent Ashue soils. The remaining 35 percent is components of minor extent.

Weirman soils are on flood plains and low terraces that are dissected by flood channels in some places. These soils are very deep and somewhat excessively drained. They formed in mixed alluvium. The surface layer is sandy loam. The upper part of the underlying material is loamy fine sand, and the lower part to a depth of 60 inches or more is extremely gravelly sand.

Ashue soils are on low terraces. They are very deep and well drained. They formed in alluvium. The surface layer is loam. The subsoil is very gravelly loam and very gravelly sandy clay loam The substratum to a depth of 60 inches or more is very gravelly sandy loam and extremely gravelly sand.

This unit is used mainly for irrigated crops. It is also used for orchards, rangeland, wildlife habitat, and homesites.

The main limitations of this unit for irrigated crops are the hazard of soil blowing and low available water capacity. Most crops need frequent applications of irrigation water; however, irrigation is not practical on the Weirman soils that have been channeled by frequent periods of flooding. Irrigated crops grown include corn, grain, grasses, legumes, and tree fruit.

The production of forage on this unit is limited by low available water capacity and, on the Weirman soils, the hazard of flooding.

This unit is well suited to habitat for wildlife such as upland game birds, waterfowl, wading birds, cavity-nesting birds, birds of prey, and a few deer.

The main limitation for homesite development is the hazard of flooding on the Weirman soils. If the Ashue soils are used for septic tank absorption fields, seepage is a concern.

3. Quincy-Hezel

Very deep, somewhat excessively drained, nearly level to moderately steep soils; on terraces

This map unit is in the eastern part of the survey area, in the vicinity of Sunnyside. Slope is 0 to 15 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 1,100 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 51 degrees F, and the frost-free season is 135 to 180 days.

This unit makes up about 1 percent of the survey area. It is about 45 percent Quincy soils and 35 percent Hezel soils. The remaining 20 percent is components of minor extent.

Quincy soils are very deep and somewhat excessively drained. They formed in eolian sand. These soils are loamy fine sand throughout

Hezel soils are very deep and somewhat excessively drained. They formed in lacustrine sediment and have a mantle of eolian sand. The surface layer is loamy fine sand. The underlying material to a depth of 60 inches or more is stratified loamy fine sand, very fine sandy loam, and silt loam.

Of minor extent in this unit are well drained Cleman, Esquatzel, and Warden soils and poorly drained Wanser soils.

This unit is used mainly for irrigated field crops and orchards. It is also used as rangeland, for wildlife habitat, and as homesites.

The main limitations of this unit for irrigated crops are the low available water capacity and the hazard of soil blowing, which makes tillage management important. Irrigated crops grown include grain, corn, and potatoes. Grasses and legumes are grown for hay, pasture, and seed.

The production of forage on this unit is limited by low available water capacity.

This unit provides habitat for some game birds such as pheasant, dove, and quail.

The main limitation of this unit for homesite development is the hazard of soil blowing during construction. Construction sites should be disturbed as little as possible. The Hezel soils are moderately slowly permeable, which affects the rate of absorption of effluent from septic tank absorption fields. If the density of housing is moderate to high, community sewage systems are needed on the Quincy soils to prevent contamination of water supplies as a result of seepage from septic tank absorption fields.

4. Warden-Esquatzel

Very deep, well drained, nearly level to moderately steep soils; on terraces and flood plains

This map unit is in the east-central part of the survey area, east of Yakima and in the vicinity of Moxee. Slope is 0 to 30 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,500 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is about 50 degrees F, and the frost-free season is 135 to 180 days.

This unit makes up about 16 percent of the survey area. It is about 60 percent Warden soils and about 20

percent Esquatzel soils. The remaining 20 percent is components of minor extent.

Warden soils are on terraces. These soils are very deep and well drained. They formed in lacustrine sediment and have a mantle of loess. The surface layer and subsoil are silt loam. The substratum to a depth of 60 inches or more is stratified silt loam and very fine sandy loam.

Esquatzel soils are on flood plains. These soils are very deep and well drained They formed in silty alluvium. These soils are silt loam throughout.

Of minor extent in this unit are Burke, Cleman, Finley, Ritzville, Scoon, Scooteney, and Shano soils. Also included are somewhat poorly drained Outlook and Sinloc soils and somewhat excessively drained Quincy soils.

This unit is used mainly for irrigated crops. It is also used for orchards, nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitation of this unit for irrigated crops is the hazard of soil blowing. Proper irrigation water management is needed to prevent overirrigation and subsequent development of saline and alkaline seeps. A wide variety of irrigated crops can be grown, including asparagus, corn, grain, grapes, hops, mint, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for nonirrigated crops are the low annual precipitation and the hazards of soil blowing and water erosion. The soil in this unit generally is too dry for annual cropping; however, it is well suited to the production of winter wheat if a summer fallow cropping system is used.

The production of forage on this unit is limited by the low annual precipitation. Proper grazing use combined with a deferred-rotation grazing system is the most effective and least expensive method of range improvement.

This unit is suited to habitat for game birds such as dove, pheasant, and quail.

The main limitations of this unit for homesite development are the hazard of flooding on the Esquatzel soils and the areas of the Warden soils that have slopes of more than 15 percent. If these areas are used for septic tank absorption fields, slope may cause lateral seepage and surfacing of effluent in downslope areas.

soils on high dissected terraces

This group consists of one map unit. It makes up about 8 percent of the survey area. The soils in this group are nearly level to steep. The native vegetation is mainly grasses, forbs, and shrubs.

The soils in this group are shallow and moderately deep and are well drained. They formed in loess and old alluvium and are underlain by a lime- and silica-cemented pan in some areas.

This group is used mainly for irrigated field and orchard crops. It is also used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

5. Harwood-Gorst-Selah

Moderately deep and shallow, well drained, nearly level to steep soils; on high dissected terraces

This map unit is in the central part of the survey area, west of Selah and Yakima, north of the Wenas Valley, and along the south flanks of Rattlesnake Ridge. Slope is 0 to 60 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,100 to 2,000 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 51 degrees F, and the frost-free season is 135 to 180 days.

This unit makes up about 8 percent of the survey area. It is about 35 percent Harwood soils, 20 percent Gorst soils, and 10 percent Selah soils. The remaining 35 percent is components of minor extent

Harwood soils are moderately deep and well drained. They formed in loess and old alluvium. The surface layer and subsoil are loam The substratum is gravelly loam. A cemented pan is at a depth of about 30 inches.

Gorst soils are shallow and well drained. They formed in loess and old alluvium. These soils are loam. A cemented pan is at a depth of about 15 inches.

Selah soils are moderately deep and well drained. They formed in loess and old alluvium. The surface layer and the upper part of the subsoil are silt loam. The lower part of the subsoil is silty clay loam or clay loam A lime- and silica-cemented pan is at a depth of about 34 inches.

Of minor extent in this unit are Cowiche, Esquatzel, Gorskel, Logy, Ritzville, Rock Creek, Roza, Selah, and Willis soils.

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitation of this unit for irrigated crops is depth to the cemented pan in the Gorst soils. Soil depth and steepness of slope make irrigation water management important. The Gorst soils are suited to permanent crops such as grasses and legumes and to orchards with perennial cover crops The Harwood soils are suited to orchards and to crops such as corn, grain, grapes, peas, grasses, and legumes. The Selah soils are suited to orchards and to crops such as grain, grasses, and legumes.

The Harwood soils are suited to nonirrigated crops such as winter wheat if a summer fallow cropping system is used.

The production of forage on this unit is limited by low available water capacity and low annual precipitation. Proper grazing use combined with a deferred-rotation grazing system is the most effective and least expensive method of range management.

This unit is suited to habitat for game birds, including dove, pheasant, and quail.

The main limitations of this unit for use as homesites are depth to the cemented pan of the Gorst soils and the areas that have slopes of more than 15 percent. The pan hinders excavation. If the unit is used for septic tank absorption fields, slope can cause lateral seepage and surfacing of effluent in downslope areas.

soils on uplands, ridgetops, and plateaus

This group consists of six map units. It makes up about 45 percent of the survey area. The soils in this group are nearly level to steep. The native vegetation is mainly grasses, forbs, and shrubs.

The soils in this group are very shallow to very deep and are well drained. They formed in loess, in residuum and colluvium derived from basalt, andesite, or sandstone, and in material derived from fine-textured sediment.

This group is used mainly for nonirrigated crops and as rangeland. It is also used for irrigated field and orchard crops, irrigated hay and pasture, wildlife habitat, and homesites.

6. Lickskillet-Starbuck

Shallow, well drained, nearly level to steep soils; on uplands

This map unit is in the northeastern part of the survey area, on Rattlesnake and Yakima Ridges, and along the eastern part of the area, near Byron. Slope is 0 to 60 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 3,200 feet. The average annual precipitation is 6 to 12 inches, the average annual air temperature is about 49 degrees F, and the frost-free season is 120 to 170 days

This unit makes up about 9 percent of the survey area. It is about 35 percent Lickskillet soils and 15 percent Starbuck soils. The remaining 50 percent is components of minor extent.

Lickskillet soils formed in loess and in residuum and colluvium derived from basalt. The surface layer is silt loam or very stony silt loam. The subsoil is very gravelly silt loam, very gravelly loam, or very cobbly loam. Basalt is at a depth of about 20 inches. Depth to basalt ranges from 12 to 20 inches.

Starbuck soils formed in loess. The surface layer and the upper part of the subsoil are silt loam. The lower part of the subsoil is gravelly silt loam. Basalt is at a depth of about 16 inches. Depth to basalt ranges from 12 to 20 inches.

Of minor extent in this unit are Bakeoven, Bickleton, Cowiche, Esquatzel, Harwood, Kiona, Moxee, Renslow, Ritzville, Selah, Simcoe, and Willis soils and Rock outcrop.

This unit is used mainly as rangeland. It is also used for irrigated crops, for wildlife habitat, and as homesites.

The production of forage on this unit is limited by low available water capacity and low annual precipitation.

The main limitations of this unit for irrigated crops are the shallow depth to bedrock and steepness of slope, which make proper irrigation water management important.

This unit is well suited to habitat for game birds such as chukar and quail and for deer and bighorn sheep.

The main limitations of this unit for homesite development are the shallow depth to rock and the areas that have slopes of more than 15 percent. The rock hinders excavation. If this unit is used for septic tank absorption fields, the shallow depth to rock limits the absorption capacity of the soils and slope can cause lateral seepage and surfacing of effluent in downslope areas.

7. Willis-Moxee

Moderately deep and shallow, well drained, nearly level to moderately steep soils; on uplands

This map unit is in the northeastern part of the survey area, along the southern flanks of Yakima and Rattlesnake Ridges. Slope is 0 to 30 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 49 degrees F, and the frost-free season is 125 to 160 days.

This unit makes up about 8 percent of the survey area. It is about 35 percent Willis soils and 15 percent Moxee soils. The remaining 50 percent is components of minor extent.

Willis soils are moderately deep and well drained. They formed in loess. The surface layer is fine sandy loam or silt loam. The subsoil and substratum are silt loam. A lime- and silica-cemented pan is at a depth of about 34 inches. Depth to the pan ranges from 20 to 40 inches.

Moxee soils are shallow and well drained. They formed in loess. The surface layer and subsoil are silt loam. The substratum is gravelly silt loam. A lime- and silica-cemented pan is at a depth of about 18 inches. Depth to the pan ranges from 10 to 20 inches

Of minor extent in this unit are Cowiche, Finley, Ritzville, Scooteney, and Starbuck soils.

This unit is used for irrigated crops, irrigated hay and pasture, nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitation of this unit for irrigated crops are depth to a cemented pan and steepness of slope, which make irrigation water management important. The Moxee soils are suited to permanent crops such as grasses and legumes and to orchards with perennial cover crops. The Willis soils are suited to orchards and to crops such as corn, grain, grapes, peas, grasses, and legumes.

The main limitations of this unit for nonirrigated crops are low annual precipitation and the hazard of water erosion. The Willis soils are suited to the production of winter wheat if a summer fallow cropping system is used.

The production of forage is limited by low annual precipitation and low available water capacity. Proper grazing use along with a deferred-rotation grazing system is the most effective and least expensive method of range management.

This unit is suited to habitat for game birds such as dove, pheasant, and quail.

The main limitations of this unit for use as homesites are depth to the cemented pan and the areas that have slopes of more than 15 percent. The pan hinders excavation. The shallow and moderate depth of the soils in this unit limits the capacity of septic tank absorption fields Slope can cause lateral seepage and surfacing of effluent in downslope areas.

8. Ritzville-Starbuck

Very deep, deep, and shallow, well drained, nearly level to steep soils; on uplands

The map unit is mainly on Horse Heaven Hills and in Moxee Valley. A few areas of the unit are west of Yakima, west of Selah, and on the northwestern end of Rattlesnake Ridge. Slope is 0 to 60 percent. The native vegetation is mainly grasses, forbs, and shrubs Elevation is 700 to 2,500 feet. The average annual precipitation is 6 to 12 inches, the average annual air temperature is about 49 degrees F, and the frost- free season is 130 to 170 days.

This unit makes up about 12 percent of the survey area. It is about 75 percent Ritzville soils and 10 percent Starbuck soils. The remaining 15 percent is components of minor extent.

Ritzville soils are deep and very deep and are well drained. They formed in loess. The soils are silt loam to a depth of 60 inches or more

Starbuck soils are shallow and well drained. They formed in loess. The surface layer and the upper part of the subsoil are silt loam. The lower part of the subsoil is gravelly silt loam. Basalt is at a depth of about 16 inches Depth to basalt ranges from 12 to 20 inches.

Of minor extent in this unit are Bickleton, Cowiche, Esquatzel, Kiona, Renslow, Selah, and Willis soils and Rock outcrop.

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites

The main limitations of this unit for irrigated crops are depth to rock in the Starbuck soils and a hazard of water erosion Depth to rock and steepness of slope make irrigation water management important. The Starbuck soils generally are suited to permanent crops such as grasses and legumes and to orchards with cover crops Crops commonly grown on the Ritzville soils include grain, corn, grapes, hops, mint, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation of the Ritzville soils for use as nonirrigated cropland is low annual precipitation These soils are well suited to the production of winter wheat if a summer fallow cropping system is used. Starbuck soils are not used for nonirrigated crops.

The production of forage on the Starbuck soils is limited by low available water capacity The Ritzville soils are well suited to the production of forage.

This unit provides habitat for game birds such as pheasant, quail, and dove

The main limitation of the Starbuck soils for use as homesites is depth to rock, which hinders excavation The Ritzville soils have few limitations. If the soils in this unit are used for septic tank absorption fields, steepness of slope can cause lateral seepage and surfacing of effluent in downslope areas.

9. Taneum-Tieton

Deep and very deep, well drained, nearly level to steep, moist soils; on uplands

This map unit is in the northern part of the Wenas Valley and in the vicinity of Tieton and Cowiche. Slope is 0 to 60 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,500 to 3,000 feet. The average annual air temperature is about 49 degrees F, the average annual precipitation is 11 to 18 inches, and the frost-free season is 120 to 150 days.

This unit makes up about 4 percent of the survey area. It is about 40 percent Taneum soils and 40 percent Tieton soils. The remaining 20 percent is components of minor extent.

Taneum soils are very deep and well drained. They formed in loess overlying weathered sandstone. The surface layer is loam. The subsoil is silty clay loam or clay loam. The substratum to a depth of 60 inches or more is loam or sandy loam.

Tieton soils are deep and well drained. They formed in loess and in material weathered from andesite. The surface layer is fine sandy loam or loam. The subsoil is loam, silty clay loam, or clay loam. The substratum is loam. Weathered andesite is at a depth of about 50 inches. Depth to andesite ranges from 40 to 60 inches.

Of minor extent in this unit are Clint, Esquatzel, Logy, McDaniel, Meystre, Rock Creek, and Roza soils.

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites.

The Tieton soils are suited to irrigated crops. The main limitations are a hazard of soil blowing in areas that have a fine sandy loam surface layer and a hazard of water erosion in areas that have a loam surface layer. Crops grown include tree fruit, grain, and grapes. Grasses and legumes are also grown for hay and pasture. The main

limitation of the soils for growing tree fruit is the length of the growing season. The Taneum soils generally are not irrigated.

This unit is suited to nonirrigated crops. The main limitation is low annual precipitation. The soils in this unit are suited to the production of winter wheat in rotation with summer fallow and spring barley.

This unit is well suited to use as rangeland. Most of the areas of rangeland are on the Taneum soils.

This unit is well suited to habitat for game birds such as pheasant, quail, and dove and for deer and elk.

The main limitations of this unit for use as homesites are shrink-swell potential and the areas that have slopes of more than 15 percent. If the unit is used for septic tank absorption fields, slope can cause lateral seepage and surfacing of effluent in downslope areas.

10. Rock Creek-McDaniel

Very shallow and very deep, well drained, nearly level to steep soils; on plateaus and ridgetops on uplands

This unit is in the northwestern part of the survey area. Slope is 0 to 65 percent The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 3,300 feet. The average annual precipitation is 12 to 18 inches, the average annual air temperature is about 49 degrees F, and the frost-free season is 120 to 170 days.

This unit makes up about 9 percent of the survey area. It is about 55 percent Rock Creek soils and 20 percent McDaniel soils The remaining 25 percent is components of minor extent.

Rock Creek soils are on plateaus and ridgetops on uplands. These soils are very shallow and well drained. They formed in loess and in residuum derived from basalt. The surface layer is very stony silt loam. The subsoil is very cobbly clay Basalt is at a depth of about 10 inches. Depth to basalt ranges from 8 to 15 inches.

McDaniel soils are on uplands. These soils are very deep and well drained. They formed in loess and in colluvium derived from basalt. The surface layer is very stony loam. The underlying material to a depth of 60 inches or more is very gravelly clay loam, very cobbly silty clay loam, or extremely cobbly silty clay loam.

Of minor extent in this unit are Clint, Esquatzel, Logy, Meystre, Roza, and Taneum soils.

This unit is used as rangeland, for wildlife habitat, and as homesites.

The production of forage on the Rock Creek soils is limited by low available water capacity. The McDaniel soils are well suited to use as rangeland. Seeding is difficult because of stones on the surface. Proper grazing use and periodic rest of areas of rangeland are the most effective and least expensive methods of range management and erosion control.

This unit is well suited to habitat for deer, elk, bighorn sheep, and game birds such as chukar and pheasant.

The main limitations for homesites on the Rock Creek soils are the very shallow depth to bedrock, large stones, and the areas that have slopes of more than 15 percent. The bedrock hinders excavation. The presence of large stones can interfere with the operation of equipment and the installation of absorption lines. The McDaniel soils generally are not used as homesites.

11. Cowiche-Roza

Very deep, well drained, nearly level to steep soils; on uplands

This map unit is in the north-central part of the survey area, on the north and south sides of the Wenas Valley and northwest of Selah. Slope is 2 to 60 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,000 to 2,000 feet. The average annual air temperature is about 50 degrees F, the average annual precipitation is 8 to 12 inches, and the frost-free season is 135 to 160 days.

This unit makes up about 3 percent of the survey area. It is about 40 percent Cowiche soils and 35 percent Roza soils. The remaining 25 percent is components of minor extent.

Cowiche soils formed in residuum derived from sandstone and have a mantle of loess. The surface layer and subsoil are loam. The upper part of the substratum is very fine sandy loam, and the lower part to a depth of 60 inches or more is loamy fine sand.

Roza soils formed in material derived from fine-textured sediment. The surface layer is clay loam. The subsoil is clay loam or silty clay. The substratum to a depth of 60 inches or more is silty clay, silty clay loam, or clay loam.

Of minor extent in this unit are Cleman, Gorst, Harwood, Logy, Rock Creek, and Taneum soils and Torriorthents.

This unit is used mainly as rangeland and for wildlife habitat. Some areas are used for irrigated and nonirrigated crops and as homesites.

This unit is suited to use as rangeland. Proper grazing use and periodic rest of the areas of rangeland are the most effective methods of range management and erosion control. Range seeding is a suitable practice if the range vegetation is in poor condition.

This unit is suited to habitat for game birds such as chukar, quail, and pheasant and for deer and elk.

The main limitations of this unit for irrigated crops are steepness of slope, a hazard of water erosion on the Cowiche soils, and the slow permeability of the Roza soils. Proper irrigation water management is needed to prevent overirrigation and reduce the risk of water erosion. Applications of irrigation water should be adjusted to the slow permeability of the Roza soils.

The Cowiche soils are suited to nonirrigated crops. The average annual precipitation is too low for annual cropping; however, the soils are suited to the production of winter wheat if a summer fallow cropping system is used.

The main limitations of this unit for use as homesites are the shrink-swell potential and slow permeability of the Roza soils. If the unit is used for septic tank absorption fields, steepness of slope in places can cause lateral seepage and surfacing of effluent in downslope areas.

soils on uplands and mountains and in canyons

This group consists of two map units. It makes up about 23 percent of the survey area. The soils in this group are nearly level to very steep. The native vegetation is mainly conifers, grasses, forbs, and shrubs.

The soils in this group are moderately deep and very deep and are well drained. They formed in residuum and colluvium derived from basalt and containing loess and volcanic ash.

This group is used mainly as grazable woodland and rangeland and for wildlife habitat.

12. Jumpe-Sutkin-Sapkin

Very deep and moderately deep, well drained, nearly level to very steep soils; on uplands, mountainsides, and smooth mountaintops, in canyons, and on long, broad ridges

This map unit is in the western part of the survey area. Slope is 0 to 75 percent. The native vegetation is mainly conifers, grasses, forbs, and shrubs Elevation is 2,400 to 5,800 feet. The average annual precipitation is 18 to 40 inches, the average annual air temperature is about 43 degrees F, and the average frost-free season is 95 to 130 days.

This unit makes up about 18 percent of the survey area. It is about 35 percent Jumpe soils, 20 percent Sutkin soils, and 20 percent Sapkin soils. The remaining 25 percent is components of minor extent.

Jumpe soils are on mountainsides, on long, broad ridges, and in canyons. These soils are very deep and well drained. They formed in residuum and colluvium derived from basalt and containing a minor amount of loess and volcanic ash. The surface layer is stony loam The subsoil and substratum to a depth of 60 inches or more are extremely cobbly loam.

Sutkin soils are on mountainsides and in canyons. They are very deep and well drained They formed in colluvium and residuum derived from basalt and containing a minor amount of loess. The surface layer is stony loam. The subsoil is very cobbly loam or extremely cobbly loam. The substratum to a depth of 60 inches or more is cobbly loam.

Sapkin soils are on uplands and mountainsides. These soils are moderately deep and well drained. They formed in colluvium and residuum derived from basalt and containing a minor amount of loess. The surface layer is very stony loam or loam. The subsoil is cobbly loam, very cobbly loam, or extremely cobbly clay loam. Basalt is at a depth of about 27 inches. Depth to basalt ranges from 20 to 40 inches.

Of minor extent in this unit are Bocker, Carmack, Loneridge, Mippon, and Tekison soils and areas of Rubble land and Rock outcrop.

This unit is used as grazable woodland and for wildlife habitat.

The Jumpe and Sutkin soils in this unit are suited to the production of Douglas-fir and ponderosa pine Douglas-fir is the dominant species on the Jumpe soils, and ponderosa pine is the dominant species on the Sutkin soils. The areas of Rubble land and Rock outcrop can hinder harvesting. Use of conventional methods of harvesting trees may be difficult in the steeper areas.

The Sapkin soils are well suited to the production of forage, but the production of forage is low on the Jumpe and Sutkin soils. The forage can be improved by seeding adapted species. The presence of logging debris limits seeding

This unit is well suited to use as habitat for elk, deer, and bighorn sheep.

13. Naxing-Darland

Very deep, well drained, gently sloping to very steep soils; on mountains and broad ridges

This map unit is in the western part of the survey area Slope is 5 to 75 percent. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 5,000 to 7,000 feet. The average annual precipitation is 22 to 50 inches, the average annual air temperature is about 41 degrees F, and the average growing season, at 28 degrees F, is 80 to 120 days.

This unit makes up about 5 percent of the survey area. It is about 45 percent Naxing soils and 10 percent Darland soils The remaining 45 percent is components of minor extent.

Naxing soils are on mountains and broad ridges. These soils formed in colluvium derived dominantly from basalt, volcanic ash, and loess. The surface layer is stony loam or loam The subsoil is very cobbly loam. The substratum to a depth of 60 inches or more is extremely cobbly loam.

Darland soils are on south-facing mountainsides These soils formed in colluvium derived from basalt. The surface layer is stony loam, very gravelly loam, or very cobbly loam. The subsoil is extremely cobbly loam. The substratum to a depth of 60 inches or more is extremely cobbly sandy loam.

Of minor extent in this unit are Tumac soils, Cryumbrepts, moderately well drained Saydab soils, and Aquic Cryandepts.

This unit is used as grazable woodland, as rangeland, and for wildlife habitat.

The Naxing soils are suited to the production of subalpine fir, western larch, lodgepole pine, and Engelmann spruce; however, stands of merchantable

timber are not produced on these soils. The large amount of volcanic ash in the soils increases the risk of erosion and results in low load-bearing strength. Additions of coarse base rock are needed for roads

The Darland soils are not forested and are suited to the production of forage. The main limitations are the short growing season, steepness of slope, and stones on the surface. Steepness of slope limits accessibility. The production of forage on the Naxing soils is limited by the density of the overstory canopy and the short growing season. The presence of logging debris limits seeding.

This unit is well suited to habitat for bears and other mammals and to summer range for deer and elk.

broad land use considerations

The soils in this survey area have potential for a variety of uses such as irrigated cropland, orchards, nonirrigated cropland, rangeland, grazable woodland, wildlife habitat, homesite development, and recreation.

Approximately 30 percent of the acreage in the survey area is used as irrigated cropland. The major crops grown include apples, cherries, hops, asparagus, and corn. Grasses and legumes are grown for hay, pasture, and seed. The areas of cropland are primarily in valleys in general map units 1, 2, 3, 4, 5, 7, and 8. The Lickskillet and Starbuck soils in map unit 6 are shallow and are suited to permanent pasture or to orchards with a perennial cover crop The Ritzville soils in map unit 8 are well suited to irrigated crops if irrigation water is available. The main limitation is the hazard of erosion. The Tieton soils in map unit 9 are also used for irrigated crops.

The soils in map unit 1 have a seasonal high water table, are subject to flooding, and are affected by salts or alkali in some areas Installing adequate drains and leaching excess salts may be needed to achieve optimum yields. The soils in map unit 2 have low available water capacity, and frequent applications of irrigation water are needed. The soils in map unit 3 are sandy and are subject to a high hazard of wind erosion Frequent applications of irrigation water are needed to reduce soil blowing and to satisfy crop needs Map unit 4 is the largest and best suited unit for use as irrigated cropland. It consists mainly of Warden soils The hazard of erosion is the main limitation in map units 4, 5, 7, and 8. Soils that are moderately deep or shallow to a hardpan are a concern in map units 5 and 7 because the hardpan is a limitation for the construction of irrigation systems.

About 7 percent of the acreage in the area is used as nonirrigated cropland. The soils in map units 4, 8, and 9 are well suited to a winter wheat-fallow cropping system. These include the Warden, Ritzville, and Taneum soils. The Harwood and Willis soils in map units 5 and 7 are suited to nonirrigated winter wheat but are less productive than the Warden, Ritzville, and Taneum soils.

About 48 percent of the survey area is used as rangeland. Most of the areas of rangeland are on soils in map units 6, 7, 10, and 11. These include the Lickskillet, Willis, Rock Creek, and Roza soils. Soils in most other map units are well suited to use as rangeland, but their characteristics allow them to be used for more intensive purposes. The soils in map units 12 and 13 are forested, but they provide low yields of forage. These include the Jumpe, Sutkin, and Naxing soils.

About 15 percent of the survey area is used as grazable woodland, which is mainly in map units 12 and 13. The Jumpe and Sutkin soils in unit 12 produce good stands of Douglas-fir. The soils in map unit 13 generally are less productive because of the climate

The soils in all of the map units are suited to wildlife habitat. Wetland and shallow water areas in map units 1 and 2 provide good habitat for waterfowl and wading birds. Map units 3, 4, 5, 6, 7, 8, 9, and 10 provide suitable habitat for upland game birds such as dove, pheasant, and quail The soils in map units 9, 11, and 12 provide good habitat for big game such as deer, elk, and some bighorn sheep.

Most of the map units are suited to use as homesites. In general, the nearly level to strongly sloping Warden and Ritzville soils in map units 4 and 8 are well suited for use as homesites Depth to the hardpan or bedrock severely limits the soils in map units 5, 6, and 7 for use as homesites. Map unit 1 is poorly suited because of the hazard of flooding and wetness. The Weirman soils in map unit 2 are also subject to flooding. The Roza soils in map unit 11 are poorly suited for use as homesites because of high shrink-swell potential In the other map units, steepness of slope, depth to rock, permeability, and stones are the main limitations.

The soils in map units 1 and 2 have low potential for use as recreation sites because of the hazard of flooding. The soils in the other map units have some potential, depending on steepness of slope, soil depth, and the characteristics of the surface layer. Map units 10, 11, and 12 are used most extensively for hiking, horseback riding, cross-country skiing, fishing, hunting, and snowmobiling, The Oak Creek and L T. Murray Wildlife Recreation Areas and the Darland Loop are in these map units. The Yakima River, north of Selah, is used for boating and rafting.

detailed soil map units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying material They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Warden silt loam, 2 to 5 percent slopes, is one of several phases in the Warden series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Harwood-Gorst complex, 0 to 25 percent slopes, is an example.

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

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

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

map unit descriptions

1—Aquic Cryandepts, gently sloping. These deep, moderately well drained soils are in swales on alluvial fans and on stream terraces. They formed in alluvium that is derived from basalt and contains some volcanic ash and loess. Slope is 0 to 3 percent. The native vegetation is mainly grasses Elevation is 4,400 to 6,300 feet. The average annual precipitation is 30 to 50 inches, the average annual air temperature is about 41 degrees F, and the average frost-free season is 60 to 95 days.

No single profile is typical of Aquic Cryandepts, but one commonly observed in the survey area has a surface layer of dark brown and brown silt loam about 15 inches thick. The subsoil is yellowish brown extremely cobbly silt loam and light yellowish brown very cobbly sandy loam about 16 inches thick. The substratum is yellow very gravelly silt loam about 13 inches thick. Basalt is at a depth of about 44 inches. Depth to basalt ranges from 40 to 60 inches or more.

Included in this unit are areas of poorly drained and somewhat poorly drained soils in depressional areas and some areas of soils that have a clay subsoil. Included areas make up about 15 percent of the total acreage.

Permeability of these Aquic Cryandepts is moderate. Effective rooting depth is 40 to 60 inches or more. Available water capacity is moderate. Runoff is slow, and the hazard of water erosion is slight.

This unit is used as rangeland and for wildlife habitat and recreation.

The present vegetation is mainly bluegrass, fescue, sedges, quaking aspen, and false-hellebore The production of forage is limited by the short growing

season. Because this unit consists of open meadows interspersed with heavily timbered areas, grazing pressure can be severe. The establishment of salt licks and livestock watering facilities away from the meadows or construction of management fences improves the distribution of grazing by livestock and wildlife and reduces the grazing pressure on the meadows.

Following severe overgrazing, seeding reduces soil erosion, preserves water quality, and increases production. Seeding can be done at any time of the year, but seeding late in summer or in fall is most successful. Soil wetness is the major factor limiting seeding. Broadcast seeding is the most effective method. Adapted grasses and legumes should be seeded on this unit.

This map unit is in capability subclass VIw, nonirrigated.

2—Ashue loam. This very deep, well drained soil is on low terraces. It formed in alluvium. Slope is 0 to 2 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 1,700 feet. The average annual precipitation is 7 to 9 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is brown loam about 10 inches thick. The upper part of the subsoil is yellowish brown very gravelly loam about 5 inches thick, and the lower part is yellowish brown very gravelly sandy clay loam about 14 inches thick. The upper part of the substratum is dark yellowish brown very gravelly sandy loam about 5 inches thick, and the lower part to a depth of 60 inches or more is dark grayish brown extremely gravelly sand. In some areas the surface layer is cobbly or gravelly.

Included in this unit are small areas of Naches, Weirman, Logy, Zillah, and Yakima soils.

Permeability of this Ashue soil is moderately slow above the extremely gravelly sand part of the substratum and very rapid through it Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

This unit is used for irrigated field and orchard crops, wildlife habitat, and homesites. The main irrigated crops are corn, grapes, mint, peas, tree fruit, and asparagus. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is the low available water capacity. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of irrigation system used generally depends on the kind of crop grown If surface irrigation is used, the risk of erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content and tilth. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Use of vegetated filter strips at the end of rows reduces the volume of sediment in the tailwater. Exposing the very gravelly part of the substratum when leveling fields should be avoided. Shallow cuts are feasible in some areas.

This unit is poorly suited to homesite development. The main limitation is the content of gravel and large stones. Dustiness can be a problem during construction on large building sites. Building sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in.

The main limitation for septic tank absorption fields is seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. Large stones can interfere with the installation of absorption fields.

This map unit is in capability subclass IIIs, irrigated.

3—Bakeoven very cobbly silt loam, 0 to 30 percent slopes. This very shallow, well drained soil is on uplands. It formed in loess and in residuum derived from basalt. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,500 to 3,200 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is brown very cobbly silt loam about 4 inches thick. The upper part of the subsoil is dark yellowish brown gravelly clay loam about 3 inches thick, and the lower part is dark yellowish brown very gravelly clay loam about 3 inches thick. Basalt is at a depth of about 10 inches. Depth to basalt ranges from 4 to 12 inches. In some areas the surface layer is stony.

Included in this unit are areas of Lickskillet, Moxee, and Starbuck soils.

Permeability of this Bakeoven soil is moderately slow. Available water capacity is low. Effective rooting depth is 4 to 12 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland, for wildlife habitat, and as homesites.

The potential native vegetation on this unit is mainly stiff sagebrush and Sandberg bluegrass. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as Sandberg bluegrass decreases and the proportion of less preferred forage plants such as forbs, sagebrush, and annual grasses increases.

Areas that are heavily infested with undesirable vegetation can be improved with such methods as chaining, railing, chemical treatment, and prescribed burning. Seeding on this unit generally is not practical.

This unit is poorly suited to homesite development. The main limitations are very shallow depth to rock, large stones, and steepness of slope in areas where the slope is more than 15 percent. The very shallow depth to rock hinders excavation.

The main limitations for septic tank absorption fields are large stones, very shallow depth to rock, and steepness of slope. Because of the very shallow depth to rock and steepness of slope, effluent from absorption fields can surface in downslope areas and thus create a hazard to health. Large stones can interfere with the installation of absorption lines.

This map unit is in capability subclass VIIs, nonirrigated.

4—Bickleton silt loam, 0 to 5 percent slopes. This deep, well drained soil is on uplands. It formed in loess and in residuum derived from basalt. The native vegetation is mainly grasses and forbs. Elevation is 2,600 to 3,200 feet. The average annual precipitation is 11 to 14 inches, the average annual air temperature is about 47 degrees F, and the average frost-free season is 120 to 160 days.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is brown silt loam about 16 inches thick. The upper part of the substratum is pale brown silt loam about 9 inches thick, and the lower part is calcareous, brown extremely gravelly silty clay loam about 7 inches thick. Basalt is at a depth of about 42 inches. Depth to basalt ranges from 40 to 60 inches. In some areas a thin capping of gravel conglomerate overlies the basalt.

Included in this unit are areas of Renslow and Rock Creek soils and areas of Bickleton soils that have slopes of more than 5 percent.

Permeability of this Bickleton soil is moderate. Available water capacity is high. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight.

This unit is used for nonirrigated crops, for wildlife habitat, and as rangeland.

The main limitations for nonirrigated crops are the low annual precipitation and the hazard of water erosion Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable.

Erosion can be reduced by seeding fall grain early, stubble mulching, tilling on the contour or across the slope, and shaping waterways and seeding them to perennial grass. Drop structures are needed in places to control the flow of runoff in waterways Use of terraces, diversions, and stripcropping, either singly or in combination, is advisable on long slopes.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as Sandberg bluegrass, cheatgrass, big sagebrush, and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved with such methods as chaining, railing, beating, chemical treatment, plowing, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass IIIe, nonirrigated.

5—Bickleton silt loam, 5 to 20 percent slopes. This deep, well drained soil is on uplands. It formed in loess and in residuum derived from basalt. Slope is dominantly about 10 percent. The native vegetation is mainly grasses and forbs. Elevation is 2,600 to 3,200 feet. The average annual precipitation is 11 to 14 inches, the average annual air temperature is about 47 degrees F, and the average frost-free season is 120 to 160 days.

Typically, the surface layer is dark grayish brown silt loam about 10 inches thick. The subsoil is brown silt loam about 16 inches thick. The upper part of the substratum is calcareous, pale brown silt loam about 9 inches thick, and the lower part is calcareous, brown extremely gravelly silty clay loam about 7 inches thick Basalt is at a depth of about 42 inches. Depth to basalt ranges from 40 to 60 inches. In some areas a thin capping of gravel overlies the basalt.

Included in this unit are areas of Renslow and Rock Creek soils and areas of Bickleton soils that have slopes of more than 20 percent.

Permeability of this Bickleton soil is moderate. Available water capacity is high. Effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate

This unit is used for nonirrigated crops and as rangeland.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable.

Erosion can be reduced by seeding fall grain early, stubble mulching, tilling on the contour or across the slope, and shaping waterways and seeding them to perennial grass Drop structures are needed in places to control the flow of runoff in waterways. Terracing and stripcropping, either singly or in combination, may also be advisable.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the range is overgrazed, the proportion of

preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as Sandberg bluegrass, cheatgrass, big sagebrush, and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved with such methods as chaining, railing, beating, chemical treatment, plowing, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass IIIe, nonirrigated.

6—Bocker very cobbly loam, 0 to 25 percent slopes. This very shallow, well drained soil is on mountaintops and broad ridgetops. It formed in residuum that is derived from basalt and includes a small amount of loess. The native vegetation is mainly grasses and shrubs. Elevation is 2,800 to 5,500 feet. The average annual precipitation is 18 to 40 inches, the average annual air temperature is about 42 degress F, and the average frost-free season is 85 to 130 days.

Typically, the surface layer is dark grayish brown very cobbly loam about 3 inches thick. The subsoil is dark brown very cobbly loam about 4 inches thick. Fractured basalt is at a depth of about 7 inches Depth to basalt ranges from 5 to 10 inches.

Included in this unit are about 15 percent Sapkin soils on mounds and about 5 percent Jumpe, Sutkin, and Loneridge soils.

Permeability of this Bocker soil is moderate. Available water capacity is low. Effective rooting depth is 5 to 10 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation on this unit is mainly Sandberg bluegrass, bottlebrush squirreltail, and eriogonum. The production of forage is limited by cobbles on the surface, very shallow depth to rock, and low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as Sandberg bluegrass and buckwheat decreases and the proportion of less preferred forage plants such as forbs and cheatgrass increases.

This unit is limited for livestock watering ponds and other water impoundments because of the very shallow depth to rock. Water tanks, springs, wells, and pipeline systems can be used to provide water for livestock. Seeding is not feasible because of the cobbles on the surface, low available water capacity, and very shallow soil depth.

This map unit is in capability subclass VIIs, nonirrigated.

7—Bocker-Jumpe complex, 0 to 15 percent slopes. This map unit is on smooth mountaintops and broad ridges. Slope is dominantly 5 percent. The native vegetation is mainly grasses, shrubs, and scattered stands of conifers. Elevation is 3,500 to 5,000 feet The average annual precipitation is 25 to 40 inches, the average annual air temperature is about 42 degrees F, and the average frost-free season is 85 to 130 days.

This unit is about 60 percent Bocker very cobbly loam and about 35 percent Jumpe stony loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used

Included in this unit is about 5 percent Sapkin soils. Also included are areas of Bocker and Jumpe soils that have slopes of more than 15 percent and soils that are 30 to 40 inches deep over basalt

The Bocker soil is very shallow and well drained. It formed in residuum that is derived from basalt and includes a small amount of loess. Typically, the surface layer is dark grayish brown very cobbly loam about 3 inches thick. The subsoil is dark brown very cobbly loam about 4 inches thick. Fractured basalt is at a depth of about 7 inches. Depth to basalt ranges from 5 to 10 inches.

Permeability of the Bocker soil is moderate. Available water capacity is low. Effective rooting depth is 5 to 10 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Jumpe soil is very deep and well drained. It formed in residuum that is derived from basalt and includes a small amount of loess. Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick. The surface layer is brown stony loam about 3 inches thick. The subsoil is brown extremely cobbly loam. The substratum to a depth of 60 inches or more is yellowish brown extremely cobbly loam. In some areas the soil has an ashy mantle 4 to 12 inches thick.

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

This unit is used for wildlife habitat and as rangeland and grazable woodland.

Ponderosa pine and Douglas-fir are the main woodland species on the Jumpe soil. On the basis of a 100-year site curve, the mean site index is 67 for ponderosa pine and 80 for Douglas-fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 52 cubic feet per acre for ponderosa pine at age 50 and 69 cubic feet per acre for Douglas-fir at age 40. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 40 cubic feet per acre for ponderosa pine and 55 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on the Jumpe soil is about 70 percent that of normal stands, and the total yield is correspondingly lower

The main concern for the harvesting of timber on the Jumpe soil is gaining access to the widely scattered, irregularly shaped timbered areas. The cobbles on the surface of the Bocker soil make access to the forested Jumpe soil difficult and thus hinder harvesting Wheeled and tracked equipment can be used in skidding operations. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction generally is available on this unit

Seedling establishment is the main concern in the production of timber on the Jumpe soil. If seed trees are present, natural reforestation of cutover areas by ponderosa pine and Douglas-fir occurs infrequently. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. The droughtiness of the surface layer during the dry summer months increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants on the Jumpe soil are elk sedge, pinegrass, lupine, ceanothus, and bitterbrush. The crown density in the areas where the woodland site index was measured is 20 percent. This soil is well suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful

The potential native rangeland vegetation on the Bocker soil is mainly Sandberg bluegrass, carrotleaf lomatium, and bottlebrush squirreltail If the range is overgrazed, the proportion of preferred forage plants such as Sandberg bluegrass decreases and the proportion of less desirable forbs and annual grasses increases. The main limitations for the use of the Bocker soil as rangeland are cobbles on the surface, low available water capacity, and depth to rock. Livestock grazing during the hot summer months may concentrate on the tree-shaded Jumpe soil and on nearby areas of the Bocker soil.

This map unit is in capability subclass VIIs, nonirrigated.

8—Bocker-Sapkin complex, 0 to 25 percent slopes. This map unit is on smooth mountaintops and broad ridges Slope is dominantly about 5 percent. The native vegetation is mainly grasses and shrubs. Elevation is 3,200 to 5,000 feet. The average annual precipitation is 18 to 35 inches, the average annual air temperature is about 42 degrees F, and the average frost-free season is 95 to 130 days.

This unit is about 65 percent Bocker very cobbly loam, 0 to 25 percent slopes, and about 30 percent Sapkin very stony loam, 10 to 25 percent slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Sapkin soils that have slopes of more than 15 percent, Jumpe and Sutkin soils, Rock outcrop, and soils that are similar to these Bocker and Sapkin soils but are 40 to 60 inches deep over bedrock. Included areas make up about 5 percent of the total acreage.

The Bocker soil is very shallow and well drained. It formed in residuum that is derived from basalt and includes a small amount of loess. Typically, the surface layer is dark grayish brown very cobbly loam about 3 inches thick. The subsoil is dark brown very cobbly loam about 4 inches thick. Fractured basalt is at a depth of about 7 inches. Depth to basalt ranges from 5 to 10 inches.

Permeability of the Bocker soil is moderate. Available water capacity is low. Effective rooting depth is 5 to 10 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Sapkin soil is moderately deep and well drained It formed in residuum that is derived from basalt and includes a small amount of loess. Typically, the surface layer is about 15 inches thick. It is dark grayish brown very stony loam in the upper part and brown loam in the lower part. The upper part of the subsoil is brown cobbly loam about 12 inches thick, and the lower part is brown cobbly loam and extremely cobbly clay loam about 8 inches thick. Basalt is at a depth of about 35 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is 4 to 10 inches thick.

Permeability of the Sapkin soil is moderate Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is moderate.

This unit is used for wildlife habitat and as rangeland.

The potential native vegetation on the Bocker soil is mainly Sandberg bluegrass, eriogonum, and bottlebrush squirreltail, and on the Sapkin soil it is mainly Idaho fescue, bluebunch wheatgrass, and threetip sagebrush The production of forage is limited by the very cobbly surface layer, depth to rock, and low available water capacity. Areas that are heavily infested with undesirable vegetation can be improved with such practices as chemical treatment and prescribed burning.

This map unit is in capability subclass VIIs, nonirrigated.

9—Bocker-Sutkin complex, 0 to 7 percent slopes. This map unit is on smooth mountaintops and broad ridges. Slope is dominantly about 5 percent. The native vegetation is mainly grasses, shrubs, and scattered trees. Elevation is 2,800 to 4,800 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is about 42 degrees F, and the average frost-free season is 95 to 130 days.

This unit is about 65 percent Bocker very cobbly loam and about 30 percent Sutkin stony loam. The components of this unit are so intricately intermingled

that it was not practical to map them separately at the scale used.

Included in the unit are small areas of Sutkin soils that have slopes of more than 15 percent or that have a very cobbly clay subsoil. Included areas make up about 5 percent of the total acreage.

The Bocker soil is very shallow and well drained. It formed in residuum that is derived from basalt and includes a small amount of loess. Typically, the surface layer is dark grayish brown very cobbly loam about 3 inches thick. The subsoil is dark brown very cobbly loam about 4 inches thick. Fractured basalt is at a depth of about 7 inches. Depth to basalt ranges from 5 to 10 inches.

Permeability of the Bocker soil is moderate. Available water capacity is low. Effective rooting depth is 5 to 10 inches. Runoff is medium, and the hazard of water erosion is slight.

The Sutkin soil is very deep and well drained. Typically, the surface layer is covered with a mat of partially decomposed organic material about 1/2 inch thick. The surface layer is dark brown stony loam about 10 inches thick. The subsoil is dark yellowish brown very cobbly loam and extremely cobbly loam about 28 inches thick. The substratum to a depth of 60 inches or more is dark yellowish brown extremely cobbly loam.

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

This unit is used for wildlife habitat and as rangeland and grazable woodland.

Ponderosa pine and Douglas-fir are the main woodland species on the Sutkin soil. On the basis of a 100-year site curve, the mean site index is 67 for ponderosa pine and 81 for Douglas-fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 52 cubic feet per acre for ponderosa pine at age 50 and 71 cubic feet per acre for Douglas-fir at age 45. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 40 cubic feet per acre for ponderosa pine and 50 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on the Sutkin soil is about 90 percent that of normal stands, and the total yield is correspondingly lower.

The main concern for the harvesting of timber is gaining access to the widely scattered, irregularly shaped timbered areas of the Sutkin soil. The cobbles on the surface of the Bocker soil make access to the forested Sutkin soil difficult and thus hinder harvesting. Wheeled and tracked equipment can be used in skidding operations. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction generally is available on this unit.

Seedling establishment on the Sutkin soil is the main concern in the production of timber. Where seed trees are present, natural reforestation of cutover areas by ponderosa pine and Douglas-fir occurs infrequently. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. Droughtiness of the soil increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants on the Sutkin soil are mainly pinegrass, elk sedge, yarrow, bitterbrush, and common snowberry. The crown density in the areas where the woodland site index was measured is 25 percent. This soil is well suited to grazing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

The potential native vegetation on the Bocker soil is mainly Sandberg bluegrass, eriogonum, and lomatium. The production of forage is limited by the very cobbly surface layer, depth to rock, and low available water capacity.

If the range is overgrazed, the proportion of preferred forage plants such as Sandberg bluegrass decreases and the proportion of less desirable forbs and annual grasses increases. Livestock grazing during the hot summer months tends to concentrate on the shaded Sutkin soil and on nearby areas of the Bocker soil.

This map unit is in capability subclass VIIs, nonirrigated.

10—Burke silt loam, 2 to 5 percent slopes. This moderately deep, well drained soil is on uplands. It formed in loess over a lime- and silica-cemented hardpan. Slope is dominantly about 4 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,000 to 1,300 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is pale brown silt loam about 7 inches thick. The substratum is pale brown silt loam about 18 inches thick. A hardpan is at a depth of about 25 inches. Depth to the hardpan ranges from 20 to 40 inches. The hardpan commonly is underlain by basalt. In some areas the surface layer is very fine sandy loam, in some areas fragments of the hardpan are scattered throughout the profile and on the surface, and in some areas the hardpan is underlain by gravelly alluvium, tuffaceous sandstone, or alternate layers of loess and hardpan.

Permeability of this Burke soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, wildlife habitat, and homesites. The main irrigated crops are corn, grain, grapes, hops, mint, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are depth to the cemented pan and the hazard of water erosion. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used generally depends on the kind of crop grown. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. The risk of erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content and tilth. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion.

Growing mint in meadows rather than in rows greatly reduces water erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. Exposing the hardpan when leveling fields should be avoided. Shallow cuts are feasible in some areas.

This unit is poorly suited to homesite development. The main limitation is the depth to the cemented pan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is the depth to the cemented pan, which limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation.

This map unit is in capability subclass IIIe, irrigated.

11—Burke silt loam, 5 to 8 percent slopes. This moderately deep, well drained soils is on uplands. It formed in loess over a lime- and silica-cemented hardpan. The average size of areas is less than 35 acres. Slope is dominantly about 7 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,000 to 1,300 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is pale brown silt loam about 7 inches thick. The substratum is pale brown silt loam about 18 inches thick. A hardpan is at a depth of about 25 inches. Depth to the hardpan ranges from 20 to 40 inches. The hardpan commonly is underlain by basalt. In some areas the surface layer is very fine sandy loam, in some areas fragments of the hardpan are scattered throughout the profile and on the surface, and in some areas the hardpan is underlain by gravelly alluvium, tuffaceous sandstone, or alternate layers of loess and hardpan.

Included in this unit are small areas of Scoon, Shano, and Starbuck soils.

Permeability of this Burke soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated field and orchard crops, wildlife habitat, and homesites. The main irrigated crops are corn, mint, grain, grapes, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are depth to the cemented pan, steepness of slope, and the hazard of water erosion. Drip and sprinkler irrigation systems are suited to the soil in this unit. The type of system used generally depends on the kind of crop grown. Use of drip or sprinkler irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil improve the organic matter content and tilth. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Growing mint in meadows rather than in rows also greatly reduces water erosion.

This unit is poorly suited to homesite development. The main limitation is the depth to the cemented pan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is the depth to the cemented pan, which limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation.

This map unit is in capability subclass IIIe, irrigated.

12—Burke silt loam, 8 to 15 percent slopes. This moderately deep, well drained soil is on uplands. It formed in loess over a lime- and silica-cemented hardpan. Slope is dominantly about 12 percent. The native vegetation is mainly forbs and shrubs. Elevation is 1,000 to 1,300 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is pale brown silt loam about 7 inches thick. The substratum is pale brown silt loam about 18 inches thick. A hardpan is at a depth of about 25 inches. Depth to the hardpan ranges from 20 to 40 inches. The hardpan is commonly underlain by basalt. In some areas the surface layer is very fine sandy loam, in some areas fragments of the hardpan are scattered throughout the profile and on the surface, and in some areas the hardpan is underlain by gravelly alluvium, tuffaceous sandstone, or alternate layers of loess and hardpan.

Included in this unit are small areas of Scoon, Shano, and Starbuck soils and areas of Burke soils that have slopes of less than 8 percent or more than 15 percent.

Permeability of this Burke soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated field and orchard crops, for nonirrigated crops, as rangeland, for wildlife habitat, and as homesites. The main irrigated crops are grain, grapes, and tree fruit. A cover crop is grown in orchards. Grasses and legumes are grown for hay, pasture, or seed.

The main limitations for irrigated crops are depth to the cemented pan, steepness of slope, and the hazard of water erosion. Because of the steepness of slope, sprinkler and drip irrigation systems are best suited to the soil in this unit. If sprinkler irrigation is used, puddling reduces the water intake rate and impairs aeration. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Use of annual or perennial cover crops reduces erosion. A rotation of grain followed by alfalfa and grass commonly is used.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using diversions, and stripcropping. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and proportion of less preferred forage plants such as big sagebrush, Sandberg bluegrass, and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses or legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is the depth to the cemented pan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is the depth to the cemented pan, which restricts the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation. Steepness of slope and the cemented pan can cause lateral movement and surfacing of effluent in downslope areas.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

13—Carmack loam, 0 to 25 percent slopes. This very deep, well drained soil is on uplands. It formed in residuum derived from basaltic conglomerate and tuffaceous sandstone. The native vegetation is mainly conifers, grasses, and shrubs. Elevation is 2,200 to 3,500 feet. The average annual precipitation is 20 to 35 inches, the average annual air temperature is about 43 degrees F, and the average growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick. The upper part of the surface layer, where mixed to a depth of about 7 inches, is brown loam. The lower part is pale brown loam about 8 inches thick. The upper part of the subsoil is brown loam and pale brown silty clay loam about 28 inches thick, and the lower part to a depth of 60 inches or more is pale brown loam.

Included in this unit are small depressional areas that are poorly drained and areas of Carmack soils that have slopes of 25 to 50 percent. Included areas make up about 5 percent of the total acreage.

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

This unit is used as grazable woodland and for wildlife habitat.

Douglas-fir and ponderosa pine are the main woodland species on this unit. Among the trees of limited extent are western larch and scattered grand fir. On the basis of a 100-year site curve, the mean site index is 105 for Douglas-fir and 82 for ponderosa pine. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 112 cubic feet per acre for Douglas-fir at age 40 and 72 cubic feet per acre for ponderosa pine at age 40. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 100 cubic feet per acre for Douglas-fir and 60 cubic feet per acre for ponderosa pine. However, the typical basal area of stands on this unit is about 70 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is short periods of seasonal soil wetness. Wheeled and tracked equipment can be used in skidding operations. Use of wheeled and tracked equipment when the soil is moist can produce ruts, compact the soil, and damage tree roots. Unsurfaced roads and skid trails are soft when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit. Skid trails and firebreaks in the steeper areas of this unit are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover.

Seedling establishment is the main concern in the production of timber. If seed trees are present, natural reforestation of cutover areas by Douglas-fir and ponderosa pine occurs periodically. Reforestation can be accomplished by planting Douglas-fir and ponderosa pine seedlings. Droughtiness of the soil increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, pinegrass, lupine, and American vetch. The crown density in the areas where the woodland site index was measured is 30 percent. This unit is well suited to grazing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass IVe, nonirrigated.

14—Carmack cobbly loam, 25 to 50 percent slopes. This very deep, well drained soil is on uplands. It formed in residuum derived from basaltic conglomerate and tuffaceous sandstone. The native vegetation is conifers, grasses, and shrubs. Elevation is 2,200 to 3,500 feet. The average annual precipitation is 20 to 35 inches, the average annual air temperature is about 43 degrees F, and the average growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick. The upper part of the surface layer, where mixed to a depth of about 7 inches, is brown cobbly loam. The lower part is pale brown loam about 8 inches thick. The upper part of the subsoil is brown loam and pale brown silty clay loam 28 inches thick, and the lower part to a depth of 60 inches or more is pale brown loam. In some places, along drainageways and on convex slopes, the subsoil is gravelly.

Included in this unit are areas of Rock outcrop and Rubble land and areas of Carmack soils that have slopes of less than 25 percent. Included areas make up about 5 percent of the total acreage.

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

This unit is used as grazable woodland and for wildlife habitat.

Douglas-fir and ponderosa pine are the main woodland species on this unit. On the basis of a 100-year site curve, the mean site index is 87 for Douglas-fir and 77 for ponderosa pine. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 80 cubic feet per acre for Douglas-fir at age 40 and 65 cubic feet per acre for ponderosa pine at age 45. The mean annual for trees 6.6 inches in diameter and larger at 80 years of age is 65 cubic feet per acre for Douglas-fir and 50 cubic feet per acre for ponderosa pine. However, the typical basal area of stands on this unit is about 75 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is steepness of slope, which makes the use of wheeled and tracked equipment difficult. Cable yarding systems may be safer, and they disturb the soil less. Use of wheeled and tracked equipment when the soil is wet can produce ruts, compact the soil, and damage tree roots. Unsurfaced roads and skid trails are soft when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover.

Seedling establishment is the main concern in the production of timber. If seed trees are present, natural reforestation of cutover areas by Douglas-fir and

ponderosa pine occurs periodically. Reforestation can be accomplished by planting Douglas-fir and ponderosa pine seedlings. The droughtiness of the soil increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, bitterbrush, Oregon-grape, and pinegrass. The crown density in the areas where the woodland site index was measured is 25 percent. This unit is suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIe, nonirrigated.

15—Carmack cobbly loam, 50 to 75 percent slopes. This very deep, well drained soil is on north-facing mountainsides. It formed in residuum derived from basaltic conglomerate and tuffaceous sandstone. The native vegetation is mainly conifers, grasses, and shrubs. Elevation is 2,200 to 3,500 feet. The average annual precipitation is 20 to 35 inches, the average annual air temperature is about 43 degrees F, and the average growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick. The upper part of the surface layer, where mixed to a depth of about 7 inches, is brown cobbly loam. The lower part is pale brown loam about 8 inches thick. The upper part of the subsoil is brown loam and pale brown silty clay loam about 28 inches thick, and the lower part to a depth of 60 inches or more is pale brown loam. In some areas on knolls and along drainageways the subsoil is gravelly.

Included in this unit are areas of Rock outcrop and Rubble land and areas of Carmack soils that have slopes of 25 to 50 percent. Included areas make up about 10 percent of the total acreage.

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

This unit is used as grazable woodland and for wildlife habitat.

Douglas-fir and ponderosa pine are the main woodland species on this unit. Among the trees of limited extent are grand fir and western larch. On the basis of a 100-year site curve, the mean site index is 93 for Douglas-fir and 81 for ponderosa pine. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 90 cubic feet per acre for Douglas-fir at age 40 and 71 cubic feet per acre for ponderosa pine at age 40. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 55 cubic feet per acre for Douglas-fir and 40 cubic feet per acre for ponderosa pine. However, the typical basal area of stands on this unit is about 95 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is steepness of slope, which restricts the use of wheeled and tracked equipment in skidding operations. Cable yarding systems generally are safer, and they disturb the soil less. Harvesting systems that lift logs entirely off the ground reduce the disturbance of the protective layer of duff. Use of wheeled and tracked equipment when the soil is moist, produces ruts, compacts the soil, and damages tree roots. Unsurfaced roads and skid trails are soft when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover.

Seedling establishment is the main concern in the production of timber. If seed trees are present, natural reforestation of cutover areas of Douglas-fir and ponderosa pine occurs periodically. Reforestation can be accomplished by planting Douglas-fir and ponderosa pine seedlings. The droughtiness of the soil in this unit increases seedling morality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, pinegrass, and spirea. The production of understory vegetation is limited by the density of the overstory canopy. The crown density in the areas where the woodland site index was measured is 30 percent.

This unit is poorly suited to grazing. Steepness of slope limits access by livestock. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful. Because of the steepness of slope, broadcast seeding should be used.

This map unit is in capability subclass VIIe, nonirrigated.

16—Carmack cobbly loam, 25 to 50 percent north slopes. This very deep, well drained soil is on north-facing mountainsides. It formed in residuum derived from basaltic conglomerate and tuffaceous sandstone. The native vegetation is mainly conifers, grasses, and shrubs. Elevation is 2,200 to 3,500 feet. The average annual precipitation is 20 to 35 inches, the average annual air temperature is about 43 degrees F, and the average growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick. The upper part of the surface layer, where mixed to a depth of about 7 inches, is brown cobbly loam. The lower part is pale brown loam about 8 inches thick. The upper part of the subsoil is brown loam and pale brown silty clay loam about 28 inches thick, and the lower part to a

depth of 60 inches or more is pale brown loam In some areas, on knolls and along drainageways, the subsoil is gravelly.

Included in this unit are small areas of Rock outcrop and Rubble land and areas of Carmack soils that have slopes of less than 25 percent or more than 50 percent. Included areas make up about 10 percent of the total acreage.

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

This unit is used as grazable woodland and for wildlife habitat.

Douglas-fir and ponderosa pine are the main woodland species on this unit. Among the trees of limited extent are grand fir and western larch. On the basis of a 100-year site curve, the mean site index is 93 for Douglas-fir and 81 for ponderosa pine. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger at age 40 is 90 cubic feet per acre for Douglas-fir and 71 cubic feet per acre for ponderosa pine. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 75 cubic feet per acre for Douglas-fir and 55 cubic feet per acre for ponderosa pine. The basal area typically is about the same as that of normal stands.

The main limitation for the harvesting of timber is steepness of slope, making the use of wheeled and tracked equipment difficult. Cable yarding systems may be safer, and they disturb the soil less. Use of wheeled and tracked equipment when the soil is moist can produce ruts, compact the soil, and damage tree roots. Unsurfaced roads and skid trails are soft when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover. The protective layer of duff should be disturbed as little as possible.

Seedling establishment is the main concern in the production of timber. If seed trees are present, natural reforestation of cutover areas by Douglas-fir and ponderosa pine occurs periodically. Reforestation can be accomplished by planting Douglas-fir and ponderosa pine seedlings. The droughtiness of the soil in this unit increases the mortality of seedlings.

The common forest understory plants are elk sedge, pinegrass, spirea, lupine, western yarrow, and Oregon-grape. The crown density in the areas where the woodland site index was measured is 40 percent. This unit is suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIe, nonirrigated.

17—Carmack-Rock outcrop complex, 40 to 70 percent slopes. This map unit is on mountainsides. Slope is dominantly about 50 percent. Areas face south. The native vegetation is mainly conifers, grasses, and shrubs. Elevation is 2,200 to 3,500 feet. The average annual precipitation is 20 to 35 inches, the average annual air temperature is about 43 degrees F, and the average growing season, at 28 degrees F, is 145 to 170 days.

This unit is about 55 percent Carmack loam and about 35 percent Rock outcrop. The components of this unit are so intricately intermingled it was not practical to map them separately at the scale used.

Included in this unit are small areas of Carmack soils that have slopes of less than 40 percent and areas of shallow soils and Rubble land below the Rock outcrop. Included areas make up about 10 percent of the total acreage.

The Carmack soil is very deep and well drained. It formed in residuum derived dominantly from basaltic conglomerate and tuffaceous sandstone. Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick. The upper part of the surface layer, where mixed to a depth of about 7 inches, is brown loam. The lower part is pale brown loam about 8 inches thick. The upper part of the subsoil is brown loam and silty clay loam about 28 inches thick, and the lower part to a depth of 60 inches or more is pale brown loam.

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

Rock outcrop is exposed areas of bedrock occurring as bands and escarpments that generally extend from east to west.

This unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine and scattered Douglas-fir are the main woodland species on the Carmack soil. On the basis of a 100-year site curve, the mean site index is 77 for ponderosa pine and 87 for Douglas-fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inches in diameter and larger is 65 cubic feet per acre for ponderosa pine at age 45 and 80 cubic feet per acre for Douglas-fir at age 40. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 50 cubic feet per acre for ponderosa pine and 65 cubic feet per acre for Douglas-fir. However, the typical basal area of stands is about 75 percent that of normal stands, and the total yield is correspondingly lower.

The main limitations for the harvesting of timber are steepness of slope and the areas of Rock outcrop. The areas of Rock outcrop hinder harvesting and force yarding and skidding paths to converge, which results in increased potential for erosion and soil compaction. Unsurfaced roads are soft when wet, and they may be impassable during spring runoff or in rainy periods. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover. Logging roads require suitable surfacing for year-round use. Rock for road construction is available on this unit.

Seedling establishment is the main concern in the production of timber. If seed trees are present, natural reforestation of cutover areas by ponderosa pine occurs infrequently. The areas of Rock outcrop limit the even distribution of reforestation. The droughtiness of the soil in this unit increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, pinegrass, bluebunch wheatgrass, common snowberry, and bitterbrush. The crown density in the areas where the woodland site index was measured is 20 percent. The Carmack soil is poorly suited to grazing. Steepness of slope and the areas of Rock outcrop limit access by livestock. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIIs, nonirrigated.

18—Cleman very fine sandy loam, 0 to 2 percent slopes. This very deep, well drained soil is on flood plains and alluvial fans. It formed in alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 1,600 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is brown very fine sandy loam about 10 inches thick. Below this to a depth of 60 inches or more is brown and yellowish brown, stratified fine sandy loam, sandy loam, very fine sandy loam, and silt loam. In some areas the surface layer is silt loam, fine sandy loam, or loam, in some areas very gravelly loamy sand is below a depth of about 30 inches, and in some areas the subsoil is sandy clay loam.

Included in this unit are areas of Outlook, Esquatzel, Warden, Ashue, and Naches soils.

Permeability of this Cleman soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. This unit is subject to rare periods of flooding. The hazard of soil blowing is high.

This unit is used for irrigated field and orchard crops, for wildlife habitat, and as homesites. The main irrigated crops are grain, grapes, hops, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is the hazard of soil blowing. Using a cropping system that includes close-growing, high-residue crops in the rotation, maintaining crop residue on the surface, and using minimum tillage reduce soil blowing. Mulching may be needed to stabilize small areas where soil blowing begins. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation systems are used, the risk of water erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This unit is poorly suited to homesite development. The main limitation for homesites and septic tank absorption fields is the hazard of flooding. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in.

This map unit is in capability subclass IIe, irrigated.

19—Cleman very fine sandy loam, 2 to 5 percent slopes. This very deep, well drained soil is on flood plains. It formed in alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 1,600 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is brown very fine sandy loam about 10 inches thick. Below this to a depth of 60 inches or more is brown and yellowish brown, stratified fine sandy loam, sandy loam, very fine sandy loam, and silt loam. In some areas the surface layer is silt loam, fine sandy loam, or loam; in some areas very gravelly loamy sand is below a depth of about 40 inches; and in some areas the subsoil is sandy clay loam.

Included in this unit are areas of Esquatzel, Warden, Outlook, Ashue, Willis, Moxee, and Ritzville soils. Also included are areas of Cleman soils that have slopes of less than 2 percent.

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

erosion is moderate. This unit is subject to rare periods of flooding. The hazard of soil blowing is high.

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain, grapes, hops, peas, and tree fruits. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are the hazards of soil blowing and water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation, maintaining crop residue on the surface, and using minimum tillage reduce erosion. Mulching may be needed to stabilize small areas where soil blowing begins. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

Furrow, corrugation, drip, or sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. The risk of water erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

The main limitations for nonirrigated crops are low annual precipitation, the hazard of soil blowing, and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Soil blowing can be reduced by stripcropping and orienting rows at right angles to the prevailing wind. Water erosion can be reduced by seeding early in fall, using stubble mulch tillage, and shaping and seeding waterways to perennial grasses. Drop structures are needed in a few places to stabilize the flow of runoff in waterways.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, needleandthread, and big sagebrush. The production of forage is limited by the hazard of soil blowing. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is limited for livestock watering ponds and other water impoundments because of seepage. Water tanks, springs, wells, and pipeline systems can be used to provide water for livestock.

Range seeding is a suitable practice if the range vegetation is in poor condition. Seeding should be done in fall using a drill. Adapted legumes and grasses should be seeded on this unit.

This unit is poorly suited to homesite development. The main limitation for homesites and septic tank absorption fields is the hazard of flooding. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. These sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in.

This map unit is in capability subclasses IIe, irrigated, and IIIe, nonirrigated.

20—Cleman very fine sandy loam, 5 to 8 percent slopes. This very deep, well drained soil is on alluvial fans. It formed in alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 1,600 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is brown very fine sandy loam about 10 inches thick. Below this to a depth of 60 inches or more is brown and yellowish brown, stratified fine sandy loam, sandy loam, very fine sandy loam, and silt loam. In some areas gravelly loamy sand is below a depth of about 40 inches, and in some areas the subsoil is sandy clay loam.

Included in this unit are small areas of Ashue and Naches soils.

Permeability of this Cleman soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high. This unit is subject to rare periods of flooding.

This unit is used for irrigated field and orchard crops, as rangeland, for wildlife habitat, and as homesites. The main irrigated crops are grain, grapes, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are the hazards of soil blowing and water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation, maintaining crop residue on the surface, and using minimum tillage reduce erosion. Mulching may be needed to stabilize small areas where soil blowing begins.

Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from

overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, needleandthread, and big sagebrush. The production of forage is limited by the hazard of soil blowing. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is limited for livestock watering ponds and other water impoundments because of seepage. Water tanks, springs, wells, and pipeline systems can be used to provide water for livestock.

Range seeding is a suitable practice if the range vegetation is in poor condition. This unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation for homesites and septic tank absorption fields is the hazard of flooding. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in.

This map unit is in capability subclass IIIe, irrigated and nonirrigated.

21—Cleman very fine sandy loam, 8 to 15 percent slopes. This very deep, well drained soil is on alluvial fans. It formed in alluvium. Native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 1,600 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is brown very fine sandy loam about 10 inches thick. Below this to a depth of 60 inches or more is brown and yellowish brown, stratified fine sandy loam, sandy loam, very fine sandy loam, and silt loam. In some areas gravelly loamy sand is below a depth of about 40 inches, and in some areas the subsoil is sandy clay loam.

Included in this unit are small areas of Ashue and Naches soils and areas of Cleman soils that have slopes of less than 8 percent.

Permeability of this Cleman soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high. This unit is subject to rare periods of flooding.

This unit is used for irrigated field and orchard crops, for nonirrigated crops, as rangeland, for wildlife habitat, and as homesites. The main irrigated crops are grain, grapes, and tree fruit. Grasses and legumes are grown for hay, pasture, or seed. A cover crop is grown in orchards.

The main limitations for irrigated crops are steepness of slope, the hazard of soil blowing, and the hazard of water erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. A rotation of grain followed by alfalfa and grass commonly is used. Mulching may be needed to stabilize small areas where soil blowing begins.

Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The main limitations for nonirrigated crops are low annual precipitation, the hazard of soil blowing, and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Soil blowing can be reduced by stripcropping, stubble mulch farming, and seeding early and at right angles to the prevailing wind. Seeding early in fall and tilling and chiseling stubble fields either on the contour when the soil is dry or across the slope reduce water erosion. Construction of level terraces and stripcropping, either singly or in combination, may be needed. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, needleandthread, and big sagebrush. The production of forage is limited by the hazard of soil blowing. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, and chemical treatment.

This unit is poorly suited to livestock watering ponds because of seepage. Other water storage systems or pipelines should be used to provide water for livestock.

Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is the hazard of flooding. Dikes and

channels that have outlets to bypass floodwater can be used to protect buildings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are the hazard of flooding and steepness of slope. Slope can cause lateral seepage of effluent so that it surfaces in downslope areas. Septic tank absorption lines should be installed on the contour. Cutbanks are not stable and are subject to caving in.

This map unit is in capability subclass IVe, irrigated, and IIIe, nonirrigated.

22—Clint very stony loam, 15 to 45 percent slopes. This moderately deep, well drained soil is on uplands. It formed in loess and in residuum derived from basalt. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 2,300 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is 49 degrees F, and the average frost-free season is 120 to 135 days.

Typically, the upper part of the surface layer is reddish brown very stony loam about 6 inches thick, and the lower part is reddish brown gravelly loam about 4 inches thick. The subsoil is reddish brown very gravelly loam about 9 inches thick. The substratum is dark brown extremely gravelly loam about 9 inches thick. Basalt is at a depth of about 28 inches. Depth to bedrock ranges from 20 to 40 inches.

Included in this unit are areas of McDaniel and Rock Creek soils and Rubble land. The percentage of included components varies from one area to another.

Permeability of this Clint soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The production of forage is limited by the low available water capacity and large stones. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition, but it is difficult because of stoniness. The unit should be seeded in fall using a drill. Adapted legumes and grasses should be seeded.

This map unit is in capability subclass VIIs, nonirrigated.

23—Clint-Rubble land complex, 8 to 75 percent slopes. This map unit is on uplands. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 2,300 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 120 to 135 days.

This unit is 50 percent Clint very stony loam and 25 percent Rubble land. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 10 percent McDaniel soils and about 15 percent Rock Creek soils. Also included are areas of Rock outcrop. Included areas make up about 25 percent of the total acreage.

The Clint soil is moderately deep and well drained. It formed in loess and in residuum derived from basalt. Typically, the upper part of the surface layer is reddish brown very stony loam about 6 inches thick, and the lower part is reddish brown gravelly loam about 4 inches thick. The subsoil is reddish brown very gravelly loam about 9 inches thick. The substratum is dark brown extremely gravelly loam about 9 inches thick. Basalt is at a depth of about 28 inches. Depth to bedrock ranges from 20 to 40 inches.

Permeability of the Clint soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

Rubble land is areas of basalt cobbles, stones, and boulders. It does not support vegetation.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation on the Clint soil is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. The production of forage is limited by. the steepness of slope, large stones on the surface, and the areas of Rubble land. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Brush control is largely limited to aerial applications of chemicals or prescribed burning because of the steepness of slope and the areas of Rubble land. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Proper location of salt licks, stock water tanks, and fences promotes more uniform distribution of grazing.

Range seeding on the Clint soil is a suitable practice if the range vegetation is in poor condition; however, seeding is difficult because of the large stones and the areas of Rubble land. The soil should be seeded in fall by broadcasting. Adapted legumes and grasses should be seeded.

This map unit is in capability subclass VIIs, nonirrigated.

24—Cowiche loam, 2 to 5 percent slopes. This very deep, well drained soil is on uplands. It formed in

residuum derived from sandstone and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,000 to 2,000 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 135 to 160 days.

Typically, the surface layer is grayish brown and brown loam about 10 inches thick. The subsoil is brown, yellowish brown, and pale brown loam about 25 inches thick. The upper part of the substratum is pale brown very fine sandy loam about 10 inches thick, and the lower part to a depth of 60 inches or more is brown loamy fine sand. In some areas weathered sandstone is at a depth of 40 to 60 inches.

Included in this unit are about 10 percent Willis soils, 5 percent Ritzville soils, and 5 percent Selah and Harwood soils.

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

This unit is used for irrigated field crops and orchards, for wildlife habitat, and as homesites. The main irrigated crops are grain, grapes, hops, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is the hazard of water erosion. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to soil in this unit. The type of system used depends on the kind of crop grown. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. The risk of erosion can be minimized by keeping runs short. Sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Use of annual or perennial cover crops during the irrigation season reduces erosion in fields of hops and in orchards and vineyards (fig 1). Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

This unit is suited to homesite development. The main limitation is the moderate shrink-swell potential. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is the moderate permeability of the soil. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation. Cutbanks are not stable and are subject to caving in.

This map unit is in capability subclass IIe, irrigated.

25—Cowiche loam, 5 to 8 percent slopes. This very deep, well drained soil is on uplands. It formed in residuum derived from sandstone and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,000 to 2,000 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is 49 degrees F, and the average frost-free season is 135 to 160 days.

Typically, the surface layer is grayish brown and brown loam about 10 inches thick. The subsoil is brown, yellowish brown, and pale brown loam about 25 inches thick. The upper part of the substratum is pale brown very fine sandy loam about 10 inches thick, and the lower part to a depth of 60 inches or more is brown loamy fine sand. In some areas weathered sandstone is at a depth of 40 to 60 inches.

Included in this unit are about 10 percent Willis soils, 5 percent Ritzville soils, and 5 percent Selah and Harwood soils.

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

This unit is used for irrigated field and orchard crops, for wildlife habitat, and as homesites. The main irrigated crops are grain, grapes, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve organic matter content, help to maintain soil structure, improve the water infiltration rate, and reduce erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop

Figure 1.—Irrigated orchard with a permanent cover crop on Cowiche loam, 2 to 5 percent slopes.

residue on the surface also reduce erosion. A rotation of grain followed by alfalfa and grass commonly is used. Using cover crops in orchards and vineyards during the irrigation season reduces erosion. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

This unit is suited to homesite development. The main limitation is the moderate shrink-swell potential. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling excavations with material that has low shrink-swell potential. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is moderate permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation. Cutbanks are not stable and are subject to caving in.

This map unit is in capability subclass IIIe, irrigated.

26—Cowiche loam, 8 to 15 percent slopes. This very deep, well drained soil is on uplands. It formed in residuum derived from sandstone and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,000 to 2,000 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 135 to 160 days.

Typically, the surface layer is grayish brown and brown loam about 10 inches thick. The subsoil is brown, yellowish brown, and pale brown loam about 25 inches thick. The upper part of the substratum is pale brown very fine sandy loam about 10 inches thick, and the lower part to a depth of 60 inches or more is brown

loamy sand. In some areas weathered sandstone is at a depth of 40 to 60 inches.

Included in this unit are about 10 percent Willis soils, 5 percent Ritzville soils, 5 percent Selah and Harwood soils, and areas of Cowiche loam that has slopes of less than 8 percent.

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

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain, grapes, and tree fruit. A cover crop is grown in orchards. Grass and legumes are grown for hay, pasture, or seed.

The main limitations for irrigated crops are steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain soil structure, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. A rotation of grain followed by alfalfa and grass commonly is used. Use of annual or perennial cover crops in orchards and vineyards during the irrigation season reduces erosion. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding early and using stubble mulch tillage. Use of terraces and stripcropping, either singly or in combination, may be needed. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation on this unit is mainly bluebunch wheatgrass and Idaho fescue. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted legumes and grasses should be seeded.

This unit is suited to homesite development. The main limitations are the moderate shrink-swell potential and steepness of slope. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling excavations with material that has low shrink-swell potential. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are the moderate permeability of the soil and steepness of slope. Use of sandy backfill for the trench and long absorption lines helps to compensate for the moderate permeability. Slope can promote lateral seepage and surfacing of effluent in downslope areas. Absorption lines should be installed on the contour. Cutbanks are not stable and are subject to caving in.

This map unit is in capability subclasses IVe, irrigated, and IIIe, nonirrigated.

27—Cowiche loam, 15 to 30 percent slopes. This very deep, well drained soil is on uplands. It formed in residuum derived from sandstone and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,000 to 2,000 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 135 to 160 days.

Typically, the surface layer is grayish brown and brown loam about 10 inches thick. The subsoil is brown, yellowish brown, and pale brown loam about 25 inches thick. The upper part of the substratum is pale brown very fine sandy loam about 10 inches thick, and the lower part to a depth of 60 inches or more is brown loamy fine sand. In some areas weathered sandstone is at a depth of 40 to 60 inches.

Included in this unit are about 5 percent Willis soils, 10 percent Ritzville soils, and 5 percent Selah and Harwood soils.

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

This unit is used for irrigated and nonirrigated field and orchard crops, for wildlife habitat, and as rangeland and homesites. The main irrigated crops are grain, grapes, and tree fruit. A cover crop is grown in orchards. Grasses and legumes are grown for hay, pasture, or seed.

The main limitations for irrigated crops are steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion. To avoid loss of water and leaching of plant nutrients from overirrigation,

applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Perennial cover crops are needed in orchards and vineyards to reduce erosion. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion is reduced if fall grain is seeded early and stubble mulch tillage is used. Seeding early in fall, either on the contour or across the slope, slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Divided-slope farming and stripcropping are effective in reducing erosion. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation on this unit is mainly bluebunch wheatgrass and Idaho fescue. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, and chemical treatment. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted legumes and grasses should be seeded.

This unit is poorly suited to homesite development. The main limitation is steepness of slope. Dustiness can be a problem during contruction on large building sites; therefore, these sites should be disturbed as little as possible. This unit should be seeded to reduce erosion and soil slippage.

The main limitation for septic tank absorption fields is steepness of slope, which can promote lateral seepage and surfacing of effluent in downslope areas. Cutbanks are not stable and are subject to caving in.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

28—Cowiche-Rock Creek complex, 5 to 15 percent slopes. This map unit is on uplands. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,500 to 2,400 feet. The average annual precipitation is about 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the frost-free season is about 135 to 160 days.

This unit is about 50 percent Cowiche loam and about 30 percent Rock Creek very stony silt loam. The Cowiche soil is on mounds, and the Rock Creek soil is in areas between the mounds. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Simcoe, Clint, Harwood, and Gorst soils. Also included are areas of Cowiche soils where about 25 percent of the surface layer has been removed by erosion. Included areas make up about 20 percent of the total acreage.

The Cowiche soil is very deep and well drained. It formed in residuum derived from sandstone and has a mantle of loess. Typically, the surface layer is grayish brown and brown loam about 10 inches thick. The subsoil is brown, yellowish brown, and pale brown loam about 25 inches thick. The upper part of the substratum is pale brown very fine sandy loam about 10 inches thick, and the lower part to a depth of 60 inches or more is brown loamy fine sand. In some areas weathered sandstone is at a depth of 40 to 60 inches.

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

The Rock Creek soil is very shallow and well drained. It formed in loess and in residuum derived from basalt. Typically, the surface layer is grayish brown very stony silt loam about 2 inches thick. The subsoil is grayish brown and brown very cobbly clay about 8 inches thick. Basalt is at a depth of about 10 inches. Depth to basalt ranges from 8 to 15 inches.

Permeability of the Rock Creek soil is moderately slow. Available water capacity is low. Effective rooting depth is 8 to 15 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation of the Cowiche soil is mainly bluebunch wheatgrass and Idaho fescue. The potential native vegetation of the Rock Creek soil is mainly stiff sagebrush, Sandberg bluegrass, and eriogonum. The main limitations for the production of forage on the Rock Creek soil are depth to rock and low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as stiff sagebrush and Sandberg bluegrass decreases and the proportion of less preferred forage plants such as forbs and annual grasses increases.

Areas of the Cowiche soil that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, and chemical treatment. Care should be taken during brush control to disturb the Rock Creek soil as little as possible.

Range seeding on the Rock Creek soil is not feasible because of low available water capacity and depth to rock. Proper range use and periodic rest are the most effective methods of range management and erosion control. Range seeding on the Cowiche soil is a suitable practice if the range vegetation is in poor condition. The soil should be seeded in fall using a drill. Adapted legumes and grasses should be seeded.

This map unit is in capability subclass VIs, nonirrigated.

29—Cryumbrepts, gently sloping. These very deep, well drained soils are on terraces. They formed in old mixed alluvium and volcanic ash. Slope is 0 to 10 percent. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 4,700 to 5,200 feet. The average annual precipitation is 30 to 50 inches, the average annual air temperature is about 41 degrees F, and the average length of the growing season, at 28 degrees F, is 100 to 170 days.

No single profile of Cryumbrepts is typical, but one commonly observed in the survey area is covered with a mat of partially decomposed organic material about 1-1/2 inches thick. The surface layer is brown loam about 19 inches thick. The subsoil is brown loam about 8 inches thick. The upper part of the substratum is yellowish brown loam about 12 inches thick, and the lower part to a depth of 60 inches or more is yellowish brown sandy loam.

Included in this unit are 10 percent Aquic Cryandepts along streams and in depressional areas and about 5 percent Naxing soils in convex areas near the border of the unit.

Permeability of these Cryumbrepts is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight.

This unit is used as grazable woodland and for wildlife habitat.

Lodgepole pine, western larch, and grand fir are the main woodland species on this unit. Among the trees of limited extent are subalpine fir and Engelmann spruce. On the basis of a 100-year site curve, the mean site index is 89 for lodgepole pine. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for lodgepole pine is about 100 cubic feet per acre at 100 years of age. On the basis of a 50-year site curve, the mean site index is 50 for western larch. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination for western larch trees 0.6 inch in diameter and larger at 70 years of age is 63 cubic feet per acre. The mean annual increment for trees 7.6 inches in diameter and larger at 80 years of age is 50 cubic feet per acre. However, the typical basal area of stands on this unit is about 105 percent that of normal stands, and the total yield is correspondingly higher.

Snowpack hinders the use of equipment on this unit and limits access in winter. Unsurfaced roads and skid trails are soft when wet, and they may be impassable during spring runoff or in rainy periods. Use of wheeled and tracked equipment when the soil in this unit is wet produces ruts, compacts the soil, and damages tree roots. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Seedling establishment is the main concern in the production of timber. If seed trees are present, natural reforestation of cutover areas by lodgepole pine and western larch occurs readily.

The common forest understory plants are lupine, yarrow, and strawberry. The crown density in the areas where the woodland site index was measured is 35 percent. This unit is suited to grazing and browsing. It has few limitations for the production of forage. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIe, nonirrigated.

30—Darland stony loam, 45 to 75 percent slopes. This very deep, well drained soil is on south-facing mountainsides. It formed in colluvium derived from basalt. The native vegetation is mainly grasses, scattered trees, forbs, and shrubs. Elevation is 5,000 to 6,900 feet. The average annual precipitation is 25 to 45 inches, the average annual air temperature is about 42 degrees F, and the average length of the growing season, at 28 degrees F, is 100 to 120 days.

Typically, the upper part of the surface layer is dark yellowish brown stony loam about 8 inches thick, and the lower part is dark brown very gravelly loam and very cobbly loam about 23 inches thick. The subsoil is dark yellowish brown extremely cobbly loam about 12 inches thick. The substratum to a depth of 60 inches or more is dark yellowish brown extremely cobbly sandy loam. In some areas the surface layer is severely eroded, in some areas there are no stones in the surface layer, and in some areas basalt is at a depth of 20 to 60 inches. At the southern edge of the headwaters of Foundation Creek, the parent material is shale.

Included in this unit are areas of Naxing soils on benches; areas of extremely stony soils; small concave areas of soils that have slopes of 20 to 45 percent; and soils, on ridgetops, that have slopes of 5 to 20 percent. Included areas make up about 10 percent of the total acreage.

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

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation on this unit is mainly Idaho fescue, Cusick bluegrass, elk sedge, and mountain brome. The main limitations for the production of forage are steepness of slope and stones on the surface. Steepness of slope promotes overgrazing of the less sloping areas. If the range is overgrazed, the proportion of preferred forage plants such as Cusick bluegrass decreases and the proportion of less preferred forage

plants such as cheatgrass and sagebrush increases. Brush control is largely limited to aerial application of chemicals or prescribed burning. Proper location of salt licks, stock water tanks, and fences improves the distribution of livestock grazing. Seeding is limited by stones on the surface and steepness of slope.

This unit is poorly suited to livestock watering ponds and other water impoundments. Water tanks, springs, wells, or pipeline systems can be used to provide water for livestock.

This map unit is in capability subclass VIIs, nonirrigated.

31—Darland-Rubble land complex, 45 to 75 percent slopes. This map unit is on mountainsides. Slope is dominantly about 60 percent. The native vegetation is mainly grasses, forbs, shrubs, and scattered trees Elevation is 5,000 to 6,500 feet. The average annual precipitation is 25 to 45 inches, the average annual air temperature is about 42 degrees F, and the average length of the growing season, at 28 degrees F, is 100 to 120 days.

This unit is about 55 percent Darland stony loam and about 35 percent Rubble land. The Darland soil is in long, irregularly shaped areas, and Rubble land is talus fans on mountain toe slopes below areas of Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 5 percent Naxing soils and Aquic Cryandepts on benches and about 10 percent areas of Rock outcrop, severely eroded soils, and Darland soils that have slopes of 30 to 45 percent. The percentage varies from one area to another.

The Darland soil is very deep and well drained. It formed in colluvium derived from basalt. Typically, the upper part of the surface layer is dark yellowish brown stony loam about 8 inches thick. The lower part is dark brown very gravelly loam and very cobbly loam about 23 inches thick. The subsoil is dark yellowish brown extremely cobbly loam about 12 inches thick. The substratum to a depth of 60 inches or more is dark yellowish brown extremely cobbly sandy loam. In some areas the surface layer does not have stones.

Permeability of the Darland soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very high.

Rubble land is areas of cobbles, stones, and boulders. It is mostly free of vegetation.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation on the Darland soil is mainly Idaho fescue, Cusick bluegrass, elk sedge, and mountain brome. The main limitations for the production of forage are steepness of slope, large stones in the surface layer, and areas of Rubble land. Steepness of slope promotes overgrazing of the less sloping areas. If the range is overgrazed, the proportion of preferred forage plants such as Cusick bluegrass decreases and the proportion of less preferred forage plants such as sagebrush and cheatgrass increases. Brush control is limited mainly to aerial application of chemicals or prescribed burning. Proper location of salt licks, stock water tanks, and fences improves the distribution of livestock grazing. Seeding is limited by very steep slopes and the areas of Rock outcrop and Rubble land.

This unit is poorly suited to livestock watering ponds and other water impoundments. Water tanks, springs, wells, and pipeline systems can be used to provide water for livestock.

This map unit is in capability subclass VIIs, nonirrigated.

32—Esquatzel silt loam, 0 to 2 percent slopes. This very deep, well drained soil is on flood plains dissected by intermittent and perennial streams. It formed in silty alluvium. The native vegetation is grasses, forbs, and shrubs. Elevation is 650 to 1,500 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 160 days.

Typically, the surface layer is brown silt loam about 17 inches thick. The underlying material to a depth of 60 inches or more is pale brown silt loam. In some areas the surface layer is fine sandy loam, in some areas the soil is stratified with thin lenses of sandy loam, and in some areas very gravelly loamy sand is at a depth of 36 inches or more.

Included in this unit are small areas of Willis, Outlook, Warden, Umapine, and Selah soils.

Permeability of this Esquatzel soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very slow. This unit is subject to rare periods of flooding.

This unit is used for irrigated field and orchard crops, for wildlife habitat, and as homesites. The main irrigated crops are asparagus, corn, grain, grapes, hops, mint, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

This unit has few limitations for irrigated crops. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The rate of application of water should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and

leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve organic matter content, help to maintain tilth, and improve the infiltration rate. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is poorly suited to homesite development. The main limitation for homesites and septic tank absorption fields is the hazard of flooding. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This map unit is in capability class I, irrigated.

33—Esquatzel silt loam, 2 to 5 percent slopes. This very deep, well drained soil is on flood plains that are dissected by intermittent streams. It formed in silty alluvium. The native vegetation is grasses, forbs, and shrubs. Elevation is 650 to 1,500 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 160 days.

Typically, the surface layer is brown silt loam about 17 inches thick. The underlying material to a depth of 60 inches or more is pale brown silt loam. In some areas the surface layer is fine sandy loam, and in some areas the soil is stratified with thin lenses of fine sandy loam.

Included in this unit are small areas of Warden, Quincy, Willis, Scoon, Outlook, Finley, and Selah soils and areas of Esquatzel soils that have slopes of less than 2 percent.

Permeability of this Esquatzel soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. This unit is subject to rare periods of flooding.

This unit is used for irrigated and nonirrigated field and orchard crops, for wildlife habitat, and as rangeland and homesites. The main irrigated crops are asparagus, corn, grain, grapes, hops, mint, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is the hazard of water erosion. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. The risk of erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The rate of application of water should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion.

Growing mint in meadows rather than in rows greatly reduces water erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

The main limitations for nonirrigated crops are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable.

Erosion can be reduced by seeding fall grain early, stubble mulching, and shaping waterways and seeding them to perennial grass. Drop structures may be needed in a few places to stabilize the flow of runoff in waterways.

The potential native vegetation on this unit is mainly basin wildrye, bluebunch wheatgrass, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, and chemical treatment. Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation for homesites and septic tank absorption fields is the hazard of flooding. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Dustiness can be a problem

during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This map unit is in capability subclasses IIe, irrigated, and IIIe, nonirrigated.

34—Fiander silt loam. This very deep, artificially drained soil is on flood plains. It formed in alluvium. Slope is 0 to 3 percent, but it is dominantly about 1 percent. The native vegetation is mainly alkali-tolerant grasses, forbs, and shrubs. Elevation is 700 to 900 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is moderately alkaline, grayish brown silt loam about 2 inches thick. The subsoil is strongly alkaline and very strongly alkaline, brown and pale brown silty clay loam about 23 inches thick. The upper part of the substratum is strongly alkaline, pale brown silt loam about 25 inches thick, and the lower part to a depth of 60 inches or more is mildly alkaline, brown loamy very fine sand.

Included in this unit are small areas of Umapine, Kittitas, and Toppenish soils and areas of undrained, salt-affected Fiander soils.

Permeability of this Fiander soil is slow. Available water capacity is high. Effective rooting depth is limited by a seasonal water table that is at a depth of 24 to 36 inches from June to December. Runoff is very slow. This unit is subject to rare periods of flooding

This unit is used for irrigated crops, as rangeland, for wildlife habitat, and as homesites. The main irrigated crops are corn, grain, and mint. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is slow permeability. If the drainage systems are not maintained, the soil in this unit has a seasonal high water table during the irrigation season and a high content of sodium. Tile drainage can be used to lower the water table if a suitable outlet is available. Dikes are effective in diverting floodwater and reducing the risk of flooding. Deep-rooted crops are suited to areas where the natural drainage is adequate or where a drainage system has been installed and maintained. Reclamation may require addition of amendments such as gypsum, sulfur, or ferric sulfate to facilitate leaching.

Furrow, corrugation, and sprinkler irrigation systems are suited to this soil. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. Use of sprinkler irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to avoid compaction and to maintain or improve the organic matter content, improve the water infiltration rate, and help to maintain tilth. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

The potential native vegetation on this unit is mainly basin wildrye, inland saltgrass, and black greasewood. The main limitations for the production of forage are wetness because of the seasonal high water table and high sodium content. If the range is overgrazed, the proportion of less preferred forage plants such as black greasewood and inland saltgrass increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, and chemical treatment. Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted alkali-tolerant plants should be seeded.

The main limitations for homesite development are the hazard of flooding and soil wetness. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings from flooding. Wetness can be reduced by installing drain tile around footings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in. Mulching, fertilizing, and irrigating are needed to establish lawn grasses and other small seeded plants.

The main limitations for septic tank absorption fields are the hazard of flooding, soil wetness, and slow permeability. Flooding can be controlled only by the use of major flood control structures. Slow permeability and the seasonal high water table increase the possibility of failure of septic tank absorption fields. Use of sandy backfill for the trench and long absorption lines helps to compensate for the slow permeability.

This map unit is in capability subclasses IVw, irrigated, and VIw, nonirrigated.

35—Finley fine sandy loam, 0 to 5 percent slopes. This very deep, well drained soil is on terraces and alluvial fans. It formed in old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 800 to 1,400 feet. The average annual precipitation is 6 to 9 inches, the average annual air

temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the upper part of the surface layer is brown fine sandy loam about 4 inches thick, and the lower part is brown sandy loam about 10 inches thick. The subsoil is yellowish brown very gravelly loam about 16 inches thick. The substratum to a depth of 60 inches or more is yellowish brown extremely gravelly sand. In some areas the surface layer is cobbly.

Included in this unit is areas of Quincy soils.

Permeability of this Finley soil is moderately rapid above the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly bluebunch wheatgrass, needleandthread, Thurber needlegrass, and big sagebrush. The main limitations for the production of forage are low available water capacity and the hazard of soil blowing. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as annual forbs and big sagebrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, and chemical treatment. Seeding is a suitable practice if the range vegetation is in poor condition. This unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIe, nonirrigated.

36—Finley cobbly fine sandy loam, 0 to 5 percent slopes. This very deep, well drained soil is on terraces and alluvial fans. It formed in old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 800 to 1,400 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the upper part of the surface layer is brown cobbly fine sandy loam about 4 inches thick. The lower part is brown sandy loam about 10 inches thick. The subsoil is yellowish brown very gravelly loam about 16 inches thick. The substratum to a depth of 60 inches or more is yellowish brown extremely gravelly sand. In some areas the surface layer is not cobbly.

Included in this unit are areas of Quincy soils.

Permeability of this Finley soil is moderately rapid above the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly bluebunch wheatgrass, needleandthread, Thurber needlegrass, and big sagebrush. The main limitations for the production of forage are low available water capacity and the hazard of soil blowing. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as annual forbs and big sagebrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chemical treatment and prescribed burning. Seedbed preparation is difficult because of large stones. This unit should be seeded in fall when moisture conditions are optimal. A drill should be used. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIe, nonirrigated.

37—Finley silt loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces and alluvial fans. It formed in old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown silt loam about 12 inches thick. The subsoil is yellowish brown very gravelly loam about 18 inches thick. The substratum to a depth of 60 inches or more is yellowish brown extremely gravelly sand. In some areas the surface layer is sandy loam.

Included in this unit are small areas of Scooteney, Scoon, and Burke soils.

Permeability of this Finley soil is moderately rapid above the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. The main irrigated crops are grain, grapes, hops, mint, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is moderate available water capacity. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely

critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve organic matter content, improve infiltration, and help to maintain tilth. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is well suited to homesite development. It has few limitations. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in.

The main limitation for septic tank absorption fields is seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability subclass IIIs, irrigated.

38—Finley silt loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces and alluvial fans. It formed in old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown silt loam about 12 inches thick. The subsoil is yellowish brown very gravelly loam about 18 inches thick. The substratum to a depth of 60 inches or more is yellowish brown extremely gravelly sand.

Included in this unit are small areas of Burke, Scooteney, and Scoon soils and areas of Finley soils that have slopes of more than 5 percent.

Permeability of this Finley soil is moderately rapid above the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. The main irrigated crops are grain, grapes, hops, mint, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are moderate available water capacity and the hazard of water erosion. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. The risk of water erosion can be minimized by keeping runs short. Use of sprinkler and drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and reduce ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion.

Growing mint in meadows rather than in rows greatly reduces water erosion. Use of annual or perennial cover crops during the irrigation season reduces erosion in fields of hops, in orchards, and in vineyards. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is well suited to homesite development. It has few limitations. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in.

The main limitation for septic tank absorption fields is seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability subclass IIIe, irrigated.

39—Finley silt loam, 5 to 8 percent slopes. This very deep, well drained soil is on terraces and alluvial fans. It formed in old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown silt loam about 12 inches thick. The subsoil is yellowish brown very gravelly loam about 18 inches thick. The substratum to a depth

of 60 inches or more is yellowish brown extremely gravelly sand.

Included in this unit are small areas of Burke, Scooteney, and Scoon soils.

Permeability of this Finley soil is moderately rapid above the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. The main irrigated crops are grain, grapes, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are moderate available water capacity, steepness of slope, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Growing cover crops reduces erosion in orchards and vineyards.

This unit is well suited to homesite development. It has few limitations. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Cutbanks are not stable and subject to caving in.

The main limitation for septic tank absorption fields is seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability subclass IIIe, irrigated.

40—Finley silt loam, 8 to 15 percent slopes. This very deep, well drained soil is on terraces and alluvial fans. It formed in old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,300 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown silt loam about 12 inches thick. The subsoil is yellowish brown very gravelly loam about 18 inches thick. The substratum to a depth of 60 inches or more is yellowish brown extremely gravelly sand.

Included in this unit are small areas of Burke, Scooteney, and Scoon soils and areas of Finley soils that have slopes of 15 to 30 percent.

Permeability of this Finley soil is moderately rapid above the substratum and very rapid through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. The main irrigated crops are grain and grapes. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are the moderate available water capacity, steepness of slope, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Use of annual or perennial cover crops is needed in orchards and vineyards to reduce erosion. A rotation of grain followed by alfalfa and grass commonly is used.

This unit is suited to homesite development. The main limitation is steepness of slope. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. The unit should be seeded to reduce erosion and slippage of the soil. Cutbanks are not stable and subject to caving in.

The main limitation for septic tank absorption fields is seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage

from onsite sewage disposal systems. Slope can cause lateral seepage and surfacing of effluent in downslope areas. Absorption lines should be installed on the contour.

This map unit is in capability subclass IVe, irrigated.

41—Gorskel very stony loam, 0 to 25 percent slopes. This shallow, well drained soil is on terraces and foot slopes. It formed in loess and old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 3,000 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 120 to 150 days.

Typically, the surface layer is brown very stony loam about 5 inches thick. The upper part of the subsoil is yellowish brown gravelly loam about 3 inches thick, and the lower part is dark yellowish brown very gravelly clay loam about 5 inches thick. A hardpan is at a depth of about 13 inches. Depth to the hardpan ranges from 9 to 15 inches. In some areas the surface layer is stony silt loam.

Included in this unit are areas of Gorst, Harwood, Rock Creek, and Taneum soils.

Permeability of this Gorskel soil is moderately slow above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 9 to 15 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland, for wildlife habitat, and as homesites.

The potential native vegetation is mainly stiff sagebrush, Sandberg bluegrass, and eriogonum. The main limitations for the production of forage are large stones on the surface, low available water capacity, and low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants such as stiff sagebrush and Sandberg bluegrass decreases and the proportion of less preferred forage plants such as forbs and annual grasses increases.

This unit is poorly suited to homesite development. The main limitations are the shallow depth to the hardpan and steepness of slope in areas where slopes are more than 15 percent. The pan hinders excavation. Access roads must be designed to control surface runoff and help stabilize cut slopes.

The main limitation for septic tank absorption fields is the depth to the cemented pan, which limits the capacity of the absorption field. Use of long absorption lines helps to compensate for this limitation. Absorption lines should be installed on the contour.

This map unit is in capability subclass VIIs, nonirrigated.

42—Gorskel-Harwood complex, 0 to 25 percent slopes. This map unit is on uplifted terraces. The native vegetation is mainly forbs and shrubs. Elevation is 1,200 to 2,300 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

This unit is about 50 percent Gorskel very stony loam and about 40 percent Harwood loam. The Harwood soil is on mounds, and the Gorskel soil is in areas between the mounds. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of Gorst, Rock Creek, and Taneum soils. Included areas make up about 10 percent of the total acreage.

The Gorskel soil is shallow and well drained. It formed in loess and old alluvium. Typically, the surface layer is brown very stony silt loam about 5 inches thick. The upper part of the subsoil is yellowish brown gravelly loam about 3 inches thick, and the lower part is dark yellowish brown very gravelly clay loam about 5 inches thick. A hardpan is at a depth of about 13 inches. Depth to the hardpan ranges from 9 to 15 inches.

Permeability of the Gorskel soil is moderately slow above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 9 to 15 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Harwood soil is moderately deep and well drained. It formed in loess and old alluvium. Typically, the surface layer is grayish brown loam about 8 inches thick. The subsoil is brown loam about 18 inches thick. The substratum is brown gravelly loam about 4 inches thick. A hardpan is at a depth of about 30 inches. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of the Harwood soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation of the Gorskel soil is mainly stiff sagebrush, Sandberg bluegrass, and eriogonum. If the range plants on the Gorskel soil are overgrazed, the proportion of preferred forage plants such as stiff sagebrush and Sandberg bluegrass decreases and the proportion of less preferred forage plants such as forbs and annual grasses increases. The production of forage on the Gorskel soil is limited by depth to bedrock, large stones on the surface, and low available water capacity. The potential native vegetation of the Harwood soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range plants on the Harwood soil are overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas of the Harwood soil that are heavily infested with undesirable vegetation can be improved by such methods as chemical treatment and prescribed burning. Care should be taken during brush control to disturb the Gorskel soil as little as possible. Range seeding on the Harwood soil is a suitable practice if the range is in poor condition. The soil should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIIs, nonirrigated.

43—Gorst loam, 2 to 15 percent slopes. This well drained soil is on high, dissected terraces. It is shallow over a hardpan. It formed in loess and old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,000 feet. The average annual precipitation is 8 to 12 inches, and the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is brown loam about 7 inches thick. The subsoil is pale brown and brown loam about 8 inches thick. A hardpan is at a depth of about 15 inches. Depth to the hardpan ranges from 12 to 20 inches. In some areas the surface layer is cobbly, in some areas the subsoil is silty clay loam, and in some areas the soil is underlain by sandstone.

Included in this unit are about 5 percent Harwood soils and 5 percent Rock Creek soils.

Permeability of this Gorst soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops and as rangeland, wildlife habitat, and homesites. The main irrigated crop is tree fruit. Grasses and legumes are grown for hay, pasture, and seed. A perennial cover crop is grown in orchards.

The main limitations for irrigated crops are depth to the hardpan, steepness of slope, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these systems permits the even, controlled application of irrigation water, reduces runoff, and minimizes the risk of erosion. The depth to the hardpan and steepness of slope make water management extremely important. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Use of perennial cover crops in orchards reduces erosion.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, Thurber needlegrass, and Sandberg bluegrass. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as sagebrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, chemical treatment, and prescribed burning.

Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is the depth to the hardpan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is depth to the hardpan, which limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation.

This map unit is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

44—Gorst loam, 15 to 30 percent slopes. This well drained soil is on high, dissected terraces. It is shallow over a hardpan. It formed in loess and old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,000 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is brown loam about 7 inches thick. The subsoil is pale brown and brown loam about 8 inches thick. A hardpan is at a depth of about 15 inches. Depth to the hardpan ranges from 12 to 20 inches. In some areas the surface layer is cobbly, in some areas the subsoil is silty clay loam, and in some areas the soil is underlain by sandstone.

Included in this unit are about 5 percent Harwood soils and about 10 percent Rock Creek soils.

Permeability of this Gorst soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 12 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated field and orchard crops and as rangeland, wildlife habitat, and homesites. The main irrigated crop is tree fruit. A perennial cover crop is grown in orchards. Grasses and legumes are grown for hay, pasture, or seed.

The main limitations for irrigated crops are the depth to the hardpan, steepness of slope, and the hazard of

water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Use of perennial cover crops is needed in orchards to reduce erosion.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, Thurber needlegrass, and Sandberg bluegrass. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as sagebrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are the depth to the hardpan and steepness of slope. The hardpan hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are depth to the hardpan and steepness of slope. The pan limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation. Slope can cause lateral seepage and surfacing of effluent in downslope areas.

This map unit is in capability subclass VIe, irrigated and nonirrigated

45—Gorst cobbly loam, 0 to 25 percent slopes. This shallow, well drained soil is on high, dissected terraces. It formed in loess and old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,000 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown cobbly loam about 7 inches thick. The subsoil is pale brown and brown loam about 8 inches thick. A hardpan is at a depth of about 15 inches. Depth to the hardpan ranges from 12 to 20 inches. In some areas the surface layer is gravelly, in some areas the subsoil is silty clay loam, and in some areas the soil is underlain by sandstone.

Included in this unit are areas of Gorskel, Harwood, Rock Creek, and Simcoe soils.

Permeability of this Gorst soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 12 to 20 inches. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, as rangeland, and for wildlife habitat. The main irrigated crops are permanent grasses and legumes and tree fruit. A perennial cover crop is grown in orchards.

The main limitations for irrigated crops are the depth to the hardpan and steepness of slope. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Growing perennial cover crops in orchards reduces erosion. Seedbed preparation is difficult, and removal of stones may be necessary.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, Thurber needlegrass, and Sandberg bluegrass. The production of forage is limited by large stones on the surface and low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as bitterbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. Use of equipment is difficult because of the cobbles. Removal of cobbles may be needed before seeding with a drill. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIe, irrigated and nonirrigated.

46—Harwood loam, 2 to 5 percent slopes. This well drained soil is on high, dissected terraces. It is moderately deep over a hardpan. It formed in loess and old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,000 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is grayish brown loam about 8 inches thick. The subsoil is brown loam about 18 inches thick. The substratum is brown gravelly loam about 4 inches thick. A hardpan is at a depth of about

30 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the soil is underlain by sandstone.

Included in this unit are about 10 percent Selah soils, 10 percent Gorst soils, and 5 percent Ritzville soils.

Permeability of this Harwood soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, nonirrigated crops, and wildlife habitat. It is also used as rangeland and homesites. The main irrigated crops are grain, grapes, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are depth to the hardpan and the hazard of water erosion. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If furrow or corrugation systems are used, runs should be on the contour or across the slope. The risk of erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. Exposing the substratum when leveling fields should be avoided. Shallow cuts are feasible in some areas.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, and shaping waterways and seeding them to perennial grass. Seeding early in fall, either on the contour or across the slope, slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in a few places to stabilize the flow of runoff in waterways.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, big sagebrush, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, plowing, beating, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is the depth to the hardpan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is depth to the hardpan. The pan limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation.

This map unit is in capability subclass IIIe, irrigated and nonirrigated.

47—Harwood loam, 5 to 8 percent slopes. This well drained soil is on high, dissected terraces. It is moderately deep over a hardpan. It formed in loess and old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,000 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is grayish brown loam about 8 inches thick. The subsoil is brown loam about 18 inches thick. The substratum is brown gravelly loam about 4 inches thick. A hardpan is at a depth of about 30 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the soil is underlain by sandstone.

Included in this unit are about 10 percent Selah soils, 10 percent Gorst soils, and 5 percent Ritzville soils.

Permeability of this Harwood soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain, grapes, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are the depth to the hardpan, the hazard of water erosion, and steepness of slope. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of

plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The main limitation for nonirrigated crops is low annual precipitation. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding early in fall, using stubble mulch tillage, and shaping waterways and seeding them to perennial grass. Seeding early in fall, either on the contour or across the slope, slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in a few places to stabilize the flow of runoff in waterways.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, big sagebrush, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, and chemical treatment. Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is the depth to the hardpan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is the depth to the hardpan, which limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation.

This map unit is in capability subclass IIIe, irrigated and nonirrigated.

48—Harwood loam, 8 to 15 percent slopes. This well drained soil is on high, dissected terraces. It is moderately deep over a hardpan. It formed in loess and old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,000 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is grayish brown loam about 8 inches thick. The subsoil is brown loam about 18 inches thick. The substratum is brown gravelly loam about 4 inches thick. A hardpan is at a depth of about 30 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the soil is underlain by sandstone.

Included in this unit are about 10 percent Selah soils, 5 percent Gorst soils, and 5 percent Ritzville soils.

Permeability of this Harwood soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain, grapes, and tree fruit. A cover crop is grown in orchards. Grasses and legumes are grown for hay, pasture, or seed.

The main limitations for irrigated crops are depth to the hardpan, the hazard of water erosion, and steepness of slope. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. A crop rotation of grain followed by alfalfa and grass commonly is used.

The main limitations for nonirrigated crops are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding early in fall and using stubble mulch tillage. Seeding early in fall, either on the contour or across the slope, slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Using level or gradient terraces and stripcropping, either singly or in combination, also reduce erosion. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, big sagebrush, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, and chemical treatment. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is the depth to the hardpan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is the depth to the hardpan, which limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation. Absorption lines should be

installed on the contour. Slope can promote lateral seepage and surfacing of the effluent in downslope areas.

This map unit is in capability subclasses IVe, irrigated, and IIIe, nonirrigated.

49—Harwood loam, 15 to 30 percent slopes. This well drained soil is on high, dissected terraces. It is moderately deep over a hardpan. It formed in loess and old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,000 feet The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is grayish brown loam about 8 inches thick. The subsoil is brown loam about 18 inches thick. The substratum is brown gravelly loam about 4 inches thick. A hardpan is at a depth of about 30 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the soil is underlain by sandstone.

Included in this unit are about 10 percent Selah soils, 5 percent Gorst soils, and 5 percent Ritzville soils.

Permeability of this Harwood soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated and nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grapes and tree fruit. A cover crop is grown in orchards. Grasses and legumes are grown for hay, pasture, or seed.

The main limitations for irrigated crops are depth to the hardpan, the hazard of water erosion, and steepness of slope. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Perennial cover crops are needed in orchards and vineyards to reduce erosion.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding early in fall and using stubble mulch tillage. Seeding early in fall, either on the contour or across the slope, slows runoff and reduces erosion when the snow melts rapidly while the soil is frozen. Divided-slope farming or stripcropping also reduces erosion. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, big sagebrush, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are the depth to the hardpan and steepness of slope. The pan hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields are the depth to the hardpan and steepness of slope. The hardpan limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation. Slope can promote lateral seepage and surfacing of effluent in downslope areas.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

50—Harwood-Burke-Wiehl silt loams, 2 to 5 percent slopes. This map unit is on uplands. The native vegetation is grasses, forbs, and shrubs. Elevation is 1,000 to 2,000 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 170 days.

This unit is about 30 percent Harwood silt loam, about 30 percent Burke silt loam, and about 20 percent Wiehl silt loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Selah, Gorst, and Scoon soils and areas of soils that have slopes of less than 2 percent. Also included are areas of soils that have hardpan fragments scattered throughout the profile and on the surface. Included areas make up about 20 percent of the total acreage.

The Harwood soil is well drained. It is moderately deep over a hardpan. It formed in loess and old alluvium. Typically, the surface layer is grayish brown silt loam about 8 inches thick. The subsoil is brown silt loam about 18 inches thick. The substratum is brown gravelly silt loam about 4 inches thick. A hardpan is at a depth of about 30 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Permeability of the Harwood soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is moderate.

The Burke soil is well drained. It is moderately deep over a hardpan. It formed in loess. Typically, the surface layer is pale brown silt loam about 7 inches thick. The substratum is pale brown silt loam about 18 inches thick. A hardpan is at a depth of about 25 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Permeability of the Burke soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is moderate.

The Wiehl soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam about 3 inches thick. The subsoil is brown and pale brown silt loam about 18 inches thick. The substratum is pale brown gravelly silt loam about 6 inches thick. Weakly cemented sandstone is at a depth of about 27 inches. Depth to sandstone or laminated sediment ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Permeability of the Wiehl soil is moderate. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used for irrigated and nonirrigated crops, rangeland, homesites, and wildlife habitat. The main irrigated crops are grain, grapes, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are the hazard of water erosion, depth to the hardpan in the Harwood and Burke soils, and depth to soft sandstone in the Wiehl soil. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soils in this unit. The type of system used depends on the kind of crop grown. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. The risk of water erosion can be minimized by keeping runs short. Sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content and to maintain tilth. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. Exposing the substratum when leveling fields should be avoided. Shallow cuts are feasible in some areas.

The main limitations for nonirrigated crops are the low annual precipitation, the moderate available water capacity, and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, and shaping waterways and seeding them to perennial grass. Drop structures are needed in a few places to stabilize the flow of runoff in waterways.

The potential native vegetation of the Harwood soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The potential native vegetation of the Burke soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and Thurber needlegrass. The potential native vegetation of the Wiehl soil is mainly bluebunch wheatgrass and needleandthread. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such practices as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are depth to the hardpan in the Harwood and Burke soils and depth to soft sandstone in the Wiehl soil. The hardpan and sandstone hinder excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are depth to the hardpan in the Harwood and Burke soils and depth to soft sandstone in the Wiehl soil. The hardpan and sandstone limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for these limitations.

This map unit is in capability subclasses IIIe, irrigated, and IVe, nonirrigated.

51—Harwood-Burke-Wiehl silt loams, 5 to 8 percent slopes. This map unit is on uplands. The native vegetation is grasses, forbs, and shrubs. Elevation is 1,000 to 2,000 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 170 days.

This unit is about 30 percent Harwood silt loam, about 30 percent Burke silt loam, and about 20 percent Wiehl silt loam. The components of this unit are so intricately

intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Gorst, Selah, and Scoon soils and areas of soils that have slopes of less than 5 percent. Also included are areas of soils that have hardpan fragments scattered throughout the profile and on the surface. Included areas make up about 20 percent of the total acreage.

The Harwood soil is well drained. It is moderately deep over a hardpan. It formed in loess and old alluvium. Typically, the surface layer is grayish brown silt loam about 8 inches thick. The subsoil is brown silt loam about 18 inches thick. The substratum is brown gravelly silt loam about 4 inches thick. A hardpan is at a depth of about 30 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Permeability of the Harwood soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Burke soil is well drained and it is moderately deep over a hardpan. It formed in loess. Typically, the surface layer is pale brown silt loam about 7 inches thick. The underlying material is pale brown silt loam about 18 inches thick. A hardpan is at a depth of about 25 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Permeability of the Burke soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Wiehl soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam about 3 inches thick. The subsoil is brown and pale brown silt loam about 18 inches thick. The substratum is pale brown gravelly silt loam about 6 inches thick. Weakly cemented sandstone is at a depth of about 27 inches. Depth to sandstone or laminated sediment ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Permeability of the Wiehl soil is moderate above the sandstone and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain, grapes, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are steepness of slope, the hazard of water erosion, depth to the hardpan in the Harwood and Burke soils, and depth to soft sandstone in the Wiehl soil. Sprinkler and drip irrigation systems are suited to the soils in this unit. The type of system used depends on the kind of crop grown. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion.

The potential native vegetation of the Harwood soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The potential native vegetation on the Burke soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and Thurber needlegrass. The potential native vegetation of the Wiehl soil is mainly bluebunch wheatgrass and needleandthread. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are depth the hardpan in the Harwood and Burke soils and depth to soft sandstone in the Wiehl soil. The hardpan and soft sandstone hinder excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are depth to the hardpan in the Harwood and Burke soils and depth to soft sandstone in the Wiehl soil. The hardpan and sandstone limit the capacity of the absorption fields. Use of long absorption lines helps to compensate for these limitations.

This map unit is in capability subclass IIIe, irrigated.

52—Harwood-Burke-Wiehl silt loams, 8 to 15 percent slopes. This map unit is on uplands. The native vegetation is grasses, forbs, and shrubs. Elevation is 1,000 to 1,300 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 170 days.

This unit is about 30 percent Harwood silt loam, about 30 percent Burke silt loam, and about 20 percent Wiehl silt loam. The components of this unit are so intricately

intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 10 percent Selah soils, 5 percent Ritzville soils, and 5 percent Scoon and Scooteney soils and areas of soils that have slopes of more than 15 percent. Also included are areas of soils that have hardpan fragments scattered throughout the profile and on the surface and areas of soils that have laminated sediment at a depth of 20 to 40 inches. These included areas make up about 25 percent of the total acreage.

The Harwood soil is well drained. It is moderately deep over a hardpan. It formed in loess and old alluvium. Typically, the surface layer is grayish brown silt loam about 8 inches thick. The subsoil is brown silt loam about 18 inches thick. The substratum is brown gravelly silt loam about 4 inches thick. A hardpan is at a depth of about 30 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Permeability of the Harwood soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Burke soil is well drained. It is moderately deep over a hardpan. It formed in loess. Typically, the surface layer is pale brown silt loam about 7 inches thick. The substratum is pale brown silt loam about 18 inches thick. A hardpan is at a depth of about 25 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Permeability of the Burke soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Wiehl soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam about 3 inches thick. The subsoil is brown and pale brown silt loam about 18 inches thick. The substratum is pale brown gravelly silt loam about 6 inches thick. Weakly cemented sandstone is at a depth of about 27 inches. Depth to sandstone ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Permeability of the Wiehl soil is moderate above the soft sandstone and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, homesites, and wildlife habitat. The main irrigated crops are grain, grapes, and tree fruit. A cover crop is grown in orchards. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are steepness of slope, the hazard of erosion, depth to the hardpan in the Harwood and Burke soils, and depth to soft sandstone in the Wiehl soil. Sprinkler and drip irrigation systems are suited to the soils in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. A rotation of grain followed by alfalfa and grass commonly is used. Growing annual or perennial cover crops in orchards and vineyards reduces water erosion.

The main limitations for nonirrigated crops are low annual precipitation, moderate available water capacity, and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early and stubble mulching. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Using terraces and stripcropping, either singly or in combination, also reduce erosion. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation on the Harwood soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The potential native vegetation on the Burke soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and Thurber needlegrass. The potential native vegetation on the Wiehl soil is mainly bluebunch wheatgrass and needleandthread. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are depth to the hardpan in the Harwood and Burke soils, depth to soft sandstone in the Wiehl soil, and steepness of slope. The hardpan and soft sandstone hinder excavation. Dustiness can be a

problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are depth to the hardpan in the Harwood and Burke soils and depth to soft sandstone in the Wiehl soil. The hardpan and sandstone limit the capacity of the absorption fields. Use of long absorption lines helps to compensate for these limitations. Absorption lines should be installed on the contour. Slope can promote lateral seepage and surfacing of effluent in downslope areas.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

53—Harwood-Burke-Wiehl silt loams, 15 to 30 percent slopes. This map unit is on uplands. The native vegetation is grasses, forbs, and shrubs. Elevation is 1,000 to 1,300 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 170 days.

This unit is about 30 percent Harwood silt loam, about 30 percent Burke silt loam, and about 20 percent Wiehl silt loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Ritzville, Selah, Starbuck, and Scoon soils, salt- and alkali-affected soils, Rock outcrop, and soils that have slopes of less than 15 percent or more than 30 percent. Also included are areas of soils that have hardpan fragments scattered through the profile and areas of soils that have laminated sediment at a depth of 20 to 40 inches. These included areas make up about 20 percent of the total acreage.

The Harwood soil is well drained. It is moderately deep over a hardpan. It formed in loess and old alluvium. Typically, the surface layer is grayish brown silt loam about 8 inches thick. The subsoil is brown silt loam about 18 inches thick. The substratum is brown gravelly silt loam about 4 inches thick. A hardpan is at a depth of about 30 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam

Permeability of the Harwood soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

The Burke soil is well drained and is moderately deep over a hardpan. It formed in loess. Typically, the surface layer is pale brown silt loam about 7 inches thick. The substratum is pale brown silt loam about 18 inches thick. A hardpan is at a depth of about 25 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Permeability of the Burke soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

The Wiehl soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam about 3 inches thick. The subsoil is brown and pale brown silt loam about 18 inches thick. The substratum is pale brown gravelly silt loam about 6 inches thick. Weakly cemented, soft sandstone is at a depth of about 27 inches. Depth to sandstone ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam.

Permeability of the Wiehl soil is moderate above the sandstone and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated hay, pasture, and orchard crops, for nonirrigated crops, as rangeland and homesites, and for wildlife habitat. The main irrigated crops are grasses, legumes, grapes, and tree fruit. A cover crop is grown in orchards.

The main limitations for irrigated crops are steepness of slope, the hazard of water erosion, depth to the hardpan in the Harwood and Burke soils, and depth to sandstone in the Wiehl soil. Sprinkler and drip irrigation systems are suited to the soils in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Perennial cover crops are needed in orchards and vineyards to reduce water erosion.

The main limitations for nonirrigated crops are low annual precipitation, the hazard of water erosion, and moderate available water capacity. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Seeding fall grain early and stubble mulching reduce the risk of erosion. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Divided-slope farming and stripcropping also reduce erosion. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation of the Harwood soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The potential native vegetation of the Burke soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and Thurber needlegrass. The potential native vegetation of the Wiehl soil is mainly bluebunch

wheatgrass and needleandthread. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are steepness of slope and depth to the hardpan in the Harwood and Burke soils and depth to sandstone in the Wiehl soil. The hardpan and sandstone hinder excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are steepness of slope, depth to the hardpan in the Harwood and Burke soils, and depth to sandstone in the Wiehl soil. The hardpan and sandstone limit the capacity of the absorption fields. Use of long absorption lines helps to compensate for these limitations. Slope can promote lateral seepage and surfacing of effluent in downslope areas.

This map unit is capability subclass IVe, irrigated and nonirrigated.

54—Harwood-Burke-Wiehl silt loams, 30 to 60 percent slopes. This map unit is on uplands. The native vegetation is grasses, forbs, and shrubs. Elevation is 1,000 to 1,200 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 170 days.

This unit is about 30 percent Harwood silt loam, 30 to 60 percent slopes; about 30 percent Burke silt loam, 30 to 40 percent slopes; and about 20 percent Wiehl silt loam, 30 to 60 percent slopes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 10 percent Kiona soils, 5 percent Ritzville soils, and 5 percent Scoon soils and soils that have slopes of less than 30 percent. Also included are areas of soils that have hardpan fragments scattered throughout the profile and on the surface and areas of soils that have laminated sediment at a depth of 20 to 40 inches. These inclusions make up about 25 percent of the total acreage.

The Harwood soil is well drained. It is moderately deep over a hardpan. It formed in loess and old alluvium. Typically, the surface layer is grayish brown silt loam about 8 inches thick. The subsoil is brown silt loam about 18 inches thick. The substratum is brown gravelly silt loam about 4 inches thick. A hardpan is at a depth of about 30 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam or is very stony.

Permeability of the Harwood soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very high.

The Burke soil is well drained and is moderately deep over a hardpan. It formed in loess. Typically, the surface layer is pale brown silt loam about 7 inches thick. The substratum is pale brown silt loam about 18 inches thick. A hardpan is at a depth of about 25 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam or is very stony.

Permeability of the Burke soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very high.

The Wiehl soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is grayish brown silt loam about 3 inches thick. The subsoil is brown and pale brown silt loam about 18 inches thick. The substratum is pale brown gravelly silt loam about 6 inches thick. Weakly cemented sandstone is at a depth of about 27 inches. Depth to sandstone ranges from 20 to 40 inches. In some areas the surface layer is very fine sandy loam or is very stony.

Permeability of the Wiehl soil is moderate above the sandstone and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very high.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation on the Harwood soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The potential native vegetation on the Burke soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and Thurber needlegrass. The potential native vegetation on the Wiehl soil is mainly bluebunch wheatgrass and needleandthread. The production of forage is limited by the steepness of slope, which restricts access by livestock and promotes overgrazing of the less sloping areas. Proper location of salt licks, stock water tanks, and fences promotes more uniform distribution of grazing.

If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chemical treatment and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Use of equipment is limited in

the more steeply sloping areas. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIIe, nonirrigated.

55—Harwood-Burke-Wiehl very stony silt loams, 15 to 30 percent slopes. This map unit is on uplands. The native vegetation is grasses, forbs, and shrubs. Elevation is 1,000 to 1,300 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 170 days.

This unit is about 30 percent Harwood very stony silt loam, about 30 percent Burke very stony silt loam, and about 20 percent Wiehl very stony silt loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit areas of Ritzville and Kiona soils and areas of soils that have slopes of less than 15 percent. Also included are areas of soils that have hardpan fragments scattered throughout the profile and soils that have laminated sediment at a depth of 20 to 40 inches. These included areas make up about 20 percent of the total acreage.

The Harwood soil is well drained and is moderately deep over a hardpan. It formed in loess and old alluvium. Typically, the surface layer is grayish brown very stony silt loam about 8 inches thick. The subsoil is brown silt loam about 18 inches thick. The substratum is brown gravelly silt loam about 4 inches thick. A hardpan is at a depth of 30 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas, the surface layer is fine sandy loam and the soil does not have stones on the surface.

Permeability of the Harwood soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Burke soil is well drained and is moderately deep over a hardpan. It formed in loess. Typically, the surface layer is pale brown very stony silt loam about 7 inches thick. The substratum is pale brown silt loam about 18 inches thick. A hardpan is at a depth of about 25 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas, the surface layer is fine sandy loam and the soil does not have stones on the surface.

Permeability of the Burke soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Wiehl soil is moderately deep and well drained. It formed in loess. Typically, the surface layer is grayish brown very stony silt loam about 3 inches thick. The subsoil is brown and pale brown silt loam about 18 inches thick. The substratum is pale brown gravelly silt loam about 6 inches thick. Weakly cemented sandstone is at a depth of about 27 inches. Depth to sandstone ranges from 20 to 40 inches. In some areas, the surface layer is fine sandy loam and the soil does not have stones on the surface.

Permeability of the Wiehl soil is moderate above the sandstone and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation on the Harwood soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The potential native vegetation on the Burke soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and Thurber needlegrass. The potential native vegetation on the Wiehl soil is mainly bluebunch wheatgrass and needleandthread. The production of forage is limited by the large stones on the surface. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chemical treatment and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition, but it is difficult because of the large stones on the surface. The unit should be seeded in fall using a drill or by broadcasting. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIs, nonirrigated.

56—Harwood-Gorst complex, 0 to 25 percent slopes. This map unit is on dissected terraces. The native vegetation is grasses, forbs, and shrubs. Elevation is 1,200 to 2,000 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 150 days.

This unit is about 60 percent Harwood loam and about 30 percent Gorst cobbly loam. The Harwood soil is on mounds, and the Gorst soil is in areas between the mounds. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Cowiche, Selah, and Rock Creek soils. Also included are areas of Gorst soils that have a very cobbly or very gravelly surface layer and areas of Harwood and Gorst soils that have slopes of more than 25 percent. These included areas make up about 10 percent of the total acreage.

The Harwood soil is well drained. It is moderately deep over a hardpan. It formed in loess and old alluvium. Typically the surface layer is grayish brown loam about 8

inches thick. The subsoil is brown loam about 18 inches thick. The substratum is brown gravelly loam about 4 inches thick. A hardpan is at a depth of about 30 inches. Depth to the hardpan ranges from 20 to 40 inches.

Permeability of the Harwood soil is moderate above the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

The Gorst soil is well drained. It is shallow over a hardpan. It formed in loess and old alluvium. Typically, the surface layer is brown cobbly loam about 7 inches thick. The subsoil is pale brown and brown loam about 8 inches thick. A hardpan is at a depth of about 15 inches. Depth to the hardpan ranges from 12 to 20 inches.

Permeability of the Gorst soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 12 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and for irrigated field and orchard crops, wildlife habitat, and homesites. The main irrigated crops are tree fruit and grasses and legumes grown for hay, pasture, and seed. A perennial cover crop is grown in orchards.

The potential native vegetation on the Harwood soil is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The potential native vegetation on the Gorst soil is mainly bluebunch wheatgrass and Thurber needlegrass. The production of forage is limited by the low annual precipitation, depth to the hardpan, very low available water capacity, and large stones on the Gorst soil. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Undesirable vegetation on the Gorst soil can be controlled by chemical methods. Use of equipment is difficult because of the presence of cobbles. Removal of the cobbles may be necessary before using equipment. Adapted grasses and legumes should be seeded.

The main limitations for irrigated crops are depth to the hardpan, steepness of slope, the hazard of water erosion, and large stones on the surface of the Gorst soil. This unit can be leveled by spreading the mounds of the Harwood soil over the Gorst soil so that the entire area is underlain by a hardpan at a depth of about 16 to 25 inches. Exposing the hardpan when leveling fields should be avoided.

Shallow soil depth makes water management extremely important. Sprinkler and drip irrigation systems are suited to the soils in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Growing perennial cover crops in orchards reduces erosion.

This unit is poorly suited to homesite development. The main limitations are depth to the hardpan and steepness of slope in areas where the slope is more than 15 percent. The hardpan hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is depth to the hardpan, which limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation. Absorption lines should be installed on the contour. Slope can cause lateral seepage and surfacing of effluent in downslope areas.

This map unit is in capability subclass VIe, irrigated and nonirrigated.

57—Hezel loamy fine sand, 0 to 2 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in lacustrine sediment overlain by a mantle of eolian sand. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 800 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is about 53 degrees F, and the average frost-free season is 150 to 180 days.

Typically, the surface layer is grayish brown loamy fine sand about 6 inches thick. The upper part of the underlying material is grayish brown and light brownish gray loamy fine sand about 16 inches thick, and the lower part to a depth of 60 inches or more is stratified, light brownish gray very fine sandy loam and silt loam.

Included in this unit are areas of Warden and Quincy soils. Also included, in depressional areas, are soils that have a high water table and a high salt content if the surrounding areas are irrigated.

Permeability of this Hezel soil is rapid in the loamy fine sand part and moderately slow in the underlying stratified material. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. The main irrigated crops are grain, potatoes, and corn. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is the hazard of soil blowing. The type of irrigation system used depends on the kind of crop grown. A sprinkler system is best suited to the soil in this unit. Use of sprinkler irrigation permits the even, controlled application of irrigation

water, reduces runoff, and minimizes the risk of water erosion. Because of rapid permeability, irrigation furrows need to be compacted and shaped so that irrigation water can reach the entire length of the run. This reduces the water intake rate. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because this soil is droughty, frequent, light applications of irrigation water are needed.

The hazard of soil blowing makes tillage and residue management extremely important. This unit should be protected with cover crops or crop residue through the period of soil blowing in spring until the crop is well established. Sufficient crop residue should be left on the surface. Fall grain, hay, or pasture should be seeded late in August or early in September to provide sufficient cover.

Use of straw, manure, or other waste material as a mulch reduces soil blowing, helps to maintain or improve the organic matter content, and conserves moisture. Seedbeds should be prepared when irrigation water is available to keep the soil surface moist. Vegetative barriers and shelterbelts are suitable for controlling soil blowing. Small grain can be used as a nurse crop when establishing grasses and legumes.

This unit has few limitations for homesite development. Building sites should be disturbed as little as possible. The main limitation for septic tank absorption fields is the moderately slow permeability, which affects the rate of absorption of the effluent. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation.

This map unit is in capability subclass IVe, irrigated.

58—Hezel loamy fine sand, 2 to 15 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in lacustrine sediment overlain by a mantle of eolian sand. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 800 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is about 53 degrees F, and the average frost-free season is about 150 to 180 days.

Typically, the surface layer is grayish brown loamy fine sand about 6 inches thick. The upper part of the underlying material is grayish brown and light brownish gray loamy fine sand about 16 inches thick, and the lower part to a depth of 60 inches or more is stratified, light brownish gray loamy very fine sandy loam and silt loam.

Included in this unit are areas of Warden and Quincy soils and soils, in depressional areas, that have a high water table and a high concentration of salt if the surrounding areas are irrigated. Also included are areas of Hezel soils that have slopes of more than 15 percent.

Permeability of this Hezel soil is rapid in the loamy fine sand part and moderately slow in the underlying stratified material. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used for irrigated crops and as rangeland, wildlife habitat, and homesites. The main irrigated crops are grain and potatoes. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are steepness of slope and the hazard of wind erosion. Sprinkler irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Because of the droughtiness of the surface layer, frequent light applications of irrigation water are needed.

The high hazard of wind erosion makes proper tillage and residue management extremely important. This unit should be protected with a cover crop when it is susceptible to wind erosion in winter and with crop residue until crops are well established in spring. Crop rows should be at right angles to the prevailing wind wherever feasible. Fall grain, hay, or pasture should be seeded late in August or early in September to provide sufficient winter cover. Use of straw, manure, or other waste material as a mulch reduces soil blowing, helps to maintain or improve the organic matter content, and conserves moisture. Seedbeds should be prepared when irrigation water is available to keep the soil surface moist. Vegetative barriers and shelterbelts also reduce soil blowing.

The potential native vegetation on this unit is mainly needleandthread, Sandberg bluegrass, bluebunch wheatgrass, and big sagebrush. The production of forage is limited by the hazard of soil blowing. If the range is overgrazed, the proportion of preferred forage plants such as needleandthread and bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as balsamroot and big sagebrush increases.

Brush control is mainly limited to chemical application because of the high hazard of soil blowing. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded with a rangeland drill in fall when the moisture content of the soil is optimal. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is steepness of slope. Building sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is moderately slow permeability, which affects the rate of absorption of the effluent. Use of sandy backfill for the

trench and long absorption lines helps to compensate for this limitation. Absorption lines should be installed on the contour.

This map unit is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

59—Jumpe stony loam, 5 to 25 percent slopes. This very deep, well drained soil is on long, broad mountain ridges. It formed in residuum and colluvium derived from basalt and a small amount of loess and volcanic ash. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 3,800 to 5,600 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is about 43 degrees F, and the average length of the growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick. The surface layer is brown stony loam about 3 inches thick. The subsoil is brown and dark yellowish brown extremely cobbly loam about 38 inches thick. The substratum to a depth of 60 inches or more is yellowish brown extremely cobbly loam. In some areas at an elevation of more than 5,000 feet, a layer of volcanic ash 4 to 12 inches thick is on the surface; in some areas the subsoil is clay loam or sandy loam; and in some areas basalt is at a depth of 30 to 40 inches.

Included in this unit are areas of Bocker soils and areas of Jumpe soils that have slopes of 25 to 45 percent.

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

The unit is used as grazable woodland and for wildlife habitat.

Douglas-fir and ponderosa pine are the main woodland species on this unit. Among the trees of limited extent are grand fir, western larch, and occasional dense stands of lodgepole pine. On the basis of a 100-year site curve, the mean site index is 80 for Douglas-fir, 67 for ponderosa pine, and 73 for grand fir. On the basis of a 50-year site curve, the mean site index is 59 for western larch. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 69 cubic feet per acre for Douglas-fir at age 40 and 52 cubic feet per acre for ponderosa pine at age 50. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 55 cubic feet per acre for Douglas-fir and 40 cubic feet per acre for ponderosa pine. However, the typical basal area of stands on this unit is about 70 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is a short period of seasonal soil wetness. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Seedling establishment is the main concern in the production of timber. If seed trees are present, natural reforestation of cutover areas by Douglas-fir and ponderosa pine occurs periodically. Reforestation can be accomplished by planting Douglas-fir and ponderosa pine seedlings. The droughtiness of the surface layer during the dry summer months increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, pinegrass, pinemat manzanita, and ceanothus. The crown density in the areas where the woodland site index was measured is 25 percent. This unit is well suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIs, nonirrigated.

60—Jumpe stony loam, 25 to 45 percent slopes. This very deep, well drained soil is on mountainsides. It formed in residuum and colluvium derived from basalt and a small amount of loess and volcanic ash. Areas generally are on south-facing side slopes. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 3,600 to 5,800 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is about 43 degrees F, and the average length of the growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick. The surface layer is brown stony loam about 3 inches thick. The subsoil is brown and dark yellowish brown extremely cobbly loam about 38 inches thick. The substratum to a depth of 60 inches or more is yellowish brown extremely cobbly loam. In some areas at an elevation of more than 5,000 feet, the soil has a mantle of volcanic ash 4 to 12 inches thick. In some areas the subsoil is clay loam or sandy loam.

Included in this unit are about 10 percent Sapkin soils, 5 percent Bocker soils, areas of Rock outcrop and Rubble land, areas of Jumpe soils that have slopes of 45 to 70 percent, and small concave areas of soils that have slopes of 5 to 25 percent.

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

This unit is used as grazable woodland and for wildlife habitat.

Douglas-fir and ponderosa pine are the main woodland species on this unit. Among the trees of limited extent

are grand fir, scattered western larch, and lodgepole pine. On the basis of a 100-year site curve, the mean site index is 86 for Douglas-fir, 64 for ponderosa pine, and 73 for grand fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 79 cubic feet per acre for Douglas-fir at age 40 and 50 cubic feet per acre for ponderosa pine at age 55. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 65 cubic feet per acre for Douglas-fir and 40 cubic feet per acre for ponderosa pine. However, the typical basal area of stands on this unit is about 70 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is steepness of slope, which makes the use of wheeled and tracked equipment difficult. A cable yarding system may be safer, and it disturbs the soil less. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Seedling establishment is the main concern in the production of timber. If seed trees are present, natural reforestation of cutover areas by Douglas-fir and ponderosa pine occurs periodically. Reforestation can be accomplished by planting Douglas-fir and ponderosa pine seedlings. The droughtiness of the surface layer during the dry summer months increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, pinegrass, and ceanothus. The crown density in the areas where the woodland site index was measured is 25 percent. This unit is well suited to grazing and browsing. It has few limitations for the production of forage. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIIs, nonirrigated.

61—Jumpe stony loam, 45 to 65 percent slopes. This very deep, well drained soil is on mountainsides and in canyons. It formed in residuum and colluvium derived from basalt and small amounts of loess and volcanic ash. Areas generally are on south-facing side slopes. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 3,600 to 5,800 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is about 43 degrees F, and the average length of the growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick. The surface layer is brown stony loam about 3 inches thick. The subsoil is brown and dark yellowish brown extremely cobbly loam about 38 inches thick. The substratum to a depth of 60 inches or more is yellowish brown extremely cobbly loam. In some areas at an elevation of more than 5,000 feet, the soil has a mantle of volcanic ash 4 to 12 inches thick. In some areas the subsoil is clay loam or sandy loam.

Included in this unit are about 10 percent Sapkin soils and about 15 percent areas of Rubble land, Rock outcrop, and Jumpe soils that have slopes of less than 45 percent.

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

This unit is used as grazable woodland and for wildlife habitat.

Douglas-fir and ponderosa pine are the main woodland species on this unit. Among the trees of limited extent are grand fir and western larch. On the basis of a 100-year curve, the mean site index is 86 for Douglas-fir, 64 for ponderosa pine, and 73 for grand fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 79 cubic feet per acre for Douglas-fir at age 40 and 50 cubic feet per acre for ponderosa pine at age 55. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 65 cubic feet per acre for Douglas-fir and 50 cubic feet per acre for ponderosa pine. However, the typical basal area of stands on this unit is about 55 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is steepness of slope, which restricts the use of wheeled and tracked equipment in skidding operations. Cable yarding systems generally are safer and disturb the soil less. Areas of Rock outcrop and Rubble land hinder harvesting. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is readily available in areas of Rubble land and Rock outcrop. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover.

Seedling establishment is the main concern in the production of timber. If seed trees are present, natural reforestation of cutover areas by Douglas-fir and ponderosa pine occurs periodically. Reforestation can be accomplished by planting Douglas-fir and ponderosa pine seedlings. The droughtiness of the surface layer during the dry summer months increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, pinegrass, and ceanothus. The crown density in the areas where the woodland site index was measured is 25 percent. This unit is suited to browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful. Because of the steepness of slope, broadcast seeding should be used.

This map unit is in capability subclass VIIs, nonirrigated.

62—Jumpe stony loam, 25 to 45 percent north slopes. This very deep, well drained soil is on mountainsides. It formed in residuum and colluvium derived from basalt and a small amount of loess and volcanic ash. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 3,200 to 5,600 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is about 42 degrees F, and the average length of the growing season, at 28 degrees F, is 135 to 160 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick and a layer of volcanic ash about 1/2 inch thick. The surface layer, where mixed to a depth of about 6 inches, is brown stony loam. The subsoil is dark brown and dark yellowish brown very cobbly loam about 31 inches thick. The substratum to a depth of 60 inches or more is dark yellowish brown very cobbly loam. In some areas the soil has a mantle of volcanic ash about 12 inches thick.

Included in this unit are areas of Rock outcrop and Rubble land and areas of Jumpe soils that have slopes of less than 25 percent or more than 45 percent.

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

This unit is used as grazable woodland and for wildlife habitat.

Douglas-fir, grand fir, and western larch are the main woodland species on this unit. Among the trees of limited extent are lodgepole pine, Engelmann spruce, western white pine, and some ponderosa pine on the more nearly west- and east-facing side slopes. On the basis of a 100-year site curve, the mean site index is 75 for Douglas-fir, 73 for grand fir, and 65 for ponderosa pine. On the basis of a 50-year site curve, the mean site index is 42 for western larch. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for Douglas-fir trees 0.6 inch in diameter and larger at 45 years of age is 62 cubic feet per acre. The mean annual increment for Douglas-fir trees 6.6 inches in diameter and larger at 80 years of age is 55 cubic feet per acre. However, the typical basal area of stands on this unit is about 90 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is steepness of slope, which makes the use of wheeled and tracked equipment difficult. A cable yarding system may be safer, and it disturbs the soil less. The north-facing slopes of this unit retain snowpack, which delays access in spring. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction generally is available in the included areas of Rubble land and Rock outcrop.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting Douglas-fir seedlings. If seed trees are present, natural reforestation of cutover areas by grand fir occurs readily and can delay establishment of planted seedlings. The droughtiness of the surface layer during the dry summer months increases seedling mortality.

The common forest understory plants are elk sedge, pinegrass, spirea, and lupine. The crown density in the areas where the woodland site index was measured is 35 percent. This unit is suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIIs, nonirrigated.

63—Jumpe stony loam, 45 to 65 percent north slopes. This very deep, well drained soil is on mountainsides and in canyons. It formed in residuum and colluvium derived from basalt and small amounts of loess and volcanic ash. The native vegetation is mainly conifers, grasses, and forbs. Elevation is 3,200 to 5,600 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is about 42 degrees F, and the average length of the growing season, at 28 degrees F, is 135 to 160 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick and a layer of volcanic ash about 1/2 inch thick. The surface layer, where mixed to a depth of about 6 inches, is brown stony loam. The subsoil is dark brown and dark yellowish brown very cobbly loam about 31 inches thick. The substratum to a depth of 60 inches or more is dark yellowish brown very cobbly loam. In some areas the soil has a mantle of volcanic ash about 12 inches thick.

Included in this unit are areas of Rubble land and Rock outcrop and small concave areas of Jumpe soils that have slopes of less than 45 percent.

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

This unit is used as grazable woodland and for wildlife habitat.

Douglas-fir and grand fir are the main woodland species on this unit. Among the trees of limited extent are Engelmann spruce, subalpine fir, and dense pockets of western larch and lodgepole pine. On the basis of a 100-year site curve, the mean site index is 75 for Douglas-fir, 73 for grand fir, and 68 for lodgepole pine. Yield tables for normal, even-aged, unmanaged stands of Douglas-fir indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger at 45 years of age is 62 cubic feet per acre. The mean annual increment for Douglas-fir trees 6.6 inches in diameter and larger at 80 years of age is 40 cubic feet per acre. However, the typical basal area of stands on this unit is about 120 percent that of normal stands, and the total yield is correspondingly higher.

The main limitation for the harvesting of timber is steepness of slope, which restricts the use of wheeled and tracked equipment in skidding operations. Cable yarding systems generally are safer and disturb the soil less. The north-facing areas of this unit retain snowpack, which delays access in spring. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Rock for road construction generally is available in included areas of Rubble land and Rock outcrop. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting Douglas-fir seedlings. If seed trees are present, natural reforestation of cutover areas by grand fir and subalpine fir occurs readily and can delay establishment of planted seedlings. The droughtiness of the surface layer during the dry summer months increases seedling mortality.

The common forest understory plants are lupine, pinegrass, and elk sedge. The crown density in the areas where the woodland site index was measured is 35 percent. This unit is poorly suited to grazing. Steepness of slope limits access by livestock. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful. Because of the steepness of slope, broadcast seeding should be used.

This map unit is in capability subclass VIIs, nonirrigated.

64—Jumpe-Rock outcrop complex, 40 to 80 percent slopes. This map unit is on mountainsides and in canyons. Areas generally are on north-facing side slopes. The native vegetation is mainly conifers, grasses, and forbs. Elevation is 2,800 to 4,400 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is about 42 degrees F, and the average length of the growing season, at 28 degrees F, is 135 to 160 days.

This unit is about 60 percent Jumpe stony loam, 40 to 65 percent slopes, and about 20 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Rubble land and areas of soils that are underlain by bedrock at a depth of 20 to 40 inches. Also included are small concave areas of Jumpe soils that have slopes of less than 40 percent. These included areas make up about 20 percent of the total acreage.

The Jumpe soil is very deep and well drained. It formed in residuum and colluvium derived from basalt and small amounts of loess and volcanic ash. Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick and a layer of volcanic ash about 1/2 inch thick. The surface layer, where mixed to a depth of about 6 inches, is brown stony loam. The subsoil is dark brown and dark yellowish brown very cobbly loam about 31 inches thick. The substratum to a depth of 60 inches or more is dark yellowish brown very cobbly loam.

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

Rock outcrop is areas of exposed bedrock.

This unit is used as grazable woodland and for wildlife habitat.

Douglas-fir and grand fir are the main woodland species on the Jumpe soil. Among the trees of limited extent are Engelmann spruce, subalpine fir, and dense pockets of western larch and lodgepole pine. On the basis of a 100-year site curve, the mean site index is 75 for Douglas- fir, 73 for grand fir, and 68 for lodgepole pine. Yield tables for normal, even-aged, unmanaged stands of Douglas-fir indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger at 45 years of age is 62 cubic feet per acre. The mean annual increment for Douglas-fir trees 6.6 inches in diameter and larger at 80 years of age is 40 cubic feet per acre. However, the typical basal area of stands on the Jumpe soil is about 120 percent that of normal stands, and the total yields are correspondingly higher.

The main limitations for the harvesting of timber are the areas of Rock outcrop and Rubble land and steepness of slope. When harvesting timber, steepness of slope restricts the use of wheeled and tracked equipment in skidding operations; cable yarding systems generally are safer and disturb the soil less. The areas of Rock outcrop and Rubble land may cause breakage of timber during felling, and they hinder yarding. The north-facing areas of this unit retain snowpack, which may delay access in spring. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads

require suitable surfacing for year-round use. Rock for road construction is readily available on this unit. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting Douglas-fir seedlings. If seed trees are present, natural reforestation of cutover areas by grand fir and subalpine fir occurs readily and can delay establishment of planted seedlings. The areas of Rock outcrop limit the even distribution of reforestation. The droughtiness of the surface layer during the dry summer months increases seedling mortality.

The common forest understory plants are elk sedge, pinegrass, and lupine. The crown density in the areas where the woodland site index was measured is 30 percent. The Jumpe soil is poorly suited to grazing. Steepness of slope and the areas of Rock outcrop limit access by livestock. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIIs, nonirrigated.

65—Kiona stony silt loam, 15 to 45 percent slopes. This very deep, well drained soil is on uplands. It formed in loess and colluvium derived from basalt. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 800 to 2,500 feet. The average annual precipitation is 7 to 12 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 140 to 200 days.

Typically, the surface layer is brown stony silt loam about 5 inches thick. The subsoil is pale brown very cobbly silt loam about 9 inches thick. The substratum to a depth of 60 inches or more is pale brown very cobbly silt loam.

Included in this unit are areas of Lickskillet, Starbuck, Ritzville, Burke, Shano, Renslow, and Bakeoven soils. Also included are areas of soils that are underlain by basalt at a depth of 30 to 40 inches, areas of Rock outcrop and Rubble land, and areas of Kiona soils that have slopes of less than 15 percent.

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

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and Thurber needlegrass. The production of forage is limited by large stones. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rubber rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved with such methods as chemical treatment and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. Mechanical seeding is difficult because of stoniness. This unit should be seeded with a drill in fall when the moisture content of the soil is optimal. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIs, nonirrigated.

66—Kittitas silt loam. This very deep, artificially drained soil is on flood plains. It formed in mixed alluvium. Slope is 0 to 2 percent. The native vegetation is mainly salt-tolerant grasses and shrubs. Elevation is 700 to 1,100 feet. The average annual precipitation is 6 to 12 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is dark grayish brown and grayish brown, very strongly alkaline silt loam about 19 inches thick. The upper part of the underlying material is light brownish gray, moderately alkaline silt loam about 22 inches thick, and the lower part to a depth of 60 inches or more is light brownish gray, moderately alkaline very fine sandy loam and fine sandy loam. In some areas the surface layer is silty clay loam.

Included in this unit are small areas of Toppenish and Umapine soils, areas of Kittitas soils that are not artificially drained and are salt-affected, and areas of Kittitas soils that have slopes of more than 2 percent.

Permeability of this Kittitas soil is moderately slow. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 18 to 42 inches from June to November Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding.

This unit is used for crops, for wildlife habitat, and as homesites. Where the unit is protected from flooding and is drained, leached, and irrigated, the main crops are corn, grain, and hops. Grasses and legumes are grown for hay, pasture, and seed. Deep-rooted crops are suited to areas where the drainage is adequate or where a drainage system has been installed and maintained.

If a drainage system is not maintained, the soil in this unit has a seasonal high water table during the irrigation season and has a high content of salt. Dikes can be used to divert floodwater and thus reduce the risk of flooding. Reclamation may require the addition of such amendments as gypsum, sulfur, or ferric sulfate to facilitate leaching.

Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. The water application rate should be reduced to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation,

applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to avoid compaction, to maintain or improve the organic matter content, to maintain tilth, and to improve the water infiltration rate. Using vegetated filter strips at the end of rows and using sediment ponds, or both, reduces the amount of sediment in the tailwater. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

This unit is poorly suited to homesite development. The main limitation is the hazard of flooding. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Selection of adapted vegetation is critical for the establishment of lawns, shrubs, trees, and vegetable gardens.

The main limitations for septic tank absorption fields are the high water table and moderately slow permeability. The moderately slow permeability and the high water table increase the possibility of failure of septic tank absorption fields.

This map unit is in capability subclass IIIw, irrigated.

67—Lickskillet silt loam, 5 to 30 percent slopes. This shallow, well drained soil is on uplands. It formed in loess and in residuum and colluvium derived from basalt. Most slopes are about 10 percent. The native vegetation is mainly grasses, forbs, and shrubs (fig. 2). Elevation is 1,500 to 3,200 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is about 48 degrees F, and the average frost-free season is 120 to 150 days.

Typically, the surface layer is grayish brown silt loam about 3 inches thick. The upper part of the subsoil is

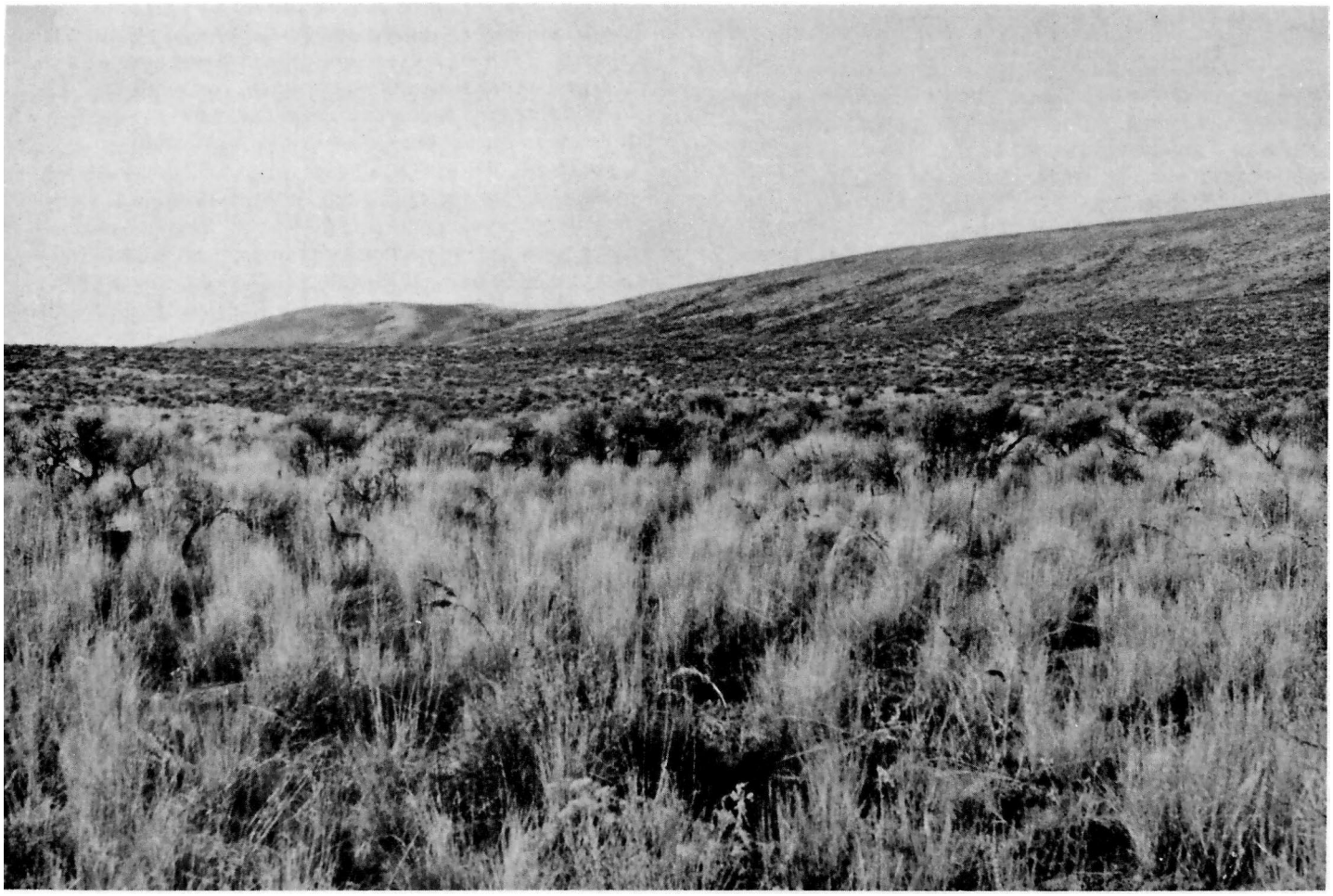


Figure 2.—Typical area of Lickskillet silt loam, 5 to 30 percent slopes, in the foreground.

brown very gravelly silt loam about 5 inches thick, and the lower part is yellowish brown very gravelly loam and very cobbly loam about 11 inches thick. Fractured basalt is at a depth of about 19 inches. Depth to basalt ranges from 12 to 20 inches. In some areas the surface layer is stony.

Included in this unit are areas of Rock Creek, Kiona, Starbuck, and Bakeoven soils.

Permeability of this Lickskillet soil is moderate. Available water capacity is low. Effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland, for wildlife habitat, and as homesites.

The potential native vegetation on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred species such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved with such methods as chaining, railing, beating, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. This unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are the shallow depth to rock and steepness of slope where the slope is more than 15 percent. Bedrock hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are depth to rock and steepness of slope. The bedrock limits the capacity of the absorption fields. Effluent from absorption fields can surface in downslope areas and thus create a hazard to health. Absorption lines need to be installed on the contour in the more nearly level areas of the unit.

This map unit is in capability subclass VIe, nonirrigated.

68—Lickskillet very stony silt loam, 5 to 45 percent slopes. This shallow, well drained soil is on uplands. It formed in loess and residuum and colluvium derived from basalt. Most slopes are about 25 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,500 to 3,200 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is about 48 degrees F, and the average frost-free season is 120 to 150 days.

Typically, the surface layer is grayish brown very stony silt loam about 3 inches thick. The upper part of the subsoil is brown very gravelly silt loam about 5 inches thick, and the lower part is yellowish brown very gravelly loam and very cobbly loam about 11 inches thick. Fractured basalt is at a depth of about 19 inches. Depth to basalt ranges from 12 to 20 inches. In some areas the surface layer does not have stones.

Included in this unit are areas of Rock Creek, Kiona, Starbuck, and Bakeoven soils and areas of Rock outcrop.

Permeability of this Lickskillet soil is moderate. Available water capacity is low. Effective rooting depth is 12 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland, for wildlife habitat, and as homesites.

The potential native vegetation on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by the low available water capacity and large stones on the surface. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved with such methods as chaining, railing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition, but it is difficult because of stoniness. This unit should be seeded in fall when the moisture content of the soil is optimal, and a rangeland drill should be used. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are depth to rock and steepness of slope in areas where the slope is more than 15 percent. Bedrock hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Removal of stones might be necessary before seeding lawns.

The main limitations for septic tank absorption fields are depth to rock and steepness of slope in areas where the slope is more than 15 percent. Bedrock limits the capacity of the absorption fields. Effluent can surface in downslope areas and thus create a hazard to health. Absorption lines need to be installed on the contour in the more nearly level areas of the unit.

This map unit is in capability subclass VIIs, nonirrigated.

69—Logy silt loam, 0 to 2 percent slopes. This very deep, well drained soil is on flood plains. It formed in alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 1,200 feet. The average annual precipitation is 7 to 10 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is dark grayish brown silt loam about 12 inches thick. The subsoil is brown extremely gravelly loam about 21 inches thick. The upper part of the substratum is brown extremely cobbly coarse sand about 12 inches thick, and the lower part to a depth of 60 inches or more is grayish brown extremely gravelly coarse sand. In some areas the surface layer is gravelly, cobbly, or stony.

Included in this unit are areas of Yakima and Weirman soils.

Permeability of this Logy soil is moderate to the substratum and very rapid through it. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to occasional periods of flooding from January to April.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. Grasses and legumes are grown for hay, pasture, and seed. The main irrigated crop is grain.

The main limitation for irrigated crops is the low available water capacity. Corrugation and sprinkler irrigation systems are suited to the soil in this unit. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. Water application rates should be reduced to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to avoid compaction, to maintain or improve the organic matter content, to maintain tilth, and to improve the water infiltration rate. Using vegetated filter strips at the end of rows reduces the volume of sediment in the tailwater. Exposing the extremely gravelly coarse sand substratum when leveling fields should be avoided. Shallow cuts are feasible in some areas. Dikes are effective in diverting floodwater.

This unit is poorly suited to homesite development. The main limitation is the hazard of flooding. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings from flooding. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is the hazard of flooding. Flooding can be controlled only by use of major flood control structures. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems. Cutbanks are not stable and are subject to caving in.

This map unit is in capability subclass IVw, irrigated.

70—Logy cobbly silt loam, 0 to 5 percent slopes. This very deep, well drained soil is on flood plains. It formed in alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 1,200 feet. The average annual precipitation is 7 to 10 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is dark grayish brown cobbly silt loam about 12 inches thick. The subsoil is brown extremely gravelly loam about 21 inches thick. The upper part of the substratum is brown extremely cobbly coarse sand about 12 inches thick, and the lower part to a depth of 60 inches or more is grayish brown extremely gravelly coarse sand. In some areas the surface layer does not have cobbles.

Included in this unit are areas of Logy soils that have slopes of more than 5 percent.

Permeability of this Logy soil is moderate above the subsoil and very rapid through it. Available water capacity is low. Effective rooting depth is limited by the gravelly coarse sand that is at a depth of about 45 inches. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to occasional periods of flooding from January to April.

This unit is used as rangeland and homesites and for wildlife habitat. Some small areas are used for irrigated pasture and grass or legumes.

The potential native vegetation on this unit is mainly bluebunch wheatgrass and basin wildrye. The production of forage is limited by the large stones on the surface. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved with such methods as chaining, railing, beating, chemical treatment, and prescribed burning.

Seeding is a suitable practice if the range vegetation is in poor condition, but it may be difficult because of cobbles. The unit should be seeded using a drill. Removal of rocks may be necessary before seeding. Adapted grasses should be seeded.

This unit is limited for livestock watering ponds and other water impoundments because of seepage. Water tanks, springs, wells, or pipeline systems can be used to provide water for livestock.

The main limitations for irrigated pasture are the low available water capacity and large stones. Sprinkler irrigation systems are suited to the soil in this unit. Use of sprinkler irrigation permits the even, controlled application of water. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Before tilling or seeding, removal of cobbles may be necessary. Dikes can be used to divert floodwater.

This unit is poorly suited to homesite development. The main limitation is the hazard of flooding. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in.

The main limitations for septic tank absorption fields are the hazard of of flooding and seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability subclasses IIIw, irrigated, and VIw, nonirrigated.

71—Loneridge stony loam, 0 to 25 percent slopes. This very deep, well drained soil is on ridges, benches, and mountaintops. It formed in residuum and colluvium derived dominantly from basalt that contains small amounts of loess. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 3,200 to 4,500 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is about 43 degrees F, and the average length of the growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1 inch thick. The surface layer is dark grayish brown stony loam about 3 inches thick. The upper part of the subsoil is pale brown very cobbly loam about 20 inches thick, and the lower part to a depth of 60 inches or more is dark yellowish brown and yellowish brown very cobbly clay.

Included in this unit are areas of Bocker soils, areas of Rock outcrop, and small convex areas of Loneridge soils that have slopes of more than 25 percent. Included areas make up about 5 percent of the total acreage.

Permeability of this Loneridge soil is moderate above the lower part of the subsoil and slow through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight to moderate.

This unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine and Douglas-fir are the main woodland species on this unit. Among the trees of limited extent are western larch and grand fir. On the basis of a 100-year site curve, the mean site index is 75 for ponderosa pine and 86 for Douglas-fir. On the basis of a 50-year site curve, the mean site index for western larch is 61. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 62 cubic feet per acre for ponderosa pine at age 45 and 79 cubic feet per acre for Douglas-fir at age 40. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 50 cubic feet per acre for ponderosa pine and 65 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on this unit is about 55 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is a short period of seasonal soil wetness. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction generally is available on this unit.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. If seed trees are present, natural reforestation of cutover areas by ponderosa pine and Douglas-fir occurs periodically. The droughtiness of the soil increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, pinegrass, Oregon-grape, pinemat manzanita, and common snowberry. The crown density in the areas where the woodland site index was measured is 25 percent. This unit is well suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIs, nonirrigated.

72—Loneridge stony loam, 25 to 45 percent slopes. This very deep, well drained soil is on mountainsides and ridges. It formed in residuum and colluvium derived dominantly from basalt that contains small amounts of loess. Areas generally are on south-facing slopes. The native vegetation is mainly conifers, grasses, and shrubs. Elevation is 3,200 to 4,800 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is about 43 degrees F, and the average length of the growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1 inch thick. The surface layer is dark grayish brown stony loam about 3 inches thick. The upper part of the subsoil is pale brown very cobbly loam about 20 inches thick, and the lower part to a depth of 60 inches or more is dark yellowish brown and yellowish brown very cobbly clay.

Included in this unit are areas of Bocker soils, areas of Rock outcrop, small concave areas of Loneridge soils that have slopes of less than 25 percent, and a few areas of Loneridge soils that have short slopes of more than 45 percent. Included areas make up about 5 percent of the total acreage.

Permeability of this Loneridge soil is moderate above the lower part of the subsoil and slow through it.

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

This unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine and Douglas-fir are the main woodland species on this unit. Among the trees of limited extent are grand fir, lodgepole pine, and western larch. On the basis of a 100-year site curve, the mean site index is 80 for ponderosa pine, 92 for Douglas-fir, and 90 for grand fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 69 cubic feet per acre for ponderosa pine at age 40 and 88 cubic feet per acre for Douglas-fir at age 40. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 55 cubic feet per acre for ponderosa pine and 75 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on this unit is about 80 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is steepness of slope, which makes the use of wheeled and tracked equipment difficult. Cable yarding systems may be safer, and they disturb the soil less. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction generally is available on this unit.

Seeding establishment is the main concern in the production of timber. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. If seed trees are present, natural reforestation of cutover areas by ponderosa pine and Douglas-fir occurs periodically. The droughtiness of the soil increases seedling mortality, especially on south- and southwest-facing slopes.

Among the common forest understory plants are elk sedge, pinegrass, Oregon-grape, pinemat manzanita, lupine, and oceanspray. The crown density in the areas where the woodland site index was measured is 30 percent. This unit is suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIIs, nonirrigated.

73—Loneridge stony loam, 25 to 45 percent north slopes. This very deep, well drained soil is on mountainsides and ridges. It formed in residuum and colluvium that are derived dominantly from basalt and contain small amounts of loess. The native vegetation is mainly conifers, grasses, and shrubs. Elevation is 2,400 to 3,400 feet. The average annual precipitaton is 25 to 40 inches, the average annual air temperature is about 42 degrees F, and the average length of the growing season, at 28 degrees F, is 135 to 160 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1 inch thick. The surface layer is dark grayish brown stony loam about 3 inches thick. The upper part of the subsoil is pale brown very cobbly loam about 20 inches thick, and the lower part to a depth of 60 inches or more is dark yellowish brown and yellowish brown very cobbly clay.

Included in this unit are areas of Bocker soils, areas of Rock outcrop, and small concave areas of Loneridge soils that have slopes of less than 25 percent or more than 45 percent. Included areas make up about 5 percent of the total acreage.

Permeability of this Loneridge soil is moderate above the lower part of the subsoil and slow through it. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as grazable woodland and for wildlife habitat.

Douglas-fir and ponderosa pine are the main woodland species on this unit. On the basis of a 100-year site curve, the mean site index is 96 for Douglas-fir and 80 for ponderosa pine. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 95 cubic feet per acre for Douglas-fir at age 40 and 69 cubic feet per acre for ponderosa pine at age 40. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 110 cubic feet per acre for Douglas-fir and 70 cubic feet per acre for ponderosa pine. However, the typical basal area of stands on this unit is about 70 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is steepness of slope, which makes the use of wheeled and tracked equipment difficult. Cable yarding systems may be safer, and they disturb the soil less. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction generally is available on this unit. The north-facing side slopes of this unit retain a snowpack, which delays access in spring.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting Douglas-fir and ponderosa pine seedlings. If seed trees are present, natural reforestation of cutover areas by Douglas-fir and ponderosa pine occurs periodically. The droughtiness of the soil increases seedling mortality.

The common forest understory plants are pinegrass, elk sedge, lupine, oceanspray, and common snowberry. The crown density in the areas where the woodland site

index was measured is 40 percent. This unit is suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIIs, nonirrigated.

74—McDaniel very stony loam, 5 to 30 percent slopes. This very deep, well drained soil is on uplands. It formed in loess and colluvium derived from basalt. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 2,200 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 120 to 135 days.

Typically, the surface layer is grayish brown very stony loam about 8 inches thick. The upper part of the subsoil is brown very gravelly clay loam about 16 inches thick, and the lower part to a depth of 60 inches or more is brown very cobbly silty clay loam and yellowish brown extremely cobbly silty clay loam. In some areas the surface layer does not have stones.

Included in this unit are areas of Clint, Rock Creek, and Taneum soils and areas of Rock outcrop and McDaniel soils that have slopes of more than 30 percent. Included areas make up about 15 percent of the total acreage.

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

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The production of forage is limited by large stones. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as balsamroot and big sagebrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chemical treatment and prescribed burning. Seeding is difficult because of stoniness. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIs, nonirrigated.

75—McDaniel very stony loam, 30 to 65 percent slopes. This very deep, well drained soil is on uplands. It formed in loess and colluvium derived from basalt. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 2,200 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 120 to 135 days.

Typically, the surface layer is grayish brown very stony loam about 8 inches thick. The upper part of the subsoil is brown very gravelly clay loam about 16 inches thick, and the lower part to a depth of 60 inches or more is brown very cobbly silty clay loam and yellowish brown extremely cobbly silty clay loam. In some areas the surface layer does not have stones.

Included in this unit are areas of Clint, Rock Creek, and Taneum soils, areas of Rock outcrop, and areas of McDaniel soils that have slopes of less than 30 percent.

Permeability of this McDaniel soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly bluebunch wheatgrass and Idaho fescue. The production of forage is limited by steepness of slope and large stones. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as balsamroot and big sagebrush increases.

Areas that are heavily infested with undesirable vegetation can be improved with such methods as chemical treatment and prescribed burning. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Proper location of salt licks, stock water tanks, and fences promotes more uniform distribution of grazing.

Seeding is a suitable practice if the range vegetation is in poor condition, but it is difficult because of stoniness. Use of equipment may be difficult on the steeper slopes. The unit should be seeded in fall using a drill or by broadcasting. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIIs, nonirrigated.

76—McDaniel-Rock Creek complex, 5 to 30 percent slopes. This map unit is on uplands. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 2,200 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 120 to 135 days.

This unit is about 60 percent McDaniel very stony loam and about 25 percent Rock Creek very stony silt loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Clint, Taneum, and Simcoe soils. Included areas make up about 15 percent of the total acreage.

The McDaniel soil is very deep and well drained. It formed in loess and in colluvium derived from basalt. Typically, the surface layer is grayish brown very stony loam about 8 inches thick. The upper part of the subsoil

is brown very gravelly clay loam about 16 inches thick, and the lower part to a depth of 60 inches or more is brown very cobbly silty clay loam and yellowish brown extremely cobbly silty clay loam. In some areas the surface layer is stony.

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

The Rock Creek soil is very shallow and well drained. It formed in loess and in residuum derived from basalt. Typically, the surface layer is grayish brown very stony silt loam about 2 inches thick. The subsoil is grayish brown and brown cobbly and very cobbly clay about 8 inches thick. Basalt is at a depth of about 10 inches. Depth to basalt ranges from 8 to 15 inches.

Permeability of the Rock Creek soil is moderately slow. Available water capacity is low. Effective rooting depth is 8 to 15 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation on the McDaniel soil is mainly bluebunch wheatgrass and Idaho fescue. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as balsamroot and big sagebrush increases.

The potential native vegetation on the Rock Creek soil is mainly Sandberg bluegrass, stiff sagebrush, and eriogonum. If the range is overgrazed, the proportion of preferred forage plants such as stiff sagebrush and Sandberg bluegrass decreases and the proportion of less preferred forage plants such as forbs and annual grasses increases.

The production of forage on the McDaniel soil is limited by large stones. Droughtiness and depth to rock are the main limitations on the Rock Creek soil. Areas of the McDaniel soil that are heavily infested with undesirable vegetation can be improved with such methods as chaining, railing, beating, chemical treatment, and prescribed burning. Range seeding on the Rock Creek soil is not feasible because of the very shallow soil depth and soil droughtiness. Range seeding on the McDaniel soil is a suitable practice if the range vegetation is in poor condition, but it is difficult because of stoniness. The soil should be seeded in fall using a drill or by broadcasting. Adapted grasses and legumes should be seeded on this unit.

This map unit is in capability subclass VIIs, nonirrigated.

77—Meystre loam, 0 to 15 percent slopes. This very deep, well drained soil is on uplands. It formed in loess and in material weathered from sandstone. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 2,200 to 3,300 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is about 48 degrees F, and the average length of the growing season, at 28 degrees F, is 150 to 175 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1 inch thick. The surface layer is grayish brown and dark grayish brown loam about 11 inches thick. The subsoil is brown and yellowish brown clay loam and light yellowish brown fine sandy loam about 30 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown fine sandy loam. In some areas the subsoil is clay.

Included in this unit are small areas of Taneum and Odo soils and areas of Meystre soils that have slopes of more than 15 percent. Included areas make up about 10 percent of the total acreage.

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

This unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine and Douglas-fir are the main woodland species on this unit. Among the trees of limited extent is Oregon white oak. On the basis of a 100-year site curve, the mean site index is 63 for ponderosa pine and 74 for Douglas-fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 49 cubic feet per acre for ponderosa pine at age 55 and 61 cubic feet per acre for Douglas-fir at age 45. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 40 cubic feet per acre for ponderosa pine and 50 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on this unit is about 80 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is a short period of seasonal soil wetness. Wheeled and tracked equipment can be used in skidding operations. Use of such equipment when the soil is moist can produce ruts, compact the soil, and damage tree roots. Unsurfaced roads and skid trials are soft when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting ponderosa pine seedlings. If seed trees are present, natural reforestation of cutover areas by ponderosa pine occurs infrequently. The droughtiness of the soil increases seedling mortality, especially on south- and southwest- facing slopes.

The common forest understory plants are elk sedge, pinegrass, Idaho fescue, lupine, antelope bitterbrush, and Oregon-grape. The crown density in the areas where the

woodland site index was measured is 35 percent. This unit is well suited to grazing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass IIIe, nonirrigated.

78—Meystre stony loam, 15 to 45 percent slopes. This very deep, well drained soil is on uplands. It formed in loess and in material weathered from sandstone. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 2,200 to 3,300 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is about 48 degrees F, and the average length of the growing season, at 28 degrees F, is 150 to 175 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1 inch thick. The surface layer is grayish brown and dark grayish brown stony loam about 11 inches thick. The subsoil is brown and yellowish brown clay loam and light yellowish brown fine sandy loam about 30 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown fine sandy loam.

Included in this unit are areas of Taneum and Odo soils and areas of Meystre soils that have slopes of less than 15 percent. Included areas make up about 10 percent of the total acreage.

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

This unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine and Douglas-fir are the main woodland species on this unit. On the basis of a 100-year site curve, the mean site index is 63 for ponderosa pine and 74 for Douglas-fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 49 cubic feet per acre for ponderosa pine at age 55 and 61 cubic feet per acre for Douglas-fir at age 45. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 35 cubic feet per acre for ponderosa pine and 50 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on this unit is about 80 percent that of normal stands, and the total yield is correspondingly lower.

The main limitations for the harvesting of timber are a short period of seasonal soil wetness and steepness of slope. Wheeled and tracked equipment can be used in skidding operations. Use of such equipment when the soil is moist can produce ruts, compact the soil, and damage tree roots, especially on parts of the unit that have slopes of more than 30 percent. Unsurfaced roads and skid trails are soft when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit. Steep skid trails and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting ponderosa pine seedlings. If seed trees are present, natural reforestation of cutover areas by ponderosa pine occurs infrequently. The droughtiness of the soil increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, pinegrass, Oregon-grape, ceanothus, and common snowberry. The crown density in the areas where the woodland site index was measured is 25 percent. This unit is suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIs, nonirrigated.

79—Mikkalo silt loam, 0 to 5 percent slopes. This moderately deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is brown silt loam about 5 inches thick. The subsoil is brown silt loam about 15 inches thick. The upper part of the substratum is pale brown silt loam about 6 inches thick, and the lower part is pale brown gravelly silt loam about 4 inches thick. Basalt is at a depth of about 30 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are areas of Starbuck soils, Ritzville soils that are underlain by basalt, and Willis soils.

Permeability of this Mikkalo soil is moderate. Available water capacity is moderately high. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight.

This unit is used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitation for nonirrigated crops is low annual precipitation. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces, and stripcropping. Drainageways should be shaped and seeded to perennial grass.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, Cusick bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage

plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, chemical treatment, and prescribed burning.

Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is depth to rock, which hinders excavation. Dustiness can be a problem during construction of large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, the depth to rock limits the capacity of the absorption fields. The use of long absorption lines helps to compensate for this limitation.

This map unit is in capability subclass IVe, nonirrigated.

80—Mikkalo silt loam, 5 to 15 percent slopes. This moderately deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is brown silt loam about 5 inches thick. The subsoil is brown silt loam about 15 inches thick. The upper part of the substratum is pale brown silt loam about 6 inches thick, and the lower part is pale brown gravelly silt loam about 4 inches thick. Basalt is at a depth of about 30 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are areas of Starbuck soils, Ritzville soils that are underlain by basalt, and Willis soils. Included areas make up about 10 percent of the total acreage.

Permeability of this Mikkalo soil is moderate. Available water capacity is moderately high. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for nonirrigated cropland, rangeland, wildlife habitat, and homesites.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, tilling on the contour or across the slope, using terraces, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grasses.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, Cusick bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, chemical treatment, and prescribed burning.

Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is depth to rock, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is the depth to rock. Bedrock limits the capacity of the absorption field. The use of long absorption lines helps to compensate for this limitation. Slope can promote lateral seepage and surfacing of the effluent in downslope areas. Absorption lines should be installed on the contour.

This map unit is in capability subclass IVe, nonirrigated.

81—Mikkalo silt loam, 15 to 30 percent slopes. This moderately deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is from 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is brown silt loam about 5 inches thick. The subsoil is brown silt loam about 15 inches thick. The upper part of the substratum is pale brown silt loam about 6 inches thick, and the lower part is pale brown gravelly silt loam about 4 inches thick. Basalt is at a depth of about 30 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are areas of Starbuck soils, Ritzville soils that are underlain by basalt, and Willis soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Mikkalo soil is moderate. Available water capacity is moderately high. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be

reduced by seeding fall grain early, stubble mulching, and tilling and seeding on the contour or across the slope. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grasses.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, Cusick bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable shrubs can be improved by such methods as chaining, railing, beating, chemical treatment, and prescribed burning.

Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are the moderate depth to rock and steepness of slope. The bedrock hinders excavation. Dustiness can be a problem during construction on large building sites; therefore these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are the moderate depth to rock and steepness of slope. The moderate depth to bedrock limits the capacity of the absorption fields and, along with slope, can promote lateral seepage and surfacing of effluent in downslope areas. Use of long absorption lines helps to compensate for the moderate depth to bedrock. Absorption lines should be installed on the contour.

This map unit is in capability subclass IVe, nonirrigated.

82—Mippon very cobbly silt loam. This very deep, well drained soil is on low terraces and flood plains. It formed in recent alluvium. Slope is 0 to 5 percent. Areas are long and narrow. They are characterized by old dry streambeds. The native vegetation is mainly coniferous and deciduous trees, grasses, forbs, and shrubs. Elevation is 2,400 to 4,800 feet. The average annual precipitation is 20 to 40 inches, the average annual air temperature is about 43 degrees F, and the average length of the growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1/2 inch thick. The upper 7 inches of the surface layer is very dark grayish brown very cobbly silt loam, and the lower 7 inches is dark grayish brown very cobbly loam. The substratum to a depth of 60 inches or more is brown and yellowish brown extremely gravelly sand. In some areas the surface layer is stony or extremely cobbly, the substratum is loam or sandy loam, or the soil is mottled and has a seasonal high water table in the lower part of the substratum.

Included in this unit are areas of riverwash along stream channels and in old dry streambeds. Also included are areas of poorly drained soils in depressional areas. Included areas make up about 15 percent of the total acreage.

Permeability of this Mippon soil is very rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 36 to 60 inches during February to April. This soil is subject to occasional periods of flooding from March to May. Channeling and deposition are common along streambanks.

This unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine and Douglas-fir are the main coniferous species at the lower elevations on this unit. Grand fir is the predominant coniferous species above an elevation of 3,000 feet. Trees of limited extent include western larch, lodgepole pine, and Engelmann spruce. On the basis of a 100-year site curve, the mean site index is 108 for ponderosa pine, 113 for Douglas-fir, 104 for grand fir, and 87 for lodgepole pine. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger at age 40 is 118 cubic feet per acre for ponderosa pine and 128 cubic feet per acre for Douglas-fir. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 105 cubic feet per acre for ponderosa pine and 135 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on this unit is about 85 percent that of normal stands, and the total yield is correspondingly lower.

The main limitations for the harvesting of timber are the uneven, broken topography, occasional periods of flooding, and the very cobbly surface layer. Use of equipment is limited by the occasional periods of flooding in spring. Routes for roads and skid trails commonly are restricted by old stream channels. Leveling and grading the surface layer generally are adequate for road construction on this unit. Extra caution is required during felling and yarding to prevent damage to streambeds, streambanks, and riparian vegetation. The large volume of cobbles in the surface layer increases the wear of wheeled and tracked equipment.

Plant competition is the main concern in the production of timber. Varying amounts of black cottonwood, mountain alder, quaking aspen, redosier dogwood, and willow are in the included areas of this unit. These brushy plants can invade openings on the Mippon soil in this unit and, unless controlled, delay reforestation. The droughtiness of the surface layer during the dry summer months increases seedling mortality. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. If seed trees

are present, natural reforestation of cutover areas by ponderosa pine and Douglas-fir occurs periodically.

The common forest understory plants are oceanspray, common snowberry, elderberry, currant, rose, redosier dogwood, and elk sedge. The crown density in the areas where the woodland site index was measured is 30 percent. This unit is well suited to grazing and browsing. If the understory is overgrazed, the proportion of preferred forage plants such as elk sedge decreases and the proportion of less desirable forbs and annual grasses increases. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIw, nonirrigated.

83—Moxee silt loam, 2 to 15 percent slopes. This well drained soil is on uplands. It is shallow over a hardpan. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,300 to 2,000 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 125 to 160 days.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil is pale brown silt loam about 4 inches thick. The substratum is pale brown gravelly silt loam about 7 inches thick. A lime- and silica-cemented hardpan is at a depth of about 18 inches. Depth to the hardpan ranges from 10 to 20 inches. The hardpan commonly is underlain by basalt. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of Starbuck, Selah, Roza, Willis, and Gorst soils.

Permeability of this Moxee soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated pasture and hay, rangeland (fig. 3), wildlife habitat, and homesites.

The main limitations for irrigated pasture and hay are steepness of slope, depth to the hardpan, and the hazard of water erosion. Using a cropping system that includes close-growing crops in the rotation reduces water erosion. Sprinkler irrigation systems are well suited to the soil in this unit. Use of these systems permits the even, controlled application of irrigation water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

The potential native vegetation on this unit is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by the depth to the hardpan. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning.

Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is the shallow depth to the hardpan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is the shallow depth to the hardpan, which limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation.

This map unit is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

84—Moxee silt loam, 15 to 30 percent slopes. This well drained soil is on uplands. It is shallow over a hardpan. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,300 to 2,000 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is 49 degrees F, and the average frost-free season is 125 to 160 days.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil is pale brown silt loam about 4 inches thick. The substratum is pale brown gravelly silt loam about 7 inches thick. A lime- and silica-cemented hardpan is at a depth of about 18 inches. Depth to the hardpan ranges from 10 to 20 inches. The hardpan commonly is underlain by basalt.

Included in this unit are small areas of Starbuck, Willis, Selah, and Gorst soils and areas of Moxee soils that have slopes of more than 30 percent.

Permeability of this Moxee soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated hay and pasture, for wildlife habitat, and as homesites.

The main limitations for irrigated hay and pasture are steepness of slope, depth to the hardpan, and the hazard of water erosion. Using a cropping system that includes close-growing crops in the rotation reduces water erosion. Sprinkler irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Figure 3.—Rangeland on Moxee silt loam, 2 to 15 percent slopes, in the foreground.

This unit is poorly suited to homesite development. The main limitations are the shallow depth to the hardpan and steepness of slope. The pan hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are depth to the hardpan and steepness of slope. The pan limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation. Slope can cause lateral seepage and surfacing of effluent in downslope areas.

This map unit is in capability subclass VIe, irrigated.

85—Moxee cobbly silt loam, 0 to 30 percent slopes. This well drained soil is on uplands. It is shallow over a hardpan. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,300 to 2,000 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is 49 degrees F, and the average frost-free season is 125 to 160 days.

Typically, the surface layer is brown cobbly silt loam about 7 inches thick. The subsoil is pale brown silt loam about 4 inches thick. The substratum is pale brown gravelly silt loam about 7 inches thick. A lime- and silica-cemented hardpan is at a depth of about 18 inches. Depth to the hardpan ranges from 10 to 20 inches. The hardpan commonly is underlain by basalt.

Included in this unit are areas of Starbuck and Gorst soils.

Permeability of this Moxee soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is medium, large stones, and the hazard of water erosion is moderate.

This unit is used for irrigated hay and pasture, rangeland, wildlife habitat, and homesites.

The main limitations for irrigated hay and pasture are steepness of slope, depth to the hardpan, large stones, and the hazard of water erosion. Sprinkler irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Growing perennial hay and pasture reduces erosion. Seedbed preparation is difficult, and removal of stones might be necessary.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by large stones and the low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and cheatgrass increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition, but it is difficult because of the cobbles in the surface layer. Removal of stones may be needed before seeding. The unit should be seeded in the fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are the shallow depth to the hardpan, steepness of slope, and large stones, which hinder excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. The cobbly surface makes the establishment of lawns difficult.

The main limitations for septic tank absorption fields are depth to the hardpan and steepness of slope. The hardpan limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation. Slope can cause lateral seepage and surfacing of the effluent in downslope areas. Absorption lines should be installed on the contour.

This map unit is in capability subclass VIe, nonirrigated and irrigated.

86—Naches loam. This very deep, well drained soil is on stream terraces in valleys. It formed in old alluvium. Slope is 0 to 2 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 900 feet. The average annual precipitation is 7 to 9 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is grayish brown loam about 9 inches thick. The upper part of the subsoil is brown loam about 12 inches thick, and the lower part is yellowish brown loam about 7 inches thick. The upper part of the substratum is yellowish brown gravelly loam about 6 inches thick, and the lower part to a depth of 60 inches or more is dark grayish brown extremely gravelly sand. In some areas the surface layer is gravelly, and in some areas the substratum is extremely gravelly to a depth of about 38 inches or more.

Included in this unit are small areas of Esquatzel, Ashue, and Yakima soils.

Permeability of this Naches soil is slow above the lower part of the substratum and very rapid through it. Available water capacity is moderately high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight.

This unit is used for irrigated field and orchard crops, for wildlife habitat, and as homesites. The main irrigated crops are corn, grain, grapes, hops, mint, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

This unit has few limitations for irrigated crops. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil is this unit. The type of system used depends on the kind of crop grown. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is well suited to homesite development. It has few limitations. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in.

The main limitation for septic tank absorption fields is seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability subclass IIs, irrigated.

87—Naxing loam, 5 to 25 percent slopes. This very deep, well drained soil is on mountaintops and broad mountain ridges. It formed in colluvium that is derived dominantly from basalt and contains small amounts of loess and volcanic ash. The native vegetation is mainly conifers, forbs, and shrubs. Elevation is 5,000 to 7,000 feet. The average annual precipitation is 40 to 50 inches, the average annual air temperature is about 41 degrees F, and the average length of the growing season, at 28 degrees F, is 80 to 110 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1 inch thick. The surface layer is brown loam about 14 inches thick. The subsoil is yellowish brown very cobbly loam about 7 inches thick. The substratum to a depth of 60 inches or more is yellowish brown extremely cobbly loam. In some areas the surface layer is stony.

Included in this unit are areas of Cryandepts in swales and on alluvial fans, Saydab soils on ridgetops, Darland soils on south-facing side slopes, and Naxing soils that have slopes of more than 25 percent. Also included are soils, on cirque floors, that have a glacial till substratum. Included areas make up about 10 percent of the total acreage.

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

This unit is used as grazable woodland and for wildlife habitat.

Subalpine fir, lodgepole pine, and Engelmann spruce are the main woodland species on this unit. Among the trees of limited extent are whitebark pine and western larch. Western larch and lodgepole pine commonly occur in small, densely stocked stands. On the basis of a 100-year site curve, the mean site index is 70 for lodgepole pine, 68 for subalpine fir, and 74 for Engelmann spruce. Yield tables for normal, even-aged, unmanaged stands of lodgepole pine at 100 years of age indicate that the mean annual increment at culmination (CMAI) is 70 cubic feet per acre. On the basis of a 50-year site curve, the mean site index for western larch is 55. Yield tables for normal, even-aged, unmanaged stands of western larch indicate that the mean annual increment at culmination for trees 0.6 inch in diameter and larger at 70 years of age is 72 cubic feet per acre. The mean annual increment for western larch trees 7.6 inches in diameter and larger at 80 years of age is 40 cubic feet per acre. However, the typical basal area of stands on this unit is about 125 percent that of normal stands, and total yield is correspondingly higher. The site index is quite variable on this unit. The highest site indexes generally are at the lower elevations on south-facing slopes, and the lowest site indexes are at the higher elevations on north-facing slopes.

The main limitation for the harvesting of timber is snowpack, which hinders the use of equipment and limits access in winter. Wheeled and tracked equipment can be used in skidding operations. Unsurfaced roads and skid trails are soft and slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is available in some areas of this unit.

Seedling establishment is the main concern in the production of timber. If seed trees are present, natural reforestation of cutover areas by subalpine fir and lodgepole pine occurs periodically. Low soil temperatures, heavy snowpack, and the short growing season limit the even distribution of natural reforestation, especially on north-facing slopes. The droughtiness of the surface layer during the dry summer months increases seedling mortality, especially on south- and southwest- facing slopes.

The common forest understory plants are elk sedge, pinegrass, lupine, vetch, and dwarf huckleberry. The crown density in the areas where the woodland site index was measured is 40 percent. This unit is well suited to grazing and browsing. It has few limitations for the production of forage. If the understory is overgrazed, the proportion of preferred forage plants such as elk sedge decreases and the proportion of less desirable forbs and annual grasses increases. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This unit is limited for livestock watering ponds and other water impoundments because of seepage. Spring developments, wells, or pipeline systems can be used to provide stock water.

This map unit is in capability subclass VIe, nonirrigated.

88—Naxing stony loam, 25 to 45 percent slopes. This very deep, well drained soil is on mountainsides. It formed in colluvium that is derived dominantly from basalt and contains loess and volcanic ash. The native vegetation is mainly conifers, forbs, and shrubs. Elevation is 5,000 to 7,000 feet. The average annual precipitation is 40 to 50 inches, the average annual air temperature is about 41 degrees F, and the average length of the growing season, at 28 degrees F, is 80 to 110 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1 inch thick. The surface layer is brown stony loam about 14 inches thick. The subsoil is yellowish brown very cobbly loam about 7 inches thick. The substratum to a depth of 60 inches or more is yellowish brown extremely cobbly loam.

Included in this unit are areas of Saydab soils on ridgetops, areas of Darland soils on south-facing side slopes, areas of Rock outcrop, and areas of Naxing soils that have slopes of less than 25 percent or more than 45 percent. Included areas make up about 10 percent of the total acreage.

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

This unit is used as grazable woodland and for wildlife habitat.

Western larch, subalpine fir, and lodgepole pine are the main woodland species on this unit. Among the trees of limited extent are grand fir, Engelmann spruce, and whitebark pine. On the basis of a 50-year site curve, the

mean site index for western larch is 52. Yield tables for normal, even-aged, unmanaged stands of western larch indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger at 70 years of age is 67 cubic feet per acre. The mean annual increment for western larch trees 7.6 inches in diameter and larger at 80 years of age is 35 cubic feet per acre. On the basis of a 100-year site curve, the mean site index is 85 for lodgepole pine, 75 for subalpine fir, and about 74 for Engelmann spruce. Yield tables for normal, even-aged, unmanaged stands of lodgepole pine at 100 years of age indicate that the mean annual increment at culmination is about 97 cubic feet per acre. However, the typical basal area of stands on this unit is about 95 percent that of normal stands, and the total yield is correspondingly lower. The site index is quite variable on this unit. The highest site indexes generally are at the lower elevations on south-facing slopes, and the lowest site indexes are at the higher elevations on north-facing slopes.

The main limitations for the harvesting of timber are snowpack and steepness of slope. Snowpack hinders the use of equipment and limits access in winter. North-facing side slopes retain snowpack longer, which delays access in spring. Steepness of slope makes the use of wheeled and tracked equipment difficult. Cable yarding systems may be safer, and they disturb the soil less. Unsurfaced roads and skid trails are soft and slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is available in some areas of this unit. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover.

Seedling establishment is the main concern in the production of timber. If seed trees are present, natural reforestation of cutover areas by subalpine fir and western larch occurs periodically. Low soil temperatures, deep snowpack, and the short growing season limit the even distribution of natural reforestation, especially on north-facing slopes. The droughtiness of the surface layer during the dry summer months increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, pinegrass, lupine, vetch, currant, and dwarf huckleberry. The crown density in the areas where the woodland site index was measured is 40 percent. This unit is well suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This unit is limited for livestock watering ponds and other water impoundments because of seepage. Spring developments, wells, or pipeline systems can be used to provide stock water.

This map unit is in capability subclass VIIs, nonirrigated.

89—Naxing stony loam, 45 to 65 percent slopes. This very deep, well drained soil is on mountainsides. It formed in colluvium that is derived dominantly from basalt and contains loess and volcanic ash. The native vegetation is mainly conifers, forbs, and shrubs. Elevation is 5,000 to 7,000 feet. The average annual precipitation is 40 to 50 inches, the average annual air temperature is about 41 degrees F, and the average length of the growing season, at 28 degrees F, is 80 to 110 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1 inch thick. The surface layer is brown stony loam about 14 inches thick. The subsoil is yellowish brown very cobbly loam about 7 inches thick. The substratum to a depth of 60 inches or more is yellowish brown extremely cobbly loam.

Included in this unit are Saydab soils on ridgetops, Darland soils on south-facing side slopes, areas of Rock outcrop, and Naxing soils on concave slopes of less than 45 percent. Included areas make up about 15 percent of the total acreage.

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

This unit is used as grazable woodland and for wildlife habitat.

Subalpine fir, Engelmann spruce, and western larch are the main woodland species on this unit. Among the trees of limited extent are whitebark pine, Douglas-fir, and grand fir. On the basis of a 50-year site curve, the mean site index for western larch is 52. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger at 70 years of age is 67 cubic feet per acre. The mean annual increment for trees 7.6 inches in diameter and larger at 80 years of age is 35 cubic feet per acre. However, the typical basal area of stands on this unit is about 90 percent that of normal stands, and the total yield is correspondingly lower. On the basis of 100-year site curve, the site index is 59 for subalpine fir and about 74 for Engelmann spruce. The site index is quite variable on this unit. The highest site indexes generally are at the lower elevations on south-facing slopes, and the lowest site indexes are at the higher elevations on north-facing slopes.

The main limitations for the harvesting of timber are snowpack and steepness of slope. Snowpack hinders the use of equipment and limits access in winter. North-facing side slopes retain snowpack longer, which delays access in spring. Steepness of slope restricts the use of wheeled and tracked equipment in skidding operations; cable yarding systems are safer and disturb the soil less. Unsurfaced roads and skid trails are soft and slippery

when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is available in some areas of this unit. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover.

Seedling establishment is the main concern in the production of timber. If seed trees are present, natural reforestation of cutover areas by subalpine fir and Engelmann spruce occurs periodically. Low soil temperatures, deep snowpack, and the short growing season increase seedling mortality and limit the even distribution of natural reforestation, especially on north-facing slopes. The droughtiness of the surface layer during the dry summer months increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, pinegrass, lupine, vetch, currant, pinemat manzanita, and dwarf huckleberry. The crown density in the areas where the woodland site index was measured is 30 percent. This unit is well suited to browsing. Steepness of slope limits access by livestock. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful. Because of the steepness of slope, broadcast seeding should be used.

This unit is limited for livestock watering ponds and other water impoundments because of seepage potential. Spring developments, wells, or pipeline systems can be used to provide stock water.

This map unit is in capability subclass VIIs, nonirrigated.

90—Odo cobbly silt loam, 5 to 35 percent slopes. This very deep, well drained soil is on uplands. It formed in residuum and colluvium that is derived dominantly from basalt and contains some loess and volcanic ash. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 2,000 to 3,200 feet. The average annual precipitation is 15 to 19 inches, the average annual air temperature is about 46 degrees F, and the average length of the growing season, at 28 degrees F, is 150 to 180 days.

Typically, the surface is covered with a mat of decomposing organic material about 3 inches thick. The surface layer is brown cobbly silt loam about 18 inches thick. The subsoil to a depth of 60 inches or more is yellowish brown gravelly loam. In some areas the subsoil is very gravelly or very cobbly.

Included in this unit are areas of Meystre, Rock Creek, Clint, and Tekison soils. Included areas make up about 10 percent of the total acreage.

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

The unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine and Douglas-fir are the main woodland species on this unit. Among the trees of limited extent are Oregon white oak and Rocky Mountain maple. On the basis of a 100-year site curve, the mean site index is 75 for ponderosa pine and 96 for Douglas-fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 62 cubic feet per acre for ponderosa pine at age 45 and 95 cubic feet per acre for Douglas-fir at age 40. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 50 cubic feet per acre for ponderosa pine and 80 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on this unit is about 70 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is a short period of seasonal soil wetness. Use of wheeled and tracked equipment when the soil is moist can produce ruts, compact the soil, and damage tree roots. Unsurfaced roads and skid trails are soft and slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting ponderosa pine seedlings. Where seed trees are present, natural reforestation of cutover areas by ponderosa pine occurs infrequently. Droughtiness of the soil increases seedling mortality, especially on south- and southwest- facing slopes.

The common forest understory plants are elk sedge, pinegrass, bitterbrush, common snowberry, and Oregon white oak. The crown density in the areas where the woodland site index was measured is 25 percent. This unit is well suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass IVe, nonirrigated.

91—Outlook fine sandy loam. This very deep, artificially drained soil is on flood plains. It formed in alluvium. Slope is 0 to 3 percent. The native vegetation is mainly alkali-tolerant grasses and shrubs. Elevation is 650 to 2,000 feet. The average annual precipitation is 6 to 12 inches, the average annual air temperature is 51 degrees F, and the average frost-free season is 130 to 160 days.

Typically, the surface layer is very dark grayish brown, dark grayish brown, and very dark brown fine sandy loam about 8 inches thick and has yellowish brown or dark yellowish brown mottles. It is strongly alkaline. The subsoil is grayish brown, mottled silt loam about 10

inches thick. The substratum to a depth of 60 inches or more is dark brown silt loam. The subsoil and substratum are moderately alkaline.

Included in this unit are small areas of Umapine and Sinloc soils and areas of Outlook soils that have not been artificially drained.

Permeability of this Outlook soil is moderate. Available water capacity is high. Effective rooting depth is limited by a high water table that is at a depth of 24 to 48 inches from May to December. Runoff is ponded, and the hazard of erosion is slight. The hazard of soil blowing is high. This soil is partially protected from flooding, and the hazard of flooding is rare.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. In areas that have been drained, leached, and irrigated, the main crops are asparagus, corn, grain, hops, and mint. Grasses and legumes are grown for hay, pasture, and seed. Deep-rooted crops are suited to areas where the drainage is adequate or where a drainage system has been installed and is adequately maintained.

The main limitations for irrigated crops are wetness, high alkalinity, and the hazard of soil blowing. Dikes can be used to divert floodwater. Reclamation may require the addition of such amendments as gypsum, sulfur, or ferric sulfate to facilitate leaching.

Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of sprinkler irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

The initial period of irrigation following cultivation is the most critical one for the control of erosion. The hazard of soil blowing makes proper tillage and crop residue management extremely important. This unit should be protected with plant cover or residue during the period of susceptibility to soil blowing in spring. Seedbeds should be prepared when irrigation water is available to saturate the soil surface. Use of straw, manure, or other waste material as a mulch reduces soil blowing.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the amount of sediment in the tailwater. A plowpan develops in this soil; however, it can be broken by chiseling when the soil is dry.

This unit is poorly suited to homesite development. The main limitations are the hazard of flooding and soil wetness. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings from flooding. Wetness an can be reduced by installing drain tile around footings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Plants selected for use as ground cover should be alkali tolerant.

The main limitation for septic tank absorption fields is wetness.

This map unit is in capability subclass IIIw, irrigated.

92—Outlook silt loam. This very deep, artificially drained soil is on flood plains. It formed in alluvium. Slope is 0 to 3 percent. The native vegetation is alkali-tolerant grasses and shrubs. Elevation is 650 to 2,000 feet. The average annual precipitation is 6 to 12 inches, the average annual air temperature is 51 degrees F, and the average frost-free season is 130 to 160 days.

Typically, the surface layer is very dark brown, very dark grayish brown and dark grayish brown silt loam about 8 inches thick and has yellowish brown or dark yellowish brown mottles. It is strongly alkaline. The subsoil is grayish brown, mottled silt loam about 10 inches thick. The substratum to a depth of 60 inches or more is dark brown silt loam. The subsoil and substratum are moderately alkaline.

Included in this unit are small areas of Umapine and Sinloc soils and areas of Outlook soils that have not been artifically drained.

Permeability of this Outlook soil is moderate. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 24 to 48 inches. Runoff is ponded, and the hazard of water erosion is slight. This unit is partially protected from flooding, and the hazard of flooding is rare.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. Where the soil is this unit is drained, leached, and irrigated, the main crops are asparagus, corn, grain, hops, and mint. Grasses and legumes are grown for hay, pasture, and seed. Deep-rooted crops are suited to areas where the drainage is adequate or where a drainage system has been installed and is adequately maintained.

The main limitations for irrigated crops are the hazard of water erosion and the high content of alkali. Dikes can be used to divert floodwater. Reclamation may require the addition of such amendments as gypsum, sulfur, or ferric sulfate to facilitate leaching.

Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of sprinkler irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely

critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Proper timing of minimum tillage and return of crop residue to the soil reduce compaction, help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. A plowpan develops in the soil in this unit; however, it can be broken by chiseling and subsoiling when the soil is dry.

This unit is poorly suited to homesite development. The main limitations are the hazard of flooding and soil wetness. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Wetness can be reduced by installing drain tile around footings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Plants selected for ground cover need to be alkali tolerant.

The main limitation for septic tank absorption fields is wetness.

This map unit is in capability subclass IIIw, irrigated.

93—Pits. This unit consists primarily of gravel pits, areas used for sanitary landfills, and areas used as a source of clay.

Most of the gravel pits are in areas of Weirman soils along the Yakima and Naches Rivers. These pits are mainly used as a source of material for roadfill and for surfacing roads and as a source of sand and gravel for use in concrete. Some gravel pits are in areas of Ashue and Scooteney soils and in areas of Harwood, Burke, and Wiehl soils on uplands. The Harwood and Burke soils, along with included areas of Gorst and Scoon soils, have a hardpan that contains gravel. The hardpan can be ripped and the material used as roadfill and for surfacing roads.

This map unit is in capability subclass VIIIs, nonirrigated.

94—Prosser silt loam, 0 to 15 percent slopes. This moderately deep, well drained soil is on uplands. It formed in loess and alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 300 to 1,150 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 160 to 180 days.

Typically, the surface layer is brown silt loam about 4 inches thick. The subsoil is pale brown silt loam about 10 inches thick. The substratum is pale brown and light gray silt loam about 19 inches thick. Basalt is at a depth of about 33 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are areas of Mikkalo, Shano, and Starbuck soils.

Permeability of this Prosser soil is moderate. Available water capacity is moderately high. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for nonirrigated crops, as rangeland, and for wildlife habitat.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation on this unit is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, chemical treatment, and prescribed burning.

Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass IVe, nonirrigated.

95—Quincy loamy fine sand, 0 to 10 percent slopes. This very deep, somewhat excessively drained soil is on terraces. It formed in eolian sand. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 1,100 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 49 degrees F, and the frost-free season is 135 to 180 days.

Typically, the surface layer is grayish brown loamy fine sand about 20 inches thick. The underlying material to a depth of 60 inches or more is grayish brown medium sand.

Included in this unit are small areas of Esquatzel, Warden, and Hezel soils and areas of Quincy soils that have the slopes of more than 10 percent. Also included are areas of alkali-affected soils that are somewhat poorly drained and soils that are underlain by basalt,

gravel, or lacustrine sediment at a depth of 40 inches or more.

Permeability of this Quincy soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is very slow, and hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used for irrigated field and orchard crops, for wildlife habitat, and as homesites. The main irrigated crops are grain, potatoes, corn, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are rapid permeability, low available water capacity, steepness of slope, and the hazard of soil blowing. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water. Because this soil is droughty, frequent, light applications of irrigation water are needed. To avoid leaching of plant nutrients and loss of water, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

This unit should be protected with a cover crop during periods when it is susceptible to soil blowing, and it should be protected by crop residue until crops are well established in spring. To provide adequate cover in winter, fall grain, hay, or pasture should be seeded late in August or early in September.

Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce erosion. Use of straw, manure, or other waste material as a mulch reduces soil blowing, helps to maintain or improve the organic matter content, and conserves moisture. Seedbeds should be prepared when irrigation water is available to keep the soil surface moist. Vegetative barriers and shelterbelts can be used to control soil blowing.

This unit is well suited to homesite development. Soil blowing can be a problem on large construction sites; therefore, these sites should be disturbed as little as possible. Cutbanks are not stable and subject to caving in.

The main limitation for septic tank absorption fields is seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage.

This map unit is in capability subclass IVe, irrigated.

96—Renslow silt loam, 5 to 15 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 2,500 to 2,800. The average annual precipitation is 10 to 13 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsoil is grayish brown and brown silt loam about 23 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas basalt is at a depth of more than 40 inches.

Included in this unit are areas of Starbuck, Mikkalo, and Willis soils and areas of Renslow soils that have slopes of less than 5 percent.

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

This unit is used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitations for nonirrigated crops are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is suited to homesite development. The main limitation is steepness of slope. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, steepness of slope can cause lateral seepage and surfacing of effluent in downslope areas. Lateral seepage can be reduced by installing absorption lines on the contour or across the slope.

This map unit is in capability subclass IIIe, nonirrigated.

97—Renslow silt loam, basalt substratum, 0 to 5 percent slopes. This deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 2,500 to 2,800 feet. The average annual precipitation is 10 to 13 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsoil is grayish brown and brown silt loam about 23 inches thick. The substratum is pale brown silt loam about 14 inches thick. Basalt is at a depth of about 44 inches. Depth to basalt ranges from 40 to 60 inches. In some areas basalt is at a depth of more than 60 inches.

Included in this unit are areas of Mikkalo, Rock Creek, Starbuck, and Ritzville soils.

Permeability of this Renslow soil is moderate. Available water capacity is high. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight.

This unit is used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitations for nonirrigated crops are the low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, shaping and seeding waterways to perennial grass, using terraces and diversions, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in a few places to stabilize the flow of runoff in waterways.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. This unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is suited to homesite development. The main limitation for homesites is the moderate depth to bedrock, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, the moderate depth to bedrock limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation. In areas where the bedrock is fractured, contamination of ground water by unfiltered effluent is possible.

This map unit is in capability subclass IIIe, nonirrigated.

98—Renslow silt loan, basalt substratum, 5 to 15 percent slopes. This deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 2,500 to 2,800 feet. The average annual precipitation is 10 to 13 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsoil is grayish brown and brown silt loam about 23 inches thick. The substratum is pale brown silt loam about 14 inches thick. Basalt is at a depth of 44 inches. Depth to basalt ranges from 40 to 60 inches. In some areas basalt is at a depth of more than 60 inches.

Included in this unit are areas of Mikkalo, Ritzville, Rock Creek, Starbuck, and Willis soils.

Permeability of this Renslow soil is moderate. Available water capacity is high. Effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces and diversions, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is suited to homesite development. The main limitations are moderate depth to bedrock and steepness of slope. The bedrock hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are moderate depth to bedrock and steepness of slope. The moderate depth to bedrock limits the capacity of the absorption fields. Slope can cause lateral seepage and

surfacing of effluent in downslope areas. Absorption lines should be placed on the contour or across the slope. Where the bedrock is fractured, contamination of ground water by unfiltered effluent is possible.

This map unit is in capability subclass IIIe, nonirrigated.

99—Ritzville silt loam, 2 to 5 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsoil is brown or pale brown silt loam about 30 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown and pale brown silt loam. In some areas basalt, a hardpan, or old alluvium is at a depth of more than 40 inches.

Included in this unit are small areas of Mikkalo, Selah, Willis, Harwood, Esquatzel, and Tieton soils and areas of Ritzville soils that have slopes of less than 2 percent.

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

This unit is used for irrigated and nonirrigated field and orchard crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are asparagus, corn, grain, grapes, hops, mint, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is the hazard of water erosion. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If furrow or corrugation systems are used, runs should be on the contour or across the slope. The risk of erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from over irrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Growing mint in meadows rather than in rows greatly reduces water erosion. A plowpan develops in the soil in this unit; however, it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by shaping waterways and seeding them to perennial grass. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in a few places to stabilize the flow of runoff in waterways.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is well suited to homesite development. Dustiness can be a problem during construction on large building sites. Therefore, these sites should be disturbed as little as possible.

This unit has few limitations for septic tank absorption fields.

This map unit is in capability subclasses IIe, irrigated and IIIe, nonirrigated.

100—Ritzville silt loam, 5 to 8 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsoil is brown or pale brown silt loam about 30 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown and pale brown silt loam. In some areas basalt, a hardpan, or old alluvium is at a depth of more than 40 inches.

Included in this unit are small areas of Selah, Willis, Harwood, and Tieton soils.

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

This unit is used for irrigated field and orchard crops and as rangeland, wildlife habitat, and homesites. The main irrigated crops are corn, grain, grapes, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Cover crops are needed in orchards and vineyards to reduce erosion. A plowpan develops in the soil in this unit; however, it can be broken by chiseling or subsoiling when the soil is dry.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. This unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is well suited to homesite development. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This map unit is in capability subclass IIIe, irrigated and nonirrigated.

101—Ritzville silt loam, 8 to 15 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsoil is brown or pale brown silt loam about 30 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown and pale brown silt loam. In some areas basalt, a hardpan, or old alluvium is at a depth of more than 40 inches.

Included in this unit are areas of Selah, Willis, Harwood, and Tieton soils, areas of Rock outcrop, and areas of Ritzville soils that have slopes of less than 8 percent.

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

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain, grasses, legumes, grapes, and tree fruit. A cover crop is grown in orchards.

The main limitations for irrigated crops are steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Tillage should be across the slope or on the contour. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Growing annual or perennial cover crops reduces erosion in orchards and vineyards. A plowpan develops in the soil in this unit; however, it can be broken by chiseling or subsoiling when the soil is dry.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is suited to homesite development. The main limitation is steepness of slope. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is steepness of slope, which can cause lateral seepage and surfacing of effluent in downslope areas. Absorption lines should be installed on the contour or across the slope.

This map unit is in capability subclasses IVe, irrigated, and IIIe, nonirrigated.

102—Ritzville silt loam, 15 to 30 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsoil is brown or pale brown silt loam about 30 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown and pale brown silt loam. In some areas basalt, a hardpan, or old alluvium is at a depth of more than 40 inches.

Included in this unit are small areas of Selah, Willis, Harwood, and Tieton soils.

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

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain, grasses, legumes, grapes, and tree fruit (fig. 4). A cover crop is grown in orchards.

The main limitations for irrigated crops are steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Growing perennial cover in orchards and vineyards reduces erosion. A plowpan develops in the soil in this unit; however, it can be broken by chiseling or subsoiling when the soil is dry.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces, and divided-slope farming. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable shrubs can be improved by such methods as railing, chaining, beating, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is steepness of slope. Dustiness can

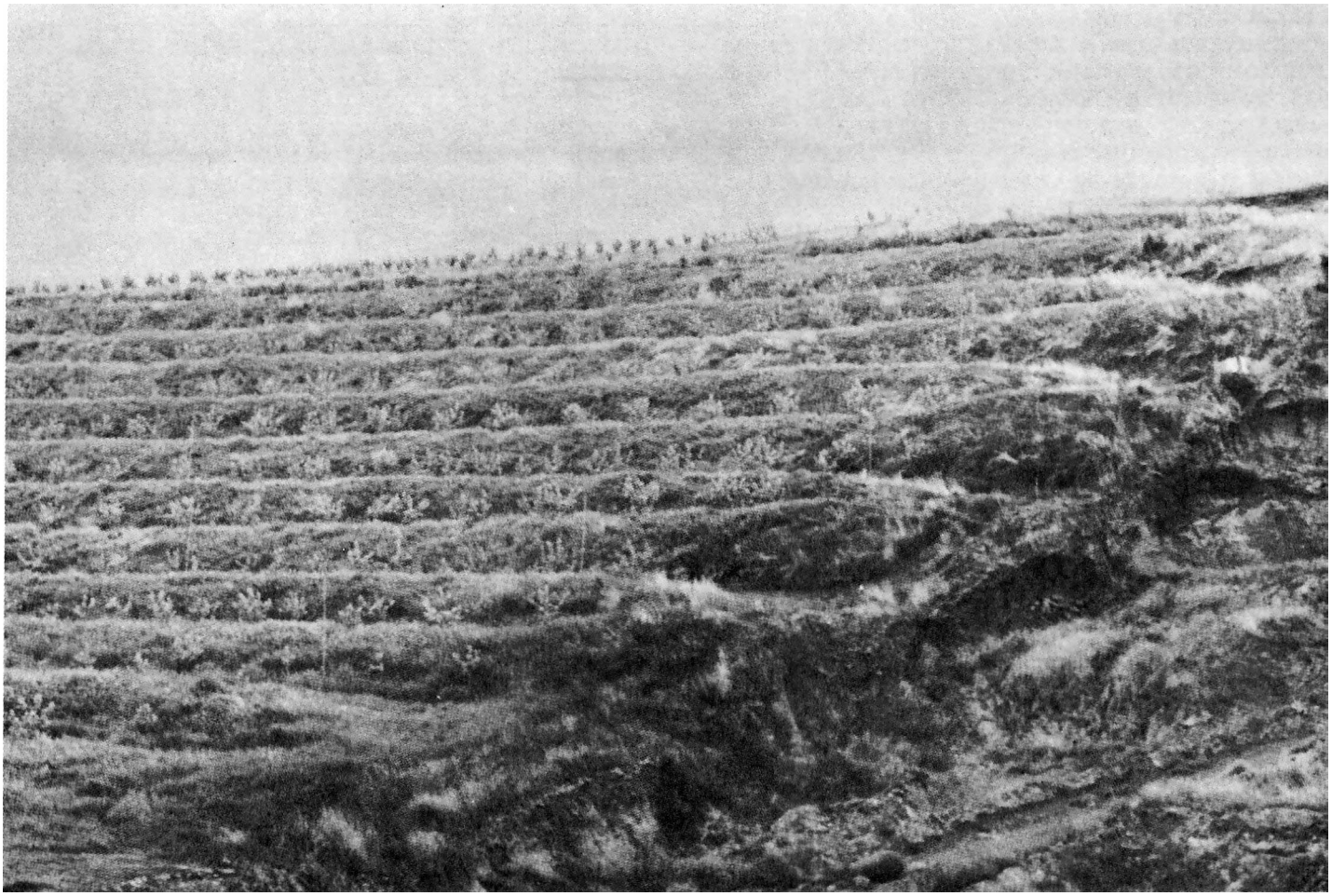


Figure 4.—New fruit trees on terraces of Ritzville silt loam, 15 to 30 percent slopes.

be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is steepness of slope. Slope can cause lateral seepage and surfacing of effluent in downslope areas. Lateral seepage can be reduced by installing absorption lines on the contour or across the slope.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

103—Ritzville silt loam, 30 to 60 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsoil is brown or pale brown silt loam about 30 inches thick. The substratum to a depth of 60 inches or more is light yellowish brown and pale brown silt loam. In some areas the surface layer is calcareous.

Included in this unit are Mikkalo, Starbuck, Willis, and Kiona soils. Included areas make up about 15 percent of the total acreage.

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

This unit is used as rangeland and for wildlife habitat.

The potential vegetation is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and big sagebrush. If the range is overgrazed the proportion of preferred forage plants such as bluebunch wheatgrass

and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Proper location of salt licks, stock water tanks, and fences promotes uniform distribution of grazing.

Areas that are heavily infested with undesirable vegetation can be improved by chemical treatment and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. Use of equipment may be difficult in the more steeply sloping areas. The unit should be seeded in fall using aerial methods. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIIe, nonirrigated.

104—Ritzville silt loam, basalt substratum, 0 to 5 percent slopes. This deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsoil is brown or pale brown silt loam about 30 inches thick. The substratum is light yellowish brown silt loam about 8 inches thick. Basalt is at a depth of about 45 inches. Depth to bedrock ranges from 40 to 60 inches. In some areas a lime- and silica-cemented hardpan is at a depth of more than 40 inches, and in some areas depth to basalt is 60 inches or more.

Included in this unit are small areas of Mikkalo, Willis, and Esquatzel soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Ritzville soil is moderate. Available water capacity is high. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight.

This unit is used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, and shaping waterways and seeding them to perennial grass. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in a few places to stabilize the flow of runoff in waterways.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is suited to homesite development. The main limitation is moderate depth to rock, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is moderate depth to rock, which limits the capacity of the absorption fields. The use of long absorption lines helps to compensate for this limitation. Where the bedrock is fractured, contamination of ground water by unfiltered effluent is possible.

This map unit is in capability subclass IIIe, nonirrigated.

105—Ritzville silt loam, basalt substratum, 5 to 15 percent slopes. This deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsoil is brown or pale brown silt loam about 30 inches thick. The substratum is light yellowish brown silt loam about 8 inches thick. Basalt is at a depth of about 45 inches. Depth to basalt ranges from 40 to 60 inches. In some areas a lime- and silica-cemented hardpan is at a depth of more than 40 inches, and in some areas depth to basalt is 60 inches or more.

Included in this unit are areas of Mikkalo and Willis soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Ritzville soil is moderate. Available water capacity is high. Effective rooting depth is 40 to 50 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

This main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces

erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbit brush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is suited to homesite development. The main limitations are steepness of slope and depth to rock, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are depth to rock and steepness of slope. The depth to rock restricts the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation. Where the bedrock is fractured, contamination of ground water by unfiltered effluent is possible. Slope can cause lateral seepage and surfacing of effluent in downslope areas. Lateral seepage can be reduced by installing absorption lines on the contour or across the slope.

This map unit is in capability subclass IIIe, nonirrigated.

106—Ritzville silt loam, basalt substratum, 15 to 30 percent slopes. This deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsoil is brown or pale brown silt loam about 30 inches thick. The substratum is light yellowish brown silt loam about 8 inches thick. Basalt is at a depth of about 45 inches. Depth to basalt ranges from 40 to 60 inches. In some areas a lime- and silica-cemented hardpan is at a depth of more than 40 inches, and in some areas depth to basalt is 60 inches or more.

Included in this unit are areas of Mikkalo and Willis soils. Included areas make up about 15 percent of the total acreage.

Permeability of this Ritzville soil is moderate. Available water capacity is high. Effective rooting depth is 40 to 60 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, divided-slope farming, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is steepness of slope. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is steepness of slope, which can cause lateral seepage and surfacing of effluent in downslope areas. Lateral seepage can be reduced by installing absorption lines on the contour or across the slope. Where the underlying basalt is fractured, contamination of ground water by unfiltered effluent is possible.

This map unit is in capability subclass IVe, nonirrigated.

107—Ritzville Variant silt loam, 5 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in loess overlying cobbly or gravelly alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 1,800 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is brown silt loam about 7 inches thick. The subsoil is pale brown silt loam about 11 inches thick. The upper part of the substratum is pale brown gravelly silt loam about 10 inches thick, and the

lower part to a depth of 60 inches or more is pale brown and light gray very cobbly loam.

Included in this unit are areas of Ritzville and Willis soils.

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

This unit is used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is suited to homesite development. The main limitation for homesites is steepness of slope. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, slope can cause lateral seepage and surfacing of effluent in downslope areas. Lateral seepage can be avoided by installing absorption lines on the contour.

This map unit is in capability subclass IIIe, nonirrigated.

108—Ritzville Variant cobbly silt loam, 5 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in loess overlying cobbly alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 1,800 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is brown cobbly silt loam about 7 inches thick. The subsoil is pale brown cobbly silt loam about 11 inches thick. The upper part of the substratum is pale brown gravelly silt loam about 10 inches thick, and the lower part to a depth of 60 inches or more is pale brown and light gray very cobbly loam.

Included in this unit are areas of Ritzville, Willis, and Kiona soils.

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

This unit is used as rangeland, wildlife habitat, and homesites.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Removal of stones might be necessary. Adapted grasses and legumes should be seeded.

This unit is suited to homesite development. The main limitation for homesites is steepness of slope. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, slope can cause lateral seepage and surfacing of effluent in downslope areas. Lateral seepage can be reduced by installing absorption lines on the contour or across the slope.

This map unit is in capability subclass IVe, nonirrigated.

109—Rock Creek very stony silt loam, 0 to 30 percent slopes. This shallow, well drained soil is on plateaus and ridgetops. It formed in loess and in residuum derived from basalt. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 3,200 feet. The average annual precipitation is 12 to 16 inches, the average annual air temperature is about 48 degrees F, and the average frost-free season is 120 to 170 days.

Typically, the surface layer is grayish brown very stony silt loam about 2 inches thick. The subsoil is brown very cobbly clay about 8 inches thick. Basalt is at a depth of about 10 inches. Depth to basalt ranges from 8 to 15 inches. In some areas the surface layer is stony.

Included in this unit are areas of McDaniel, Gorst, Clint, Taneum, and Simcoe soils and areas of Rock outcrop.

Permeability of this Rock Creek soil is moderately slow. Available water capacity is low. Effective rooting depth is 8 to 15 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland, wildlife habitat, and homesites.

The potential native vegetation is mainly Sandberg bluegrass, stiff sagebrush, and eriogonum. The main limitations for the production of forage are depth to rock and low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as stiff sagebrush and Sandberg bluegrass decreases and the proportion of less preferred forage plants such as forbs and annual grasses increases. Areas that are heavily infested with undesirable vegetation can be improved by chemical treatment.

This unit is poorly suited to homesite development. The main limitations are shallow depth to bedrock, large stones, and steepness of slope. Bedrock hinders excavation. Removal of the large stones is needed for best results when landscaping, particularly in areas used for lawns.

The main limitations for septic tank absorption fields are shallow depth to bedrock, steepness of slope, and large stones. The shallow depth to bedrock limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation. Absorption lines should be placed on the contour or across the slope. The large stones can interfere with the location of these lines.

This map unit is in capability subclass VIIs, nonirrigated.

110—Rock Creek-Clint-Simcoe complex, 0 to 45 percent slopes. This map unit is on uplands. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 2,000 to 3,300 feet. The average annual precipitation is 10 to 18 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 120 to 135 days.

This unit is about 40 percent Rock Creek very stony silt loam, about 20 percent Clint very stony loam, and about 20 percent Simcoe silt loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Harwood soils that have slopes of less than 25 percent. Also included are areas of McDaniel and Taneum soils. Included areas make up about 20 percent of the total acreage.

The Rock Creek soil is very shallow and shallow and is well drained. It formed in loess and in residuum derived from basalt. Typically, the surface layer is grayish brown very stony silt loam about 2 inches thick. The subsoil is brown very cobbly clay about 8 inches thick. Basalt is at a depth of about 10 inches Depth to bedrock ranges from 8 to 15 inches. In some areas the surface layer is stony.

Permeability of the Rock Creek soil is moderately slow. Available water capacity is low. Effective rooting depth is 8 to 15 inches. Runoff is rapid, and the hazard of water erosion is high.

The Clint soil is moderately deep and well drained. It formed in loess and in residuum derived from basalt. Typically, the upper part of the surface layer is reddish brown very stony loam about 6 inches thick, and the lower part is reddish brown gravelly loam about 4 inches thick. The subsoil is reddish brown very gravelly loam about 9 inches thick. The substratum is dark brown extremely gravelly loam about 9 inches thick. Fractured basalt is at a depth of about 28 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is stony.

Permeability of the Clint soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

The Simcoe soil is moderately deep and well drained. It formed in loess and in residuum derived from basalt. Typically, the surface layer is brown silt loam about 3 inches thick. The subsoil is brown silt loam about 24 inches thick. Basalt is at a depth of about 27 inches. Depth to basalt ranges from 20 to 40 inches.

Permeability of the Simcoe soil is moderately slow. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation of the Rock Creek soil is mainly stiff sagebrush, Sandberg bluegrass, and eriogonum. If the range is overgrazed, the proportion of preferred forage plants such as stiff sagebrush and Sandberg bluegrass decreases and the proportion of less preferred forage plants such as forbs and annual grasses increases.

The potential native vegetation of the Clint soil is mainly bluebunch wheatgrass, Idaho fescue, and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

The potential native vegetation of the Simcoe soil is mainly bluebunch wheatgrass and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases.

The main limitations for the production of forage is the very stony surface layer of the Rock Creek and Clint soils. Areas of the Clint and Simcoe soils that are heavily infested with undesirable vegetation can be improved with such methods as chaining, chemical treatment, and prescribed burning. Care should be taken during brush control not to disturb the very shallow Rock Creek soil.

Range seeding on the Rock Creek soil is not feasible because of the very shallow and shallow depth to rock and low available water capacity. Seeding is difficult because of the stoniness of the Clint soil and the predominance of the Rock Creek soil between mounds of the Clint and Simcoe soils. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIIs, nonirrigated.

111—Roza clay loam, 5 to 8 percent slopes. This very deep, well drained soil is on uplands. It formed in material derived from fine-textured sediment. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,300 to 1,800 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 51 degrees F, and the frost-free season is 135 to 150 days.

Typically, the surface layer is grayish brown clay loam about 2 inches thick. The upper part of the subsoil is grayish brown clay loam about 9 inches thick, and the lower part is light brownish gray silty clay about 8 inches thick. The substratum to a depth of 60 inches or more is light brownish gray, pale brown, and light gray silty clay, silty clay loam, and clay loam. Vertical cracks 1/2- to 1-inch wide extend from the surface to a depth of about 19 inches. In some areas the soil is underlain by sandstone, and in some areas the soil has an intermittent hardpan.

Included in this unit are areas of Selah, Cowiche, and Cleman soils. Included areas make up about 25 percent of the total acreage.

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

This unit is used for irrigated field and orchard crops, for wildlife habitat, and as homesites. The main irrigated crops are grain and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are the slow permeability and steepness of slope. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. As the moisture content of the soil increases, the clay in this soil expands and the water infiltration rate is reduced. Irrigation water, therefore, should be applied at a slow rate over a long period of time to insure that the root zone is properly wetted. This also helps to control erosion and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

When the soil in this unit is excessively moist, operation of equipment increases the possibility of soil compaction, development of a plowpan, and formation of large clods at the surface. If the soil is compacted, it can be chiseled or subsoiled when dry. Seedbed preparation and seeding should be done when the soil is dry. Applications of irrigation water should follow if needed.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Cover crops should be grown in orchards and vineyards to reduce erosion.

This unit is poorly suited to homesite development. The main limitation is shrink-swell potential, which can damage footings and foundations. Properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation.

This map unit is in capability subclass IIIe, irrigated.

112—Roza clay loam, 8 to 15 percent slopes. This very deep, well drained soil is on uplands. It formed in material derived from fine-textured sediment. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,300 to 1,800 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is about 135 to 150 days.

Typically, the surface layer is grayish brown clay loam about 2 inches thick. The upper part of the subsoil is grayish brown clay loam about 9 inches thick, and the lower part is light brownish gray silty clay about 8 inches thick. The substratum to a depth of 60 inches or more is light brownish gray, pale brown, and light gray silty clay, silty clay loam, and clay loam. Vertical cracks 1/2- to 1-inch wide extend from the surface to a depth of 19 inches. In some areas the soil is underlain by sandstone, and in some areas the soil has an intermittent hardpan.

Included in this unit are areas of Selah, Cowiche, and Cleman soils and areas of Roza soils that have slopes of less than 8 percent. Included areas make up about 25 percent of the total acreage.

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

This unit is used for irrigated field and orchard crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are steepness of slope and slow permeability. Sprinkler and drip

irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. As the moisture content of the soil increases, the clay in this soil expands and the water infiltration rate is reduced. Irrigation water, therefore, should be applied at a slow rate over a long period of time to insure that the root zone is properly wetted. This also helps to control erosion and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

The soil in this unit should be cultivated when dry to reduce the possibility of soil compaction, development of a plowpan, and formation of large clods at the surface. If the soil is compacted, it can be chiseled or subsoiled when dry. Seedbed preparation and seeding should be done when the soil is dry. Applications of irrigation water should follow if needed.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Cover crops can be grown in orchards and vineyards to reduce erosion.

The potential native vegetation is mainly bluebunch wheatgrass, Cusick bluegrass, and spiny hopsage. The unit has few limitations for the production of forage. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rubber rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved with such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded just before the rains in fall using a drill. Because of the possibility of soil compaction and formation of large clods at the surface, the soil in this unit should be tilled when dry. Seedbed preparation and seeding can be done when the soil is dry. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is shrink-swell potential, which can damage footings or foundations. Properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is slow permeability. Use of sandy backfill for the trench and long absorption lines help to compensate for this limitation. Slope can cause lateral seepage and surfacing of the effluent in downslope areas. Absorption lines should be placed on the contour or across the slope.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

113—Roza clay loam, 15 to 30 percent slopes. This very deep, well drained soil is on uplands. It formed in material derived from fine-textured sediment. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,300 to 2,400 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is grayish brown clay loam about 2 inches thick. The upper part of the subsoil is grayish brown clay loam about 9 inches thick, and the lower part is light brownish gray silty clay about 8 inches thick. The substratum to a depth of 60 inches or more is light brownish gray, pale brown, and light gray silty clay, silty clay loam, and clay loam. Vertical cracks 1/2- to 1-inch wide extend from the surface to a depth of about 19 inches. In some areas the soil is cobbly throughout, in some areas the soil is underlain by sandstone, and in some areas the soil has an intermittent hardpan.

Included in this unit are areas of Selah, Cowiche, and Cleman soils. Included areas make up about 25 percent of the total acreage.

Permeability of this Roza soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated field and orchard crops, rangeland, wildlife habitat, and homesites. The main irrigated crop is tree fruit. A cover crop is grown in orchards. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are steepness of slope and slow permeability. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. As the moisture content of the soil increases, the clay in this soil expands and the water infiltration rate is reduced. Irrigation water, therefore, should be applied at a slow rate over a long period of time to insure that the root zone is properly wetted. This also helps to control erosion and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

When moist, the soil in this unit should not be cultivated because of the possibility of soil compaction, development of a plowpan, formation of large clods at the surface, and an extremely slippery soil condition. Where the soil is compacted, it can be chiseled or subsoiled when dry. Seedbed preparation and seeding

should be done when the soil is dry. Applications of irrigation water should follow if needed.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Cover crops can be grown in orchards and vineyards to reduce erosion.

The potential native vegetation is mainly bluebunch wheatgrass, Cusick bluegrass, and spiny hopsage. This unit has few limitations for the production of forage. If the range is overgrazed, the proportion of undesirable forage plants such as big sagebrush and rubber rabbitbrush increases.

Areas that are heavily infested with undesirable vegetation can be improved with such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. When moist, the soil in this unit should not be tilled because of the possibility of soil compaction and formation of large clods at the surface. Seedbed preparation and seeding should be done when the soil is dry. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are shrink-swell potential and steepness of slope. Shrinking and swelling of the soil in this unit can damage footings and foundations. Properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are steepness of slope and slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for the slow permeability. Slope can cause lateral seepage and surfacing of the effluent in downslope areas.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

114—Roza clay loam, 30 to 60 percent slopes. This very deep, well drained soil is on uplands. It formed in fine-textured sediment. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,300 to 2,400 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is grayish brown clay loam about 2 inches thick. The upper part of the subsoil is grayish brown clay loam about 9 inches thick, and the lower part is light brownish gray silty clay about 8 inches thick. The substratum to a depth of 60 inches or more is light brownish gray silty clay and silty clay loam. Vertical cracks 1/2- to 1-inch wide extend from the surface to a depth of about 19 inches. In some areas the soil is cobbly throughout, in some areas the soil is underlain by sandstone at a depth of 40 to 60 inches, and in some areas the soil has an intermittent hardpan.

Included in this unit are areas of Taneum soils, areas of Roza soils that have slopes of less than 30 percent, and areas of eroded soils.

Permeability of this Roza soil is slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very high.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly bluebunch wheatgrass, Cusick bluegrass, and spiny hopsage. The main limitation for the production of forage is steepness of slope, which limits access and promotes overgrazing of the less sloping areas. The distribution of grazing in the steeply sloping areas of this unit can be improved by proper location of salt licks, stock watering facilities, and management fences.

If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rubber rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved with such methods as chemical treatment and prescribed burning. Aerial range seeding is a suitable practice if the range vegetation is in poor condition. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIIe, nonirrigated.

115—Rubble land-Rock outcrop association. This map unit is in canyons and on steep mountainsides and escarpments. The native vegetation is scattered grasses and shrubs. Elevation is 2,400 to 7,000 feet. The average annual precipitation is 18 to 50 inches, the average annual air temperature is about 43 degrees F, and the average frost-free season is 95 to 130 days.

This unit is about 70 percent Rubble land and 15 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 10 percent Sapkin and Bocker soils and about 5 percent Jumpe, Sutkin, and Naxing soils. Also included, on south-facing mountainsides between Darland Mountain and Klickitat Meadows, are areas that are about 70 percent Rock outcrop.

Rubble land consists of areas of cobbles and boulders on mountain toe slopes and areas of stone strips on steep mountainsides. It commonly is below areas of Rock outcrop and is mainly free of vegetation.

Rock outcrop is areas of exposed basalt.

This unit is used for wildlife habitat.

Most areas of the unit support mosses and lichens. Grazing is limited by low production and by the difficulty of animal movement. Production of timber is very limited.

Timber harvesting is restricted by stones and cobbles. Rubble land is a good source of material for road ballast.

This map unit is in capability subclass VIIIs, nonirrigated.

116—Sapkin very stony loam, 10 to 45 percent slopes. This moderately deep, well drained soil is on uplands and mountainsides. It formed in colluvium and residuum that are derived from basalt and contain small amounts of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 3,200 to 5,000 feet. The average annual precipitation is 18 to 35 inches, the average annual air temperature is about 43 degrees F, and the average frost-free season is 95 to 130 days.

Typically, the upper part of the surface layer is dark grayish brown very stony loam about 7 inches thick, and the lower part is brown loam about 8 inches thick. The upper part of the subsoil is brown cobbly loam about 12 inches thick, and the lower part is brown very cobbly loam and extremely cobbly clay loam about 8 inches thick. Basalt is at a depth of about 35 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are areas of Bocker, Jumpe, and Sutkin soils; areas of Rock outcrop and Rubble land; and small convex areas of Sapkin soils that have slopes of 45 to 75 percent. Included areas make up about 10 percent of the total acreage.

Permeability of this Sapkin soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly Idaho fescue, bluebunch wheatgrass, buckwheat, and threetip sagebrush. The production of forage is limited by the very stony surface layer. If the range is overgrazed, the proportion of preferred forage plants such as Idaho fescue and bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as threetip sagebrush and cheatgrass increases.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill.

This unit is limited for livestock watering ponds and other water impoundments because of moderate depth to bedrock. Water tanks, springs, wells, and pipelines are more suitable for providing stock water.

This map unit is in capability subclass VIIs, nonirrigated.

117—Sapkin very stony loam, 45 to 75 percent slopes. This moderately deep, well drained soil is on uplands and mountainsides. It formed in colluvium and residuum that are derived dominantly from basalt and contain small amounts of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 3,200 to 5,000 feet. The average annual precipitation is 18 to 35 inches, the average annual air temperature is about 43 degrees F, and the average frost-free season is 95 to 130 days.

Typically, the upper part of the surface layer is dark grayish brown very stony loam about 7 inches thick. The lower part is brown loam about 8 inches thick. The upper part of the subsoil is brown cobbly loam about 12 inches thick, and the lower part is brown very cobbly loam and extremely cobbly clay loam about 8 inches thick. Basalt is at a depth of about 35 inches. Depth to basalt ranges from 20 to 40 inches.

Included in this unit are areas of Jumpe, Sutkin, and Bocker soils; areas of Rock outcrop and Rubble land; and small concave areas of Sapkin soils, on toe slopes and in convex areas on ridgetops, that have slopes of 10 to 45 percent. Included areas make up about 15 percent of the total acreage.

Permeability of this Sapkin soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly Idaho fescue, bluebunch wheatgrass, and threetip sagebrush. The main limitation for the production of forage is the presence of large stones. If the range is overgrazed, the proportion of preferred forage plants such as Idaho fescue and bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as threetip sagebrush and cheatgrass increases.

Steepness of slope promotes overgrazing of the less sloping areas. Proper location of salt licks, stock water tanks, and fences promote more uniform distribution of grazing. Brush control is largely limited to aerial application of chemicals or to prescribed burning because of steepness of slope and stoniness. Seeding is hindered by stones on the surface and steepness of slope. Adapted grasses and legumes should be seeded.

This unit is limited for livestock watering ponds and other water impoundments because of moderate depth to bedrock. Water tanks, springs, wells, and pipelines are more effective means for providing stock water.

This map unit is in capability subclass VIIs, nonirrigated.

118—Sapkin-Rubble land complex, 30 to 75 percent slopes. This map unit is on mountainsides. Slope is dominantly about 45 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 2,800 to 5,600 feet. The average annual precipitation is 18 to 35 inches, the average annual air temperature is about 43 degrees F, and the average frost-free season is 95 to 130 days.

This unit is about 60 percent Sapkin very stony loam and about 30 percent Rubble land. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Sutkin and Bocker soils and areas of Rock outcrop. Included areas make up about 10 percent of the total acreage.

The Sapkin soil is moderately deep and well drained. It formed in residuum and colluvium derived dominantly from basalt and containing small amounts of loess. Typically, the upper part of the surface layer is dark grayish brown very stony loam about 7 inches thick. The lower part is brown loam about 8 inches thick. The upper part of the subsoil is brown cobbly loam about 12 inches thick, and the lower part is brown very cobbly loam and extremely cobbly clay loam about 8 inches thick. Basalt is at a depth of about 35 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the subsoil is clay loam, and in some areas bedrock is at a depth of more than 40 inches.

Permeability of the Sapkin soil is moderate. Available water capacity is low. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

Rubble land is areas of cobbles, stones, and boulders. It is mainly free of vegetation.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly Idaho fescue, bluebunch wheatgrass, and threetip sagebrush on the Sapkin soil. The main limitations for the production of forage are the presence of large stones and steepness of slope, which promotes overgrazing of the less sloping areas. Proper location of salt licks, stock water tanks, and fences promote more uniform distribution of grazing. If the range is overgrazed, the proportion of preferred forage plants such as Idaho fescue and bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as threetip sagebrush and cheatgrass increases.

Areas that are heavily infested with undesirable vegetation can be improved with such methods as chemical treatment and prescribed burning. Plant control is mainly limited to chemical application by air or to prescribed burning because of steepness of slope and stoniness. This unit should be seeded in fall. Adapted grasses and legumes should be seeded.

This unit is limited for livestock watering ponds and other water impoundments because of moderate depth to basalt. Water tanks, springs, wells, and pipelines are more effective means for providing stock water.

This map unit is in capability subclass VIIs, nonirrigated.

119—Saydab cobbly loam, 0 to 5 percent slopes. This moderately deep, moderately well drained soil is on smooth mountaintops and broad ridgetops. It formed in colluvium and residuum derived from basalt and containing small amounts of loess. The native vegetation is mainly conifers and grasses. Elevation is 5,500 to 7,000 feet. The average annual precipitation is 40 to 50 inches, the average annual air temperature is about 41 degrees F, and the average length of the growing season, at 28 degrees F, is 80 to 110 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1 inch thick. The upper part of the surface layer is dark brown cobbly loam about 5 inches thick, and the lower part is dark brown loam about 6 inches thick. The subsoil is yellowish brown very cobbly loam about 16 inches thick. Basalt is at a depth of about 27 inches. Depth to basalt ranges from 25 to 30 inches.

Included in this unit are areas of Naxing and Darland soils, areas of Saydab soils that have slopes of more than 15 percent, and areas of soils that have basalt at a depth of 10 to 20 inches. Included areas make up about 10 percent of the total acreage.

Permeability of this Saydab soil is moderate. Available water capacity is low. Effective rooting depth is 25 to 30 inches. Runoff is slow, and hazard of water erosion is slight.

This unit is used as grazable woodland and for wildlife habitat.

Subalpine fir and western larch are the main woodland species on this unit. Among the trees of limited extent are whitebark pine, lodgepole pine, and Engelmann spruce. On the basis of a 50-year site curve, the mean site index is 49 for western larch. Yield tables for normal, even-aged, unmanaged stands of western larch indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger at 70 years of age is 61 cubic feet per acre. The mean annual increment for trees 7.6 inches in diameter and larger at 80 years of age is 30 cubic feet per acre. On the basis of a 100-year site curve, the mean site index is 87 for lodgepole pine and 74 for subalpine fir. Yield tables for normal, even-aged, unmanaged stands of lodgepole pine at 100 years of age indicate that the mean annual increment at culmination is about 100 cubic feet per acre. However, the typical basal area of stands on this unit is about 60 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is snowpack, which hinders the use of equipment and limits access in winter. Unsurfaced roads and skid trails are soft when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Seedling establishment is the main concern in the production of timber. If seed trees are present, natural reforestation of cutover areas by subalpine fir occurs periodically. Low soil temperatures, heavy snowpack, and the short growing season limit the even distribution of natural reforestation, especially on north-facing

slopes. Because the rooting depth is restricted by underlying bedrock, trees are occasionally subject to windthrow.

The common forest understory plants are elk sedge, pinegrass, vetch, yarrow, sagebrush, currant, and dwarf huckleberry. The crown density in the areas where the woodland site index was measured is 30 percent. This unit is well suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This unit is limited for livestock watering ponds and other water impoundments because of moderate depth to bedrock. Spring developments, wells, or pipelines can be used to provide stock water.

This map unit is in capability subclass VIe, nonirrigated.

120—Scoon silt loam, 2 to 5 percent slopes. This well drained soil in on uplands. It is shallow over a lime- and silica-cemented hardpan. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 800 to 1,400 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is light brownish gray silt loam about 6 inches thick. The subsoil is light brownish gray silt loam about 4 inches thick. The substratum is light brownish gray gravelly silt loam about 6 inches thick. A hardpan is at a depth of about 16 inches. Depth to the hardpan ranges from 10 to 20 inches. The hardpan commonly is underlain by basalt, but in some areas it is underlain by sand and gravel. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Shano, Burke, Roza, and Starbuck soils, areas of Rock outcrop, and areas of Scoon soils that have slopes of less than 2 percent.

Permeability of this Scoon soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain, mint, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are depth to the hardpan, steepness of slope, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of irrigation water, reduces runoff, and minimizes the risk of erosion. Shallow depth to the pan and steepness of slope make water management extremely important. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Using a cropping system that includes close-growing, high-residue crops and growing mint in meadows rather than in rows reduce water erosion. Perennial cover crops reduce erosion in orchards.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition, but it is difficult because of low available water capacity. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation for homesites is the shallow depth to the hardpan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, the shallow depth to the pan limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation.

This map unit is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

121—Scoon silt loam, 5 to 8 percent slopes. This well drained soil is on uplands. It is shallow over a lime- and silica-cemented hardpan. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 800 to 1,400 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is light brownish gray silt loam about 6 inches thick. The subsoil is light brownish gray silt loam about 4 inches thick. The substratum is light brownish gray gravelly silt loam about 6 inches thick. A hardpan is at a depth of about 16 inches. Depth to the hardpan ranges from 10 to 20 inches. The hardpan commonly is underlain by basalt, but in some areas it is underlain by sand and gravel. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Shano, Burke, Roza, and Starbuck soils, areas of Rock outcrop, and areas of Scoon soils that have slopes of less than 5 percent.

Permeability of this Scoon soil is moderate above the hardpan and very slow through it. Available water

capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain, mint, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are depth to the hardpan, steepness of slope, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of irrigation system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Shallow soil depth and steepness of slope make water management extremely important. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Using a cropping system that includes close-growing, high-residue crops and growing mint in meadows rather than in rows reduce water erosion. Perennial cover crops are needed in orchards to reduce erosion.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition, but it is limited by low available water capacity. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation for homesites is depth to the hardpan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, the shallow depth to the hardpan limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation.

This map unit is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

122—Scoon silt loam, 8 to 15 percent slopes. This well drained soil is on uplands. It is shallow over a lime- and silica-cemented hardpan. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 800 to 1,400 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is light brownish gray silt loam about 6 inches thick. The subsoil is light brownish gray silt loam about 4 inches thick. The substratum is light brownish gray gravelly silt loam about 6 inches thick. A hardpan is at a depth of about 16 inches. Depth to the hardpan ranges from 10 to 20 inches. The hardpan commonly is underlain by basalt, but in some areas it is underlain by sand and gravel. In some areas the surface layer is very fine sandy loam.

Included in this unit are small areas of Shano, Roza, and Starbuck soils, areas of Rock outcrop, and areas of Scoon soils that have slopes of less than 8 percent or more than 15 percent.

Permeability of this Scoon soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are depth to the hardpan, steepness of slope, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of irrigation water, reduces runoff, and minimizes the risk of erosion. Shallow soil depth and steepness of slope make water management extremely important. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Perennial cover crops reduce erosion in orchards.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition, but it is difficult because of the low available water capacity. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation for homesites is shallow depth to the hardpan, which hinders excavation. Dustiness can be a

problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, the shallow depth to the hardpan limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation. Slope can cause lateral seepage and surfacing of effluent in downslope areas.

This map unit is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

123—Scoon silt loam, 15 to 30 percent slopes. This well drained soil is on uplands. It is shallow over a lime- and silica-cemented hardpan. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 800 to 1,400 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is light brownish gray silt loam about 6 inches thick. The subsoil is light brownish gray silt loam about 4 inches thick. The substratum is light brownish gray gravelly silt loam about 6 inches thick. A hardpan is at a depth of about 16 inches. Depth to the hardpan ranges from 10 to 20 inches. The hardpan commonly is underlain by basalt, but in some areas it is underlain by sand and gravel. In some areas the surface layer is very fine sandy loam.

Included in this unit are areas of Shano, Roza, and Starbuck soils, areas of Rock outcrop, and areas of Scoon soils that have slopes of less than 15 percent.

Permeability of this Scoon soil is moderate above the hardpan and very slow through it. Available water capacity is low. Effective rooting depth is 10 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated hay, pasture, and orchard crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grasses and legumes.

The main limitations for irrigated orchard, hay, and pasture crops are the shallow depth to the hardpan, steepness of slope, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Perennial cover crops reduce erosion in orchards.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved with such methods as chaining, railing, beating, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition; however, establishment of seedlings is difficult because of the low available water capacity. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are the shallow depth to the hardpan and steepness of slope. The pan hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, the main limitations are the shallow depth to the hardpan and steepness of slope. The pan limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation. Absorption lines should be installed on the contour.

This map unit is in capability subclass VIe, irrigated and nonirrigated.

124—Scooteney silt loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 1,300 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is 51 degrees F, and the average frost-free season is 135 to 170 days.

Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil is pale brown silt loam about 16 inches thick. The upper part of the substratum is light brownish gray gravelly fine sandy loam about 11 inches thick, and the lower part to a depth of 60 inches or more is light brownish gray very gravelly sandy loam. In some areas the surface layer is sandy loam.

Included in this unit are small areas of Starbuck and Esquatzel soils.

Permeability of this Scooteney soil is moderate. Available water capacity is moderately high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight.

This unit is used for irrigated crops, wildlife habitat, and homesites. The main irrigated crops are corn, grapes, hops, and peas. Grasses and legumes are grown for hay, pasture, and seed.

This unit has few limitations for irrigated crops. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation

permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control erosion and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is well suited to homesite development. Dustiness may be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This unit has few limitations for septic tank absorption fields.

This map unit is in capability subclass IIs, irrigated.

125—Scooteney silt loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 1,300 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is 51 degrees F, and the average frost-free season is 135 to 170 days.

Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil is pale brown silt loam about 16 inches thick. The upper part of the substratum is light brownish gray gravelly fine sandy loam about 11 inches thick, and the lower part to a depth of 60 inches or more is light brownish gray very gravelly sandy loam. In some areas the surface layer is sandy loam, and in some areas the subsoil and substratum are gravelly.

Included in this unit are small areas of Finley, Scoon, Burke, and Esquatzel soils and Scooteney soils that have slopes of more than 5 percent.

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

This unit is used for irrigated and nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are corn, grain, grapes, hops, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is the hazard of water erosion. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. The risk of erosion can be minimized by keeping runs short.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control erosion and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, and shaping and seeding waterways to perennial grass. Drop structures are needed in a few places to stabilize the flow of runoff in waterways.

The potential native vegetation is mainly bluebunch wheatgrass, Sandberg bluegrass, Thurber needlegrass, and big sagebrush. If the range is overgrazed, the proportion of less preferred forage plants such as balsamroot and big sagebrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is well suited to homesite development. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This unit has few limitations for septic tank absorption fields.

This map unit is in capability subclass IIe, irrigated and IVe, nonirrigated.

126—Scooteney silt loam, 5 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 1,300 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is 51 degrees F, and the average frost-free season is 135 to 170 days.

Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil is pale brown silt loam about 16 inches thick. The upper part of the substratum is light brownish gray gravelly fine sandy loam about 11 inches thick, and the lower part to a depth of 60 inches or more is light brownish gray very gravelly sandy loam. In some areas the surface layer is sandy loam, and in some areas the subsoil and substratum are gravelly.

Included in this unit are small areas of Finley, Scoon, and Burke soils and Scooteney soils that have slopes of more than 15 percent.

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

This unit is used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, shaping waterways and seeding them to perennial grass, using terraces, and stripcropping. Drop structures are needed in a few places to stabilize the flow of runoff in waterways.

The potential native vegetation is mainly bluebunch wheatgrass, Sandberg bluegrass, Thurber needlegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as balsamroot and big sagebrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is suited to homesite development. The main limitation for homesites is steepness of slope. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, slope can cause lateral seepage of effluent and subsequent surfacing in downslope areas. Absorption lines should be installed on the contour or across the slope.

This map unit is in capability subclass IVe, nonirrigated.

127—Scooteney cobbly silt loam, 0 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 1,300 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is 51 degrees F, and the average frost-free season is 135 to 170 days.

Typically, the surface layer is brown cobbly silt loam about 6 inches thick. The subsoil is pale brown silt loam about 16 inches thick. The upper part of the substratum is light brownish gray gravelly fine sandy loam about 11 inches thick, and the lower part to a depth of 60 inches or more is light brownish gray very gravelly sandy loam. In some areas the surface layer is sandy loam, silt loam, or gravelly silt loam.

Included in this unit are areas of Finley and Esquatzel soils.

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

This unit is used as rangeland, wildlife habitat, and homesites.

The potential native vegetation is mainly bluebunch wheatgrass, Sandberg bluegrass, and Thurber needlegrass. The main limitation for the production of forage is low annual precipitation. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as balsamroot and big sagebrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chemical treatment and prescribed burning. Seedbed preparation can be difficult because of cobbles. Removal of the cobbles might be necessary. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is well suited to homesite development. It has few limitations. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This unit has few limitations for septic tank absorption fields.

This map unit is in capability subclass VIe, nonirrigated.

128—Selah silt loam, 2 to 5 percent slopes. This well drained soil is on high dissected terraces. It is moderately deep over a lime- and silica-cemented

hardpan. It formed in loess and old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,100 to 1,800 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 52 degrees F, and the average frost-free season is 150 to 180 days.

Typically, the surface layer is grayish brown and brown silt loam about 7 inches thick. The subsoil is pale brown, light brownish gray, and brown silt loam and silty clay loam about 27 inches thick. A lime- and silica-cemented hardpan is at a depth of about 34 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the hardpan is underlain by basalt, and in some areas it is underlain by sand and gravel.

Included in this unit are small areas of Willis, Ritzville, and Roza soils.

Permeability of this Selah soil is moderately slow above the hardpan and very slow through it. Available water capacity is moderately high. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, for wildlife habitat, and as homesites. The main irrigated crops are grain and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are depth to the hardpan and the hazard of water erosion. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and reduces erosion. If surface irrigation is used, erosion can be minimized by keeping runs short. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation and growing mint in meadows rather than in rows reduce water erosion. Annual or perennial cover crops reduce erosion in orchards and vineyards. A plowpan develops in the soil in this unit; however, it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is poorly suited to homesite development. The main limitation is moderate depth to the hardpan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are the moderate depth to the hardpan and slow permeability. Moderate depth to the hardpan limits the capacity of the absorption fields. Use of sandy backfill for the trench and long absorption lines helps to compensate for both of these limitations.

The map unit is in capability subclass IIe, irrigated.

129—Selah silt loam, 5 to 8 percent slopes. This well drained soil is on high dissected terraces. It is moderately deep over a lime- and silica-cemented hardpan. It formed in loess and old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,100 to 1,800 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 52 degrees F, and the average frost-free season is 150 to 180 days.

Typically, the surface layer is grayish brown and brown silt loam about 7 inches thick. The subsoil is pale brown, light brownish gray, and brown silt loam and silty clay loam about 27 inches thick. A lime- and silica-cemented hardpan is at a depth of about 34 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the hardpan is underlain by basalt, and in some areas it is underlain by sand and gravel.

Included in this unit are small areas of Willis, Ritzville, and Roza soils.

Permeability of this Selah soil is moderately slow above the hardpan and very slow through it. Available water capacity is moderately high. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, for wildlife habitat, and as homesites. The main irrigated crops are grain and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are depth to the hardpan, steepness of slope, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Growing cover crops reduces erosion in orchards and vineyards. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

This unit is poorly suited to homesite development The main limitation is moderate depth to the hardpan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are depth to the hardpan and moderately slow permeability. Depth to the hardpan limits the capacity of

the absorption fields. Use of sandy backfill for the trench and long absorption lines helps to compensate for both of these limitations.

This map unit is in capability subclass IIIe, irrigated.

130—Selah silt loam, 8 to 15 percent slopes. This well drained soil is on high dissected terraces. It is moderately deep over a lime- and silica-cemented hardpan It formed in loess and old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,100 to 1,800 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 52 degrees F, and the average frost-free season is 150 to 180 days.

Typically, the surface layer is grayish brown and brown silt loam about 7 inches thick. The subsoil is pale brown, light brownish gray, and brown silt loam and silty clay loam about 27 inches thick. A lime- and silica-cemented hardpan is at a depth of about 34 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the hardpan is underlain by basalt, and in some areas it is underlain by sand and gravel.

Included in this unit are small areas of Willis, Ritzville, and Roza soils.

Permeability of this Selah soil is moderately slow above the hardpan and very slow through it. Available water capacity is moderately high. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain, grasses, legumes, and tree fruit. A cover crop is grown in orchards.

The main limitations for irrigated crops are depth to the hardpan, steepness of slope, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Growing annual or perennial cover crops reduces erosion in orchards. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, big sagebrush, and needleandthread. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved with such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is moderate depth to the hardpan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are depth to the hardpan and the moderately slow permeability. Depth to the hardpan limits the capacity of the absorption fields. Use of sandy backfill for the trench and long absorption lines helps to compensate for both of these limitations. Slope can cause lateral seepage and surfacing of effluent in downslope areas.

This map unit is in capability subclasses IVe, irrigated, and IIIe, nonirrigated.

131—Selah silt loam, 15 to 30 percent slopes. This well drained soil is on high dissected terraces. It is moderately deep over a lime- and silica-cemented hardpan. It formed in loess and old alluvium. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,100 to 1,800 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 52 degrees F, and the average frost-free season is 150 to 180 days.

Typically, the surface layer is grayish brown and brown silt loam about 7 inches thick. The subsoil is pale brown, light brownish gray, and brown silt loam and silty clay loam about 27 inches thick. A lime- and silica-cemented hardpan is at a depth of about 34 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the hardpan is underlain by basalt, and in some areas it is underlain by sand and gravel.

Included in this unit are small areas of Willis, Ritzville, and Roza soils.

Permeability of the Selah soil is moderately slow above the hardpan and very slow through it. Available water capacity is moderately high. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain; grasses and legumes for hay, pasture, and seed; and tree fruit. A cover crop is grown in orchards.

The main limitations for irrigated crops are depth to the hardpan, steepness of slope, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Perennial cover crops are needed in orchards and vineyards to reduce erosion. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using diversions, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, big sagebrush, and needleandthread. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are moderate depth to the hardpan and steepness of slope. The hardpan hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are moderate depth to the hardpan, steepness of slope, and moderately slow permeability. The moderate depth to the hardpan limits the capacity of the absorption fields. Slope can cause lateral seepage and surfacing of the effluent in downslope areas. Use of sandy backfill for the trench and long absorption lines helps to compensate for the moderate depth to the hardpan and the moderately slow permeability.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

132—Shano silt loam, 2 to 5 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 1,200 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 170 days.

Typically, the surface layer is brown silt loam about 4 inches thick. The subsoil is pale brown silt loam about 26 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of Warden, Burke, and Esquatzel soils and areas of Shano soils that have slopes of less than 2 percent.

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

This unit is used for irrigated and nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are corn, grain, grapes, hops, mint, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is the hazard of water erosion. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. The risk of erosion can be minimized by keeping runs short. Use of sprinkler and drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rates should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes

close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Growing mint in meadows rather than in rows greatly reduces erosion. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early and stubble mulching. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in a few places to stabilize the flow of runoff in waterways.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. This unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is well suited to homesite development. It has few limitations. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This unit has few limitations for septic tank absorption fields.

This map unit is in capability subclass IIe, irrigated, and IVe, nonirrigated.

133—Shano silt loam, 5 to 8 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 1,200 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 170 days.

Typically, the surface layer is brown silt loam about 4 inches thick. The subsoil is pale brown silt loam about 26 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas the surface layer is loam.

Included in this unit are small areas of Warden and Burke soils and areas of Shano soils that have slopes of more than 8 percent.

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

This unit is used for irrigated crops and as rangeland, wildlife habitat, and homesites. The main irrigated crops are grain, grapes, peas, and mint. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Cover crops reduce erosion in orchards and vineyards. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is well suited to homesite development. It has few limitations. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This unit has few limitations for septic tank absorption fields.

This map unit is in capability subclasses IIIe, irrigated, and IVe, nonirrigated.

134—Shano silt loam, 8 to 15 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs,

and shrubs. Elevation is 650 to 1,200 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 170 days.

Typically, the surface layer is brown silt loam about 4 inches thick. The subsoil is pale brown silt loam about 26 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of Warden, Scooteney, and Burke soils and Shano soils that have slopes of less than 8 percent.

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

This unit is used for irrigated and nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain and grapes. Grasses and legumes are grown for hay, pasture, and seed. A cover crop is grown in orchards.

The main limitations for irrigated crops are steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Annual or perennial cover crops reduce erosion in orchards and vineyards. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, divided-slope farming, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is suited to homesite development. The main limitation for homesites is steepness of slope. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If the unit is used for septic tank absorption fields, steepness of slope can cause lateral seepage and surfacing of effluent in downslope areas. Absorption lines should be installed on the contour.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

135—Shano silt loam, 15 to 30 percent slopes. This very deep, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,200 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 170 days.

Typically, the surface layer is brown silt loam about 4 inches thick. The subsoil is pale brown silt loam about 26 inches thick. The substratum to a depth of 60 inches or more is pale brown silt loam.

Included in this unit are areas of Warden and Burke soils.

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

This unit is used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, divided-slope farming, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range

vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation for homesites is steepness of slope. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, steepness of slope can cause lateral seepage and surfacing of effluent in downslope areas.

This map unit is in capability subclass IVe, nonirrigated.

136—Simcoe silt loam, 5 to 15 percent slopes. This moderately deep, well drained soil is on uplands. It formed in loess and in residuum derived from basalt and a small amount of volcanic ash. Slope is dominantly about 10 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,300 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 120 to 170 days.

Typically, the surface layer is brown silt loam about 3 inches thick. The upper part of the subsoil is brown silt loam about 11 inches thick, and the lower part is brown silt loam about 13 inches thick. Basalt is at a depth of about 27 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is loam.

Included in this unit are areas of Harwood, Rock Creek, and Selah soils, areas of Rock outcrop, and areas of Simcoe soils that have slopes of more than 15 percent.

Permeability of this Simcoe soil is moderately slow. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain and tree fruit. Grasses and legumes are grown for hay, pasture, and seed. A cover crop is grown in orchards.

The main limitations for irrigated crops are steepness of slope, depth to rock, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Annual or perennial cover crops reduce erosion in orchards.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces and diversions, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is moderate depth to rock, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are moderate depth to rock and moderately slow permeability. The moderate depth to rock limits the capacity of the absorption fields. Use of sandy backfill for the trench and long absorption lines helps to compensate for the moderately slow permeability. Slope can cause lateral seepage and surfacing of effluent in downslope areas. Absorption lines should be placed on the contour or across the slope.

This map unit is in capability subclasses IVe, irrigated, and IIIe, nonirrigated.

137—Simcoe silt loam, 15 to 30 percent slopes. This moderately deep, well drained soil is on uplands. It formed in loess and in residuum derived from basalt and contains a small amount of volcanic ash. Slope is dominantly about 20 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,200 to 2,300 feet. The average annual precipitation is 10 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 120 to 170 days.

Typically, the surface layer is brown silt loam about 3 inches thick. The subsoil is brown silt loam about 24 inches thick. Basalt is at a depth of about 27 inches. Depth to basalt ranges from 20 to 40 inches. In some areas the surface layer is loam, and in some areas the subsoil is gravelly.

Included in this unit are areas of Rock Creek and Selah soils, areas of Rock outcrop, and areas of Simcoe soils that have slopes of more than 30 percent.

Permeability of this Simcoe soil is moderately slow. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain and tree fruit. Grasses and legumes are grown for hay, pasture, and seed. A cover crop is grown in orchards.

The main limitations for irrigated crops are steepness of slope, depth to rock, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Perennial cover crops reduce erosion in orchards and vineyards.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, divided-slope farming, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are moderate depth to rock and steepness of slope. The bedrock hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are moderate depth to rock, steepness of slope, and moderately slow permeability. The moderate depth to rock limits the capacity of the absorption fields. Use of sandy backfill for the trench and long absorption lines helps to compensate for the moderately slow permeability. Steepness of slope can cause lateral seepage and surfacing of the effluent in downslope areas.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

138—Sinloc fine sandy loam, 0 to 2 percent slopes. This very deep, artificially drained soil is on terraces. It formed in lacustrine sediment and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 1,200 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is dark grayish brown, strongly alkaline fine sandy loam about 3 inches thick. The subsoil is dark grayish brown, strongly alkaline silt loam about 12 inches thick. The upper part of the substratum is dark grayish brown, strongly alkaline and moderately alkaline, stratified silt loam and fine sandy loam about 30 inches thick, and the lower part to a depth of 60 inches or more is dark grayish brown, moderately alkaline loamy fine sand.

Included in this unit are areas of Warden, Hezel, Shano, Harwood, Burke, Outlook, and Wiehl soils and areas of Sinloc soils that have not been artificially drained. Included areas make up about 20 percent of the total acreage.

Permeability of this Sinloc soil is moderate. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 18 to 42 inches from May to October. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is high.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. In areas that are drained, leached of excessive salts, and irrigated, the main irrigated crops are asparagus, corn, grain, hops, mint, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are wetness and the hazard of soil blowing. Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. Use of sprinkler irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Proper timing of minimum tillage and return of crop residue to the soil reduce compaction, help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. The soil in this unit should be protected with plant cover or residue in spring when the soil is most susceptible to soil blowing. Use of straw, manure, or other waste material as a mulch also reduces soil blowing. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. A plowpan may develop in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry. Deep-rooted crops are suited to areas where a drainage system has been installed and is adequately maintained. If the drainage system is not maintained, the soil has a seasonal high water table and a high salt content during the irrigation season.

This unit is poorly suited to homesite development. The main limitation for building sites and septic tank absorption fields is wetness. Drainage is needed if roads and building foundations are constructed. Wetness can be reduced by installing drain tile around the footings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. The plants used as ground cover should be adapted to the salt- and alkali-affected condition of the soil. The seasonal high water table increases the possibility of failure of septic tank absorption fields. It also increases the risk of contaminating water supplies as a result of seepage. Cutbanks are not stable and are subject to caving in.

This map unit is in capability subclass IIIw, irrigated.

139—Sinloc silt loam, 0 to 2 percent slopes. This very deep, artificially drained soil is on terraces. It formed in lacustrine sediment and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 1,200 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is dark grayish brown, strongly alkaline silt loam about 3 inches thick. The subsoil is dark grayish brown, strongly alkaline silt loam about 12 inches thick. The upper part of the substratum is dark grayish brown, stratified, strongly alkaline and moderately alkaline silt loam and very fine sandy loam about 30 inches thick, and the lower part to a depth of 60 inches or more is dark grayish brown, moderately alkaline loamy fine sand.

Included in this unit are small areas of Warden, Hezel, Shano, Harwood, Burke, Outlook, and Wiehl soils and areas of Sinloc soils that have not been artificially drained.

Permeability of this Sinloc soil is moderate. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 18 to 42 inches from May to October. Runoff is slow, and the hazard of water erosion is slight.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. Where drained, leached of excessive salts, and irrigated, the main irrigated crops are asparagus, corn, grain, hops, mint, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is wetness. Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. Use of sprinkler irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil reduce compaction, help to maintain or improve the organic matter content, help to maintain tilth, improve the water infiltration rate, and reduce erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. A plowpan develops in the soil in this unit; however, it can be broken by chiseling or subsoiling when the soil is dry. Deep-rooted crops are suited to areas where a drainage system has been installed and is adequately maintained. If the drainage system is not maintained, the soil has a seasonal high water table during the irrigation season and has a high content of salt.

This unit is poorly suited to homesite development. The main limitation for homesites and for septic tank absorption fields is wetness. Drainage is needed if roads and building foundations are constructed. Wetness can be reduced by installing drain tile around footings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. The plants used as ground cover should be adapted to saline conditions. The seasonal high water table increases the possibility of failure of septic tank absorption fields. It also increases the risk of contaminating water supplies as a result of seepage. Cutbanks are not stable and are subject to caving in.

This map unit is in capability subclass IIIw, irrigated.

140—Sinloc silt loam, 2 to 5 percent slopes. This very deep, artificially drained soil is on terraces. It formed in lacustrine sediment and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 1,200 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is dark grayish brown, strongly alkaline silt loam about 3 inches thick. The

subsoil is dark grayish brown, strongly alkaline silt loam about 12 inches thick. The upper part of the substratum is dark grayish brown, stratified, strongly alkaline and moderately alkaline silt loam and very fine sandy loam about 30 inches thick, and the lower part to a depth of 60 inches or more is dark grayish brown, moderately alkaline loamy fine sand.

Included in this unit are small areas of Warden, Hezel, Shano, Harwood, Burke, Outlook, and Wiehl soils, areas of Sinloc soils that have not been artificially drained, and areas of Sinloc soils that have slopes of more than 5 percent.

Permeability of this Sinloc soil is moderate. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 18 to 42 inches from May to October. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. In areas that have been drained, leached of excessive salts, and irrigated, the main irrigated crops are asparagus, corn, grain, hops, mint, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are wetness and the hazard of water erosion. Deep-rooted crops are suited to areas where a drainage system has been installed. If the drainage system is not maintained, this soil has a seasonal high water table during the irrigation season and has a high content of salt. If furrow and corrugation irrigation systems are used, runs should be on the contour or across the slope. The risk of erosion can be minimized by keeping runs short. Use of a sprinkler irrigation system permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control erosion and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Tilling when the moisture content of the soil is optimal and returning crop residue to the soil reduce compaction, help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Growing mint in meadows rather than in rows greatly reduces erosion. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is poorly suited to homesite development. The main limitation for homesites and septic tank absorption fields is wetness. Drainage is needed if roads and building foundations are constructed. Wetness can be reduced by installing drain tile around the footings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. The plants used as ground cover should be adapted to saline and alkaline conditions. The seasonal high water table increases the possibility of failure of septic tank absorption fields. It also increases the risk of contaminating water supplies as a result of seepage. Cutbanks are not stable and are subject to caving in.

This map unit is in capability subclass IIIw, irrigated.

141—Sinloc silt loam, 5 to 8 percent slopes. This very deep, artificially drained soil is on terraces. It formed in lacustrine sediment. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 650 to 1,200 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is dark grayish brown, strongly alkaline silt loam about 3 inches thick. The subsoil is dark grayish brown, strongly alkaline silt loam about 12 inches thick. The upper part of the substratum is dark grayish brown, stratified, strongly alkaline and moderately alkaline silt loam and very fine sandy loam about 30 inches thick, and the lower part to a depth of 60 inches or more is dark grayish brown, moderately alkaline loamy fine sand. The soil is strongly alkaline or moderately alkaline throughout.

Included in this unit are small areas of Warden, Hezel, Shano, Harwood, Burke, and Wiehl soils and areas of Sinloc soils that have not been artificially drained.

Permeability of this Sinloc soil is moderate. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 18 to 42 inches during May to October. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated crops, wildlife habitat, and homesites. In areas that have been drained, leached of excessive salts, and irrigated, the main irrigated crops are corn, grain, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are wetness, steepness of slope, and the hazard of water erosion. Deep-rooted crops are suited to areas where a drainage system has been installed and is adequately maintained. Dikes are effective in diverting floodwater. If drainage systems are not maintained, the soil in this unit has a seasonal high water table during the irrigation season and a high content of salt.

Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of irrigation system used depends on the kind of crop grown. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical The water application rate should be reduced accordingly to help control erosion and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, improve the water infiltration rate, and reduce erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

This unit is poorly suited to homesite development. The main limitation for homesites and septic tank absorption fields is wetness. Drainage is needed if roads and building foundations are constructed. Wetness can be reduced by installing drain tile around the footings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. The plants used as ground cover should be adapted to saline conditions. The high water table increases the possibility of failure of septic tank absorption fields. It also increases the risk of contaminating water supplies as a result of seepage. Cutbanks are not stable and are subject to caving in.

This map unit is in capability subclass IIIw, irrigated.

142—Starbuck silt loam, 2 to 15 percent slopes. This shallow, well drained soil is on uplands. It formed in loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 2,000 feet. The average annual precipitation ranges from 6 to 11 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 170 days.

Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil is pale brown silt loam and gravelly silt loam about 10 inches thick. Basalt is at a depth of about 16 inches. Depth to basalt ranges from 12 to 20 inches. In some areas the surface layer is stony.

Included in this unit are areas of Scoon, Harwood, Burke, and Wiehl soils, areas of Rock outcrop, and areas of Starbuck soils that have slopes of less than 2 percent or more than 15 percent.

Permeability of this Starbuck soil is moderate. Available water capacity is low. The effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crop is grain. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are depth to rock, steepness of slope, and the hazard of water erosion. Sprinkler irrigation is suited to the soil in this unit. It permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue in the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill when the moisture content of the soil is optimum. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation for homesites is shallow depth to rock, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, shallow depth to bedrock limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation.

This map unit is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

143—Starbuck-Rock outcrop complex, 0 to 45 percent slopes. This map unit is on uplands. Slope dominantly is about 25 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 2,000 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is about 50

degrees F, and the average frost-free season is 135 to 170 days.

This unit is about 50 percent Starbuck silt loam and about 25 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Kiona, Scoon, Bakeoven, Prosser, Ritzville, Harwood, Burke, Wiehl, and Shano soils. Also included are small areas of somewhat poorly drained soils in basins. Included areas make up about 25 percent of the total acreage.

The Starbuck soil is shallow and well drained. It formed in loess overlying basalt. Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil is pale brown silt loam and gravelly silt loam about 10 inches thick. Basalt is at a depth of about 16 inches. Depth to basalt ranges from 12 to 20 inches.

Permeability of the Starbuck soil is moderate. Available water capacity is low. The effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate.

Rock outcrop is areas of exposed bedrock.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by low available water capacity and areas of Rock outcrop. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved with such methods as chemical treatment and prescribed burning.

Range seeding on the Starbuck soil is a suitable practice if the range vegetation is in poor condition, but it is difficult because of the areas of Rock outcrop. Most areas of the soil can be seeded with a drill. The unit should be seeded in fall. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIIs, nonirrigated.

144—Starbuck-Rock outcrop complex, 45 to 60 percent slopes. This map unit is on uplands. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 2,000 feet. The average annual precipitation is 6 to 10 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 170 days.

This unit is about 45 percent Starbuck silt loam and about 35 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Kiona, Bakeoven, Ritzville, and Shano soils. Included areas make up about 20 percent of the total acreage.

The Starbuck soil is shallow and well drained. It formed in loess overlying basalt. Typically, the surface layer is brown silt loam about 6 inches thick. The subsoil is pale brown silt loam and gravelly silt loam about 10 inches thick. Basalt is at a depth of about 16 inches. Depth to basalt ranges from 12 to 20 inches.

Permeability of the Starbuck soil is moderate. Available water capacity is low. Effective rooting depth is 12 to 20 inches. Runoff is rapid, and the hazard of water erosion is high.

Rock outcrop is areas of exposed bedrock.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation of the Starbuck soil is mainly bluebunch wheatgrass and Sandberg bluegrass. The production of forage is limited by steepness of slope and areas of Rock outcrop. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Brush control is mainly limited to aerial application of chemicals or prescribed burning. Steepness of slope and the areas of Rock outcrop limit access by livestock and promote overgrazing of the less sloping areas. Proper placement of salt licks, stock water tanks, and fences promote more uniform distribution of grazing. Aerial seeding of the Starbuck soil may be desirable. Seedings generally are most successful in fall. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIIs, nonirrigated.

145—Sutkin stony loam, 0 to 25 percent slopes. This very deep, well drained soil is on smooth mountaintops. It formed in colluvium and residuum derived dominantly from basalt and containing small amounts of loess. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 3,400 to 4,400 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is about 43 degrees F, and the average length of the growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1/2 inch thick. The surface layer is dark brown stony loam about 10 inches thick. The subsoil is dark yellowish brown very cobbly loam and extremely cobbly loam about 28 inches thick. The substratum to a depth of 60 inches or more is dark yellowish brown extremely cobbly loam. In some areas the subsoil is loam, gravelly loam, or very cobbly clay.

Included in this unit are areas of Sapkin and Bocker soils and areas of Sutkin soils that have slopes of 25 to 45 percent. Included areas make up about 10 percent of the total acreage.

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

This unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine and Douglas-fir are the main woodland species on this unit. On the basis of a 100-year site curve, the mean site index is 67 for ponderosa pine and 81 for Douglas-fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 52 cubic feet per acre for ponderosa pine at age 50 and 71 cubic feet per acre for Douglas-fir at age 40. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 40 cubic feet per acre for ponderosa pine and 57 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on this unit is about 90 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is a short period of seasonal soil wetness. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. If seed trees are present, natural reforestation of cutover areas by ponderosa pine and Douglas-fir occurs infrequently. The droughtiness of the soil increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are pinegrass, elk sedge, yarrow, ceanothus, and Oregon-grape. The crown density in the areas where the woodland site index was measured is 30 percent. This unit is well suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIs, nonirrigated.

146—Sutkin stony loam, 25 to 45 percent slopes. This very deep, well drained soil is on mountainsides. It formed in colluvium and residuum derived dominantly from basalt and small amounts of loess. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 2,800 to 4,800 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is about 43 degrees F, and the average length of the growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1/2 inch thick. The surface layer is dark brown stony loam about 10 inches thick. The subsoil is dark yellowish brown very cobbly loam and extremely cobbly loam about 28 inches thick. The substratum to a depth of 60 inches or more is dark yellowish brown extremely cobbly loam. In some areas the subsoil is very cobbly clay.

Included in this unit are about 10 percent Sapkin soils, about 5 percent Bocker soils, areas of Rock outcrop and Rubble land, and areas of Sutkin soils that have slopes of less than 25 percent or more than 45 percent.

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

This unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine and Douglas-fir are the main woodland species on this unit. Among the trees of limited extent are western larch and Oregon white oak. On the basis of a 100-year site curve, the mean site index is 67 for ponderosa pine and 81 for Douglas-fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 52 cubic feet per acre for ponderosa pine at age 50 and 71 cubic feet per acre for Douglas-fir at age 40. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 45 cubic feet per acre for ponderosa pine and 60 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on this unit is about 80 percent that of normal stands, and total yield is correspondingly lower.

The main limitation for the harvesting of timber is steepness of slope, which makes the use of wheeled and tracked equipment difficult. Cable yarding systems are safer, and they disturb the soil less. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is available in included areas of Rock outcrop and Rubble land.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. If seed trees are present, natural reforestation of cutover areas by ponderosa pine and Douglas-fir occurs periodically. The droughtiness of the soil increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are pinegrass, elk sedge, bitterbrush, yarrow, Oregon-grape, common snowberry, and ceanothus. The crown density in the areas where the woodland site index was measured is 25 percent. This unit is suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIIs, nonirrigated.

147—Sutkin stony loam, 45 to 65 percent slopes. This very deep, well drained soil is on mountainsides. It formed in colluvium and residuum derived dominantly from basalt and containing small amounts of loess. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 3,400 to 4,600 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is about 43 degrees F, and the average length of the growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1/2 inch thick. The surface layer is dark brown stony loam about 10 inches thick. The subsoil is dark yellowish brown very cobbly loam and extremely cobbly loam about 28 inches thick. The substratum to a depth of 60 inches or more is dark yellowish brown extremely cobbly loam.

Included in this unit are areas of Sapkin soils, Rock outcrop, Rubble land, and Sutkin soils that have slopes of less than 45 percent. Included areas make up about 15 percent of the total acreage.

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

This unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine and Douglas-fir are the main woodland species on this unit. Among the trees of limited extent are Oregon white oak, western larch, and grand fir. On the basis of a 100-year site curve, the mean site index is 67 for ponderosa pine and 81 for Douglas-fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 52 cubic feet per acre for ponderosa pine at age 50 and 71 cubic feet per acre for Douglas-fir at age 40. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 40 cubic feet per acre for ponderosa pine and 65 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on this unit is about 70 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is steepness of slope, which restricts the use of wheeled and tracked equipment in skidding operations. Cable yarding systems generally are safer, and they disturb the soil less. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is available in included areas of Rock outcrop and Rubble land.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting ponderosa pine and Douglas-fir seedlings. If seed trees are present, natural reforestation of cutover areas by ponderosa pine and Douglas-fir occurs periodically. The droughtiness of the soil increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, pinegrass, bitterbrush, common snowberry, and Oregon-grape. The crown density in the areas where the woodland site index was measured is 35 percent. This unit is well suited to browsing; however, steepness of slope limits access by livestock. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful. Because of the steepness of slope, broadcast seeding should be used.

Seeding of adapted grazable plants following logging or burning reduces soil erosion, preserves water quality, and increases the production of understory. Seeding late in summer or in fall is most successful. The presence of logging debris and steepness of slope limit seeding.

This map unit is in capability subclass VIIs, nonirrigated.

148—Sutkin stony loam, 25 to 45 percent south slopes. This very deep, well drained soil is on mountainsides and in canyons. It formed in colluvium and residuum derived dominantly from basalt and small amounts of loess. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 2,800 to 4,000 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is about 43 degrees F, and the average length of the growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1/2 inch thick. The surface layer is dark brown stony loam about 10 inches thick. The subsoil is dark yellowish brown very cobbly loam and extremely cobbly loam about 28 inches thick. The substratum to a depth of 60 inches or more is dark yellowish brown extremely cobbly loam. In some areas the subsoil is very cobbly clay, and in some small concave areas on terraces the subsoil is loam or gravelly loam.

Included in this unit are areas of Sapkin and Bocker soils, areas of Rubble land and Rock outcrop, small convex areas of soils that have slopes of more than 45 percent, and small concave areas of soils that have slopes of less than 25 percent. Included areas make up about 15 percent of the total acreage.

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

This unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine and Douglas-fir are the main woodland species on this unit. Numerous patches of

Oregon white oak are also present. On the basis of a 100-year site curve, the mean site index is 49 for ponderosa pine and 65 for Douglas-fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 37 cubic feet per acre for ponderosa pine at age 60 and 50 cubic feet per acre for Douglas-fir at age 50. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 20 cubic feet per acre for ponderosa pine and 40 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on this unit is about 75 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is steepness of slope, which makes the use of wheeled and tracked equipment difficult. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is available in included areas of Rubble land and Rock outcrop.

Seeding establishment is the main concern in the production of timber. Reforestation can be accomplished by planting ponderosa pine seedlings. If seed trees are present, natural reforestation of cutover areas by ponderosa pine occurs infrequently. The droughtiness of the soil increases seedling mortality.

The common forest understory plants are elk sedge, pinegrass, bitterbrush, yarrow, and Oregon-grape. The crown density in the areas where the woodland site index was measured is 20 percent. This unit is suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIIs, nonirrigated.

149—Sutkin-Rock outcrop complex, 25 to 75 percent slopes. This map unit is on mountainsides. Slope is dominantly about 50 percent. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 2,800 to 4,000 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is about 43 degrees F, and the average length of the growing season, at 28 degrees F, is 145 to 170 days.

This unit is about 55 percent Sutkin stony loam and about 25 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Sapkin soils and Rubble land and concave areas of soils that have slopes of less than 25 percent. Included areas make up about 20 percent of the total acreage.

The Sutkin soil is very deep and well drained. It formed in residuum and colluvium derived dominantly from basalt and containing small amounts of loess. Typically, the surface is covered with a mat of partially decomposed organic material about 1/2 inch thick. The surface layer is dark brown stony loam about 10 inches thick. The subsoil is dark yellowish brown very cobbly loam and extremely cobbly loam about 28 inches thick. The substratum to a depth of 60 inches or more is dark yellowish brown extremely cobbly loam.

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

Rock outcrop is areas of exposed bedrock. It is on hilly to extremely steep mountainsides.

This unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine and Douglas-fir are the main woodland species on the Sutkin soil. On the basis of a 100-year site curve, the mean site index is 67 for ponderosa pine and 81 for Douglas-fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 52 cubic feet per acre for ponderosa pine at age 50 and 71 cubic feet per acre for Douglas-fir at age 40. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 40 cubic feet per acre for ponderosa pine and 65 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on the Sutkin soil is about 70 percent that of normal stands, and the total yield is correspondingly lower.

The main limitations for the harvesting of timber are steepness of slope and areas of Rock outcrop, which restrict the use of wheeled and tracked equipment in skidding operations. Cable yarding systems generally are safer, and they disturb the soil less. Areas of Rock outcrop and Rubble land hinder cable yarding. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is readily available on this unit. Avoiding areas of Rock outcrop commonly forces yarding and skidding paths to converge, which increases the potential for erosion and soil compaction.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting ponderosa pine seedlings. If seed trees are present, natural reforestation of cutover areas by ponderosa pine occurs infrequently. The droughtiness of the soil increases seedling mortality, especially on south- and southwest-facing slopes. The areas of Rock outcrop limit the even distribution of reforestation.

The common forest understory plants are elk sedge, pinegrass, bitterbrush, common snowberry, and Oregon-grape. The crown density in the areas where the woodland site index was measured is 30 percent. The

Sutkin soil is suited to grazing and browsing. Steepness of slope and the areas of Rock outcrop limit access by livestock and encourage overgrazing of the less sloping areas. The distribution of grazing in the steeply sloping areas of this soil can be improved by proper location of salt licks, stock watering facilities, and management fences. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIIs, nonirrigated.

150—Sutkin Variant stony loam, 0 to 5 percent slopes. This very deep, well drained soil is on alluvial fans. It formed in loess overlying cobbly or gravelly alluvium. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 2,400 to 2,600 feet. The average annual precipitation is 14 to 17 inches, the average annual air temperature is about 48 degrees F, and the average length of the growing season, at 28 degrees F, is 150 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 1/2 inch thick. The surface layer is grayish brown stony loam about 8 inches thick. The subsoil is brown gravelly loam and pale brown very gravelly loam about 10 inches thick. The substratum to a depth of 60 inches or more is pale brown extremely gravelly sandy loam. In some areas the part of the soil profile below the surface layer is gravelly.

Included in this unit are small areas of Wenas soils in poorly drained, depressional areas and Mippon soils near stream channels. Included areas make up about 15 percent of the total acreage.

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

This unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine is the main woodland species on this unit. On the basis of a 100-year site curve, the mean site index is 70 for ponderosa pine. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger at 50 years of age is 55 cubic feet per acre. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 45 cubic feet per acre. However, the typical basal area of stands on this unit is about 60 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is a short period of seasonal soil wetness. The numerous stones on the surface of many areas of this unit may hinder harvesting. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Seedling mortality is the main concern in the production of timber. Reforestation can be accomplished by planting ponderosa pine seedlings. If seed trees are present, natural reforestation of cutover areas by ponderosa pine occurs periodically. The droughtiness of the soil in this unit increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, pinegrass, lupine, American vetch, common snowberry, and ceanothus. The crown density in the areas where the woodland site index was measured is 25 percent. This unit is well suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This unit is limited for livestock watering ponds and other water impoundments because of seepage. Spring developments, wells, and pipeline systems can be used to provide water for livestock.

This map unit is in capability subclass VIs, nonirrigated.

151—Taneum loam, 5 to 15 percent slopes. This very deep, well drained soil is on uplands. It formed in loess overlying weathered sandstone. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 2,300 to 3,000 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 48 degrees F, and the average frost-free season is 120 to 135 days.

Typically, the surface layer is dark grayish brown and grayish brown loam about 14 inches thick. The upper part of the subsoil is brown silty clay loam about 13 inches thick, and the lower part is brown clay loam about 16 inches thick. The upper part of the substratum is yellowish brown loam about 7 inches thick, and the lower part to a depth of 60 inches or more is brown sandy loam. In some areas bedrock is at a depth of 40 to 60 inches.

Included in this unit are areas of Rock Creek, McDaniel, and Roza soils.

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

This unit is used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Spring grain can be grown during years when extra moisture is received. The amount of straw produced by spring grain generally is

not sufficient for erosion control unless it is very carefully managed.

Growing grasses and legumes in the rotation helps to control erosion and to maintain or improve tilth. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces and diversions, and stripcropping. Seeding early in fall, either on the contour or across the slope, slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. This unit has few limitations for the production of forage. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as rabbitbrush and big sagebrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is suited to homesite development. The main limitations are shrink-swell potential and steepness of slope. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage as a result of shrinking and swelling. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for the use of septic tank absorption fields is the moderately slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation. Slope can cause lateral seepage and surfacing of effluent in downslope areas. Lateral seepage can be avoided by installing absorption lines on the contour.

This map unit is in capability subclass IIIe, nonirrigated.

152—Taneum loam, 15 to 30 percent slopes. This very deep, well drained soil is on uplands. It formed in loess overlying weathered sandstone. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 2,300 to 3,000 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 48 degrees F, and the average frost-free season is 120 to 135 days.

Typically, the surface layer is dark grayish brown and grayish brown loam about 14 inches thick. The upper part of the subsoil is brown silty clay loam about 13 inches thick, and the lower part is brown clay loam about 16 inches thick. The upper part of the substratum is yellowish brown loam about 7 inches thick, and the lower part to a depth of 60 inches or more is brown sandy loam. In some areas bedrock is at a depth of 40 to 60 inches.

Included in this unit are areas of Rock Creek, McDaniel, and Roza soils.

Permeability of this Taneum soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for nonirrigated crops, rangeland, wildlife habitat, and homesites.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Spring grain can be grown during years when extra moisture is received.

Growing grasses and legumes in the rotation helps to control erosion and to maintain or improve tilth. Erosion can be reduced by seeding fall grain early, stubble mulching, divided-slope farming, and stripcropping. Fall seeding, either on the contour or across the slope, slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Diversions may be needed to intercept runoff from higher lying areas. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. This unit has few limitations for the production of forage. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as rabbitbrush and big sagebrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation is steepness of slope. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are steepness of slope and moderately slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for the moderately slow permeability. Slope can cause lateral seepage and surfacing of effluent in downslope areas.

This map unit is in capability subclass IVe, nonirrigated.

153—Taneum loam, 30 to 60 percent slopes. This very deep, well drained soil is on uplands. It formed in loess overlying weathered sandstone. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 2,300 to 3,000 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 48 degrees F, and the average frost-free season is 120 to 135 days.

Typically, the surface layer is dark grayish brown and grayish brown loam about 14 inches thick. The upper part of the subsoil is brown silty clay loam about 13 inches thick, and the lower part is brown clay loam about 16 inches thick, The upper part of the substratum is yellowish brown loam about 7 inches thick, and the lower part to a depth of 60 inches or more is brown sandy loam. In some areas bedrock is at a depth of 40 to 60 inches.

Included in this unit are areas of Rock Creek, McDaniel, and Roza soils and Rock outcrop.

Permeability of this Taneum soil is moderately slow. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of water erosion is very high.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. This unit has few limitations for the production of forage. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as rabbitbrush and big sagebrush increases. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Proper placement of salt licks, livestock watering facilities, and fences promotes more uniform distribution of grazing.

Areas that are heavily infested with undesirable vegetation can be improved by such methods as chemical treatment and prescribed burning. Plant competition can be reduced by using chemicals. Range seeding is a suitable practice if the range vegetation is in poor condition. Use of equipment in some areas is limited by steepness of slope. Fall seedings generally are most successful. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIIe, nonirrigated.

154—Taneum-Rock Creek complex, 5 to 15 percent slopes. This map unit is on uplands. The native vegetation is mainly grasses, forbs, and shrubs. The elevation is 2,300 to 3,300 feet. The average annual precipitation is 15 to 18 inches, the average annual air temperature is about 48 degrees F, and the average frost-free season is 120 to 135 days.

This unit is about 50 percent Taneum loam and about 30 percent Rock Creek very stony silt loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included with this unit are areas of Clint and McDaniel soils. Included areas make up about 20 percent of the total acreage.

The Taneum soil is very deep and well drained. It formed in loess overlying weathered sandstone. Typically, the surface layer is dark grayish brown and grayish brown loam about 14 inches thick. The upper part of the subsoil is brown silty clay loam about 13 inches thick, and the lower part is brown clay loam about 16 inches thick. The upper part of the substratum is yellowish brown loam about 7 inches thick, and the lower part to a depth of 60 inches or more is brown sandy loam.

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

The Rock Creek soil is shallow and well drained. It formed in loess and residuum derived dominantly from basalt. Typically, the surface layer is grayish brown very stony silt loam about 2 inches thick. The subsoil is brown very cobbly clay about 8 inches thick. Basalt is at a depth of about 10 inches. Depth to basalt ranges from 8 to 15 inches. In some areas the surface layer is stony, and in some areas bedrock is at a depth of more than 20 inches.

Permeability of the Rock Creek soil is moderately slow. Available water capacity is low. Effective rooting depth is 8 to 15 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation of the Taneum soil is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. This soil has few limitations for the production of forage. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as rabbitbrush and big sagebrush increases.

The potential native vegetation of the Rock Creek soil is mainly stiff sagebrush, Sandberg bluegrass, and eriogonum. The main limitations for the production of forage are depth to rock and low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as stiff sagebrush and Sandberg bluegrass decreases and the proportion of less preferred forage plants such as forbs and annual grasses increases.

Areas of the Taneum soil that are heavily infested with undesirable vegetation can be improved with such methods as chaining, railing, beating, chemical treatment, and prescribed burning. Range seeding on the Rock Creek soil is not feasible because of the low available water capacity and depth to rock. Range seeding on the Taneum soil is a suitable practice if the

range vegetation is in poor condition. The soil should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This map unit is in capability subclass VIs, nonirrigated.

155—Tekison stony loam, 0 to 25 percent slopes. This very deep, well drained soil is on ridges and benches. It formed in residuum and colluvium derived from basalt and containing small amounts of loess. The native vegetation is mainly conifers, grasses, and shrubs. Elevation is 2,800 to 3,600 feet. The average annual precipitation is 16 to 20 inches, the average annual temperature is about 47 degrees F, and the average length of the growing season, at 28 degrees F, is 150 to 170 days.

Typically, the surface layer is brown stony loam about 4 inches thick. The upper part of the subsoil is brown stony loam about 8 inches thick, the next part is brown very cobbly clay loam about 8 inches thick, and the lower part to a depth of 60 inches or more is yellowish brown very gravelly clay and very cobbly clay.

Included in this unit are small areas of Meystre, Odo, and Rock Creek soils and areas of Tekison soils that have slopes of more than 25 percent.

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

This unit is used as grazable woodland and for wildlife habitat.

Ponderosa pine and Douglas-fir are the main woodland species on this unit. On the basis of a 100-year site curve, the mean site index is 69 for ponderosa pine and 80 for Douglas-fir. Yield tables for normal, even-aged, unmanaged stands indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger is 54 cubic feet per acre for ponderosa pine at age 55 and 69 cubic feet per acre for Douglas-fir at age 40. The mean annual increment for trees 6.6 inches in diameter and larger at 80 years of age is 44 cubic feet per acre for ponderosa pine and 56 cubic feet per acre for Douglas-fir. However, the typical basal area of stands on this unit is about 95 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is a short period of seasonal soil wetness. Unsurfaced roads and skid trails are slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting ponderosa pine seedlings. If seed trees are present, natural reforestation of cutover areas by ponderosa pine occurs infrequently. The droughtiness of the soil increases seedling mortality, especially on south- and southwest-facing slopes.

The common forest understory plants are elk sedge, pinegrass, western yarrow, and bitterbrush. The crown density in the areas where the woodland site index was measured is 25 percent. This unit is well suited to grazing and browsing. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIs, nonirrigated.

156—Tieton fine sandy loam, 2 to 5 percent slopes. This deep, well drained soil is on uplands. It formed in loess and in material derived from andesite. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,500 to 2,300 feet. The average annual precipitation is 11 to 15 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is grayish brown fine sandy loam about 9 inches thick. The upper part of the subsoil is brown loam about 6 inches thick, and the lower part is yellowish brown and brown silty clay loam and clay loam about 29 inches thick. The substratum is grayish brown loam about 4 inches thick. Andesite is at a depth of about 48 inches. Depth to andesite ranges from 40 to 60 inches. In some areas the surface layer is loam or stony loam. In some areas sandstone is at a depth of 40 to 60 inches, and in some areas andesite is at a depth of more than 60 inches.

Included in this unit are areas of Simcoe and Rock Creek soils and Rock outcrop. Also included are areas of soils that have a high water table.

Permeability of this Tieton soil is moderately slow. Available water capacity is high. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used for irrigated field and orchard crops, for wildlife habitat, and as homesites. The main irrigated crops are grain and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are the hazards of soil blowing and water erosion. Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. The type of irrigation system used depends on the kind of crop grown. If furrow and corrugation irrigation systems are used, runs should be on the contour or across the slope. The hazard of water erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Pipe, ditch

lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Using a cropping system that includes close-growing, high-residue crops in the rotation, maintaining crop residue on the surface, and using minimum tillage reduce erosion. Return of crop residue to the soil also helps to maintain or improve the organic matter content and to maintain tilth. A plowpan develops in this soil from excessive tillage with heavy equipment. Growing annual cover crops in orchards and vineyards reduces erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is poorly suited to homesite development. The main limitations are depth to rock and shrink-swell potential. Bedrock hinders excavation. If buildings are constructed on the soil in this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage as a result of shrinking and swelling. Soil blowing can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is the moderately slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation.

This map unit is in capability subclass IIe, irrigated.

157—Tieton loam, 0 to 2 percent slopes. This deep, well drained soil is on uplands. It formed in loess and in material derived from andesite. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,500 to 2,300 feet. The average annual precipitation is 11 to 15 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is grayish brown loam about 9 inches thick. The upper part of the subsoil is brown loam about 6 inches thick, and the lower part is yellowish brown and brown silty clay loam and clay loam about 29 inches thick. The substratum is grayish brown loam about 4 inches thick. Andesite is at a depth of about 48 inches. Depth to andesite ranges from 40 to 60 inches. In some areas the surface layer is stony, and in some areas sandstone is at a depth of 40 to 60 inches.

Included in this unit are small areas of Simcoe, Rock Creek, and Ritzville soils and Rock outcrop. Also included are areas of soils that have a seasonal high water table.

Permeability of this Tieton soil is moderately slow. Available water holding capacity is high. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight.

This unit is used for irrigated field and orchard crops, for wildlife habitat, and as homesites. The main irrigated crops are grain and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

This unit has few limitations for irrigated crops. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or increase the organic matter content, help to maintain tilth, and increase the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Use of cover crops reduces erosion in orchards and vineyards. A plowpan develops in this soil, but it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is poorly suited to homesite development. The main limitations for homesites are depth to rock and shrink-swell potential. The bedrock hinders excavation. If buildings are constructed on the soil in this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage as a result of shrinking and swelling. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is moderately slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation.

This map unit is in capability class I, irrigated.

158—Tieton loam, 2 to 5 percent slopes. This deep, well drained soil is on uplands. It formed in loess and in material derived from andesite. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,500 to 2,300 feet. The average annual precipitation is 11 to 15 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is grayish brown loam about 9 inches thick. The upper part of the subsoil is brown loam about 6 inches thick, and the lower part is yellowish brown and brown silty clay loam and clay loam about 29 inches thick. The substratum is grayish brown loam about 4 inches thick. Andesite is at a depth of about 48 inches. Depth to andesite ranges from 40 to 60

inches. In some areas the surface layer is fine sandy loam or is stony, and in some small areas sandstone is at a depth of 40 to 60 inches.

Included in this unit are areas of Simcoe, Rock Creek, and Ritzville soils, Rock outcrop, and soils that have a seasonal high water table.

Permeability of this Tieton soil is moderately slow. Available water capacity is high. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, for wildlife habitat, and as homesites. The main irrigated crops are grain and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is the hazard of water erosion. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. The risk of erosion can be minimized by keeping the runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Use of annual or perennial cover crops during the irrigation season reduces erosion in orchards and vineyards. A plowpan develops in this soil, but it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is poorly suited to homesite development. The main limitations are depth to rock and shrink-swell potential. The bedrock hinders excavation. If buildings are constructed on the soil in this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage as a result of shrinking and swelling. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is the moderately slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation.

This map unit is in capability subclass IIe, irrigated.

159—Tieton loam, 5 to 8 percent slopes. This deep, well drained soil is on uplands. It formed in loess and in material derived from andesite. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,500 to 2,300 feet. The average annual precipitation is 11 to 15 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is grayish brown loam about 9 inches thick. The upper part of the subsoil is brown loam about 6 inches thick, and the lower part is yellowish brown and brown silty clay loam and clay loam about 29 inches thick. The substratum is grayish brown loam about 4 inches thick. Andesite is at a depth of about 48 inches. Depth to andesite ranges from 40 to 60 inches. In some areas the surface layer is fine sandy loam, and in a few small areas sandstone is at a depth of 40 to 60 inches.

Included in this unit are areas of Simcoe, Rock Creek, and Ritzville soils, areas of Rock outcrop, and areas of soils that have a seasonal high water table.

Permeability of this Tieton soil is moderately slow. Available water capacity is high. Effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops (fig. 5), for wildlife habitat, and as homesites. The main irrigated crops are grain and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to

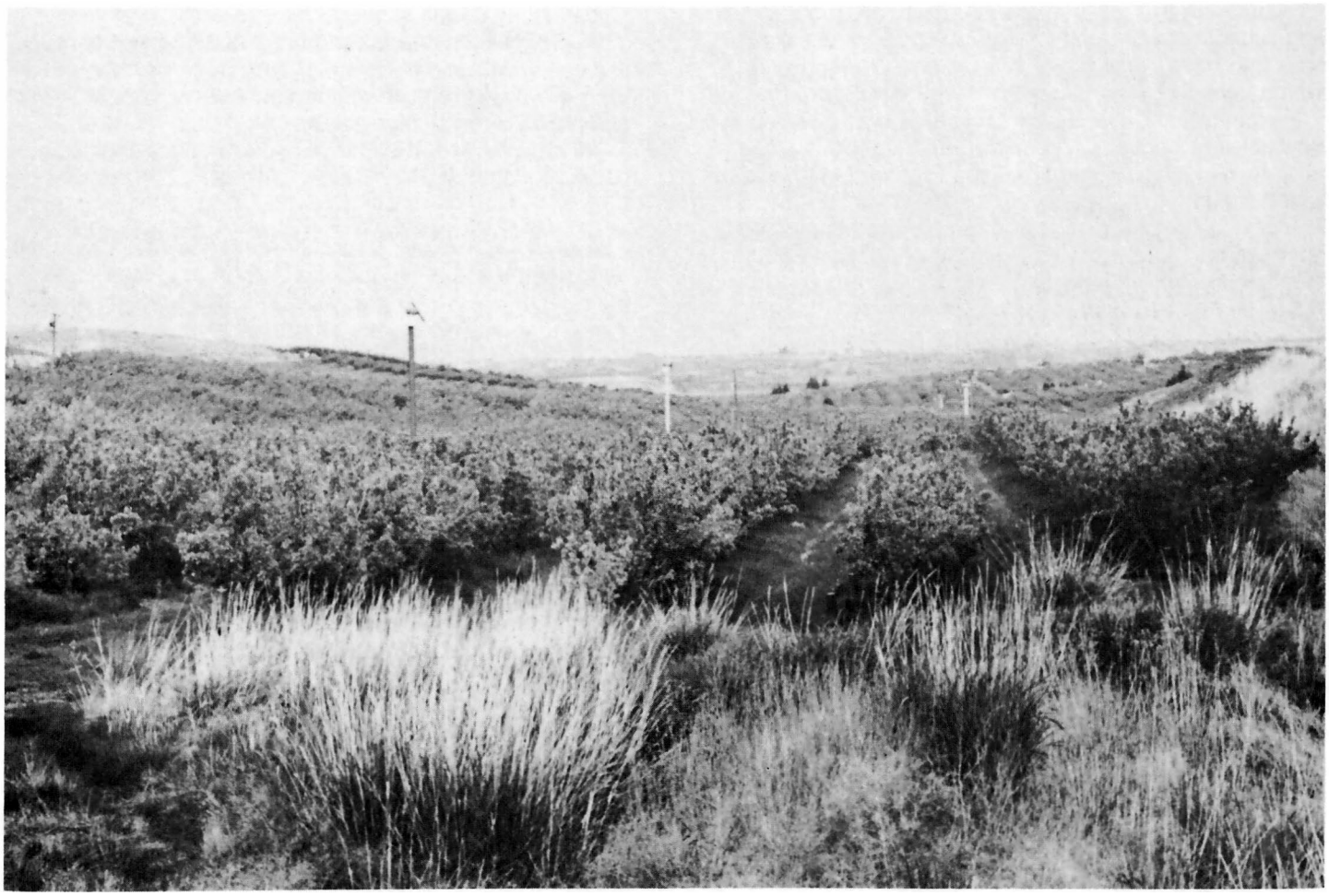


Figure 5.—Orchard on Tieton loam, 5 to 8 percent slopes, in the center. Wind machines in the orchard reduce the hazard of frost.

the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Growing cover crops helps to control erosion in orchards and vineyards. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

This unit is poorly suited to homesite development. The main limitations are depth to rock and shrink-swell potential. The bedrock hinders excavation. If building are constructed on the soil in this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage as a result of shrinking and swelling. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is the moderately slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation.

This map unit is in capability subclass IIIe, irrigated.

160—Tieton loam, 8 to 15 percent slopes. This deep, well drained soil is on uplands. It formed in loess and in material derived from andesite. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,500 to 2,300 feet. The average annual precipitation is 11 to 15 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is grayish brown loam about 9 inches thick. The upper part of the subsoil is brown loam about 6 inches thick, and the lower part is yellowish brown and brown silty clay loam and clay loam about 29 inches thick. The substratum is grayish brown loam about 4 inches thick. Andesite is at a depth of about 48 inches. Depth to andesite ranges from 40 to 60

inches. In some areas sandstone is at a depth of 40 to 60 inches.

Included in this unit are areas of Simcoe, Rock Creek, and Ritzville soils, areas of Rock outcrop, small areas of soils that have a seasonal high water table, and areas of Tieton soils that have slopes of less than 8 percent.

Permeability of this Tieton soil is moderately slow. Available water capacity is high. Effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain and tree fruit. Grasses and legumes are grown for hay, pasture, and seed. A cover crop is grown in orchards.

The main limitations for irrigated crops are steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Use of annual or perennial cover crops reduces erosion in orchards. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

The main limitations for nonirrigated crops are the hazard of water erosion and low annual precipitation. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces and diversions, and stripcropping. Seeding early in fall, either on the contour or across the slope, slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as rabbitbrush and big sagebrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations are steepness of slope, depth to rock, and shrink-swell potential. The bedrock hinders excavation. If buildings are constructed on the soil in this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage as a result of shrinking and swelling. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is the moderately slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for this limitation. Slope can cause lateral seepage and surfacing of effluent in downslope areas. Lateral seepage can be reduced by installing absorption lines on the contour.

This map unit is in capability subclasses IVe, irrigated, and IIIe, nonirrigated.

161—Tieton loam, 15 to 30 percent slopes. This deep, well drained soil is on uplands. It formed in loess and in material derived from andesite. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,500 to 2,300 feet. The average annual precipitation is 11 to 15 inches, the average annual air temperature is about 48 degrees F, and the average frost-free season is 135 to 150 days.

Typically, the surface layer is grayish brown loam about 9 inches thick. The upper part of the subsoil is brown loam about 6 inches thick, and the lower part is yellowish brown and brown silty clay loam and clay loam about 29 inches thick. The substratum is grayish brown loam about 4 inches thick. Andesite is at a depth of about 48 inches. Depth to andesite ranges from 40 to 60 inches. In some areas sandstone is at a depth of 40 to 60 inches.

Included in this unit are areas of Simcoe, Rock Creek, and Ritzville soils and Rock outcrop.

Permeability of this Tieton soil is moderately slow. Available water capacity is high. Effective rooting depth is 40 to 60 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated field and orchard crops, nonirrigated crops, wildlife habitat, rangeland and homesites. The main irrigated crops are grain and tree fruit. Grass and legumes are grown for hay, pasture, and seed. A cover crop is grown in orchards.

The main limitations for irrigated crops are steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of

irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Growing perennial cover crops reduces erosion in orchards and vineyards. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, divided-slope farming, and stripcropping. Seeding in fall, either on the contour or across the slope, slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as rabbitbrush and big sagebrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, plowing, beating, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill.

This unit is poorly suited to homesite development. The main limitation is steepness of slope. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are steepness of slope and the moderately slow permeability. Use of long absorption lines and sandy backfill for the trench helps to compensate for the moderately slow permeability. Slope can cause lateral seepage and surfacing of effluent in downslope areas.

This map unit is in capability subclasses IVe, irrigated and nonirrigated.

162—Tieton-Rock outcrop complex, 0 to 30 percent slopes. This map unit is on uplands (fig. 6). The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,500 to 2,300 feet. The average annual precipitation is 11 to 15 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 150 days.

This unit is about 60 percent Tieton loam and about 25 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are areas of Ritzville and Simcoe soils. Included areas make up about 15 percent of the total acreage.

The Tieton soil is deep and well drained. It formed in loess and in material derived from andesite. Typically, the surface layer is grayish brown loam about 9 inches thick. The upper part of the subsoil is brown loam about 6 inches thick, and the lower part is yellowish brown and brown silty clay loam and clay loam about 29 inches thick. The substratum is grayish brown loam about 4 inches thick. Andesite is at a depth of about 48 inches. Depth to andesite ranges from 40 to 60 inches. In some areas sandstone is at a depth of 40 to 60 inches, and in some areas andesite or sandstone is at a depth of more than 60 inches.

Permeability of the Tieton soil is moderately slow. Available water capacity is high. Effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

Rock outcrop is areas of exposed bedrock.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation on the Tieton soil is mainly bluebunch wheatgrass, Idaho fescue, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass and Idaho fescue decreases and the proportion of less preferred forage plants such as rabbitbrush and big sagebrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chemical treatment and prescribed burning. Because the areas of the Tieton soil are not large enough to effectively seed using a drill, proper range use, deferred grazing, and rotation grazing are the most effective methods of range management and erosion control. Fences are needed in most areas to prevent cattle from grazing in adjacent orchards.

This map unit is in capability subclass VIs, nonirrigated.

163—Toppenish silt loam. This very deep, artificially drained soil is on flood plains. It formed in alluvium. Slope is 0 to 2 percent. The native vegetation is water-tolerant grasses and deciduous trees. Elevation is 700 to 1,800 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is dark grayish brown, strongly alkaline silt loam about 4 inches thick. The upper part of the subsoil is gray, strongly alkaline silty clay loam about 10 inches thick, and the lower part is

Figure 6.—Typical area of Tieton-Rock outcrop complex, 0 to 30 percent slopes. Grasses and orchard are on Tieton soils in foreground.

gleyed, dark grayish brown and brown, moderately alkaline and mildly alkaline silt loam about 36 inches thick. The substratum to a depth of 60 inches or more is brown, mildly alkaline extremely gravelly sand. In some areas the surface layer is silty clay loam.

Included in this unit are small areas of Wenas, Track, Kittitas, Fiander, Esquatzel, and Naches soils and areas of Toppenish soils that have not been artificially drained.

Permeability of this Toppenish soil is moderately slow to the substratum and very rapid through it. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 24 to 48 inches from June to November. Runoff is very slow, and the hazard of water erosion is slight. This unit is subject to rare periods of flooding.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. Where areas of this unit are drained, the main irrigated crops are asparagus, corn, grain, and peas. Grasses and legumes are grown for hay and pasture.

The main limitation for irrigated crops is wetness. Deep-rooted crops are suited to areas where a drainage system has been installed and is maintained. Dikes are effective in diverting floodwater and they need to be maintained to provide continuing protection from flooding. If drainage systems are not maintained, the soil in this unit has a high water table during the irrigation season.

Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of irrigation system used depends on the kind of crop grown. If surface systems are used, the risk of erosion can be minimized by keeping runs short. Use of sprinkler and drip irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of

irrigation water should also be adjusted to the available water capacity and the crop needs.

Proper timing of minimum tillage and return of crop residue to the soil help to avoid soil compaction, help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

Where the soil in this unit is not adequately drained, the main limitations for use as homesites are the hazard of flooding and wetness. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings. Wetness can be reduced by installing drain tile around footings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Ground cover that is adapted to alkaline soil should be used.

The main limitations for septic tank absorption fields are wetness and the moderately slow permeability. Moderately slow permeability and the seasonal high water table increase the possibility of failure of septic tank absorption fields.

This map unit is in capability subclass IIIw, irrigated.

164—Torriorthents, steep. These shallow and moderately deep, well drained soils are on uplands. They formed in material derived from mixed sources and containing a small amount of loess. Slope is 30 to 60 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 1,600 to 2,000 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 135 to 160 days.

No single profile is typical of Torriorthents, but one commonly observed in the survey area has a surface layer of brown gravelly sandy loam about 4 inches thick. The underlying material is light brownish gray very gravelly sandy loam and gravelly sand about 27 inches thick. Soft, tuffaceous sandstone is at a depth of about 31 inches. Depth to sandstone, old gravelly alluvium, or lake sediment ranges from 10 to 40 inches. Texture of these soils varies widely within short distances. In some areas the surface layer is very gravelly.

Included in this unit are Roza, Harwood, Gorst, and Cowiche soils and areas of Rock outcrop.

Permeability of Torriorthents is rapid to the sandstone and slow through it. Available water capacity ranges from low to high. Effective rooting depth is 10 to 40 inches. Runoff is very rapid, and the hazard of water erosion is very high.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. The main limitation for the production of forage is low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Brush control is limited to aerial chemical applications and prescribed burning because of the steepness of slope and hazard of water erosion. Seeding is not feasible because of the low available water capacity. Steepness of slope limits access by livestock and promotes overgrazing of the less sloping areas. Proper location of salt licks, stock water, and fences promotes more uniform distribution of grazing. Other management practices suitable for use on this unit are proper range use, deferred grazing, and rotation grazing.

This map unit is in capability subclass VIIe, nonirrigated.

165—Track loam. This very deep, artificially drained soil is on flood plains. It formed in mixed alluvium. Slope is 0 to 2 percent. The native vegetation is water-tolerant grasses and forbs. Elevation is 800 to 1,500 feet. The average annual precipitation is 8 to 10 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is dark grayish brown, strongly alkaline loam about 14 inches thick. The upper part of the subsoil is grayish brown, strongly alkaline very gravelly loam about 7 inches thick, and the lower part is brown, strongly alkaline very gravelly loam about 5 inches thick. The substratum to a depth of 60 inches or more is brown, moderately alkaline very gravelly loamy sand. In some areas the surface layer is silty clay loam or very gravelly loam.

Included in this unit are areas of Ashue, Toppenish, Weirman, and Zillah soils. Also included are areas of salt- and alkali-affected soils, ponded soils, and Track soils that have not been artificially drained or have slopes of more than 2 percent.

Permeability of this Track soil is moderately slow. Available water capacity is moderate. Effective rooting depth is limited by a seasonal high water table that is at a depth of 24 to 48 inches from June to November. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to rare periods of flooding.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. The main irrigated crops are asparagus, corn, grain, and peas. Grasses and legumes are grown for hay and pasture.

The main limitations for irrigated crops are wetness and low available water capacity. Deep-rooted crops are suited to areas where a drainage system has been installed and maintained. Dikes are effective in diverting floodwater, but they need to be maintained to provide

continuing protection from flooding. If drainage systems are not maintained, the soil in this unit has a high water table during the irrigation season.

Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of irrigation system used depends on the kind of crop grown. If surface irrigation is used, the risk of erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to avoid compaction, to maintain or improve the organic matter content, to maintain tilth, and to improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry. Exposing the very gravelly subsoil during leveling should be avoided. Shallow cuts are feasible in some areas.

This unit is poorly suited to homesite development. The main limitations are the hazard of flooding and wetness. Dikes and channels that have outlets to bypass floodwater can be used to protect buildings from flooding. Wetness can be reduced by installing drain tile around footings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are wetness and seepage. The seasonal high water table can increase the possibility of the failure of absorption fields. Care should be taken to prevent the contamination of water supplies as a result of seepage.

This map unit is in capability subclass IIIw, irrigated.

166—Tumac very stony sandy loam, 5 to 45 percent slopes. This very deep, well drained soil is on south-facing side slopes of uplands and mountains. It formed in colluvium derived from basalt and andesite and containing volcanic ash. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 4,100 to 5,200 feet. The average annual precipitation is 30 to 60 inches, the average annual air temperature is about 43 degrees F, and the average length of the growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick. The upper part of the surface layer is brown very stony sandy loam about 4 inches thick, and the lower part is brown very gravelly loam about 11 inches thick. The upper part of the subsoil is yellowish brown very gravelly loam about 15 inches thick, and the lower part to a depth of 60 inches or more is yellowish brown and strong brown extremely gravelly loam. In some areas the subsoil is gravelly loam.

Included in this unit are areas of Tumac soils that have slopes of 45 to 60 percent and poorly drained soils in small depressional areas.

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

This unit is used as grazable woodland and for wildlife habitat.

Lodgepole pine, grand fir, and Douglas-fir are the main woodland species on the soil in this unit. Among the trees of limited extent are ponderosa pine, western larch, Engelmann spruce, and subalpine fir. On the basis of a 100-year site curve, the mean site index is 88 for Douglas-fir, 87 for grand fir, 90 for lodgepole pine, and 73 for ponderosa pine. Yield tables for normal, even-aged, unmanaged stands of Douglas-fir indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger at 40 years of age is 82 cubic feet per acre. The mean annual increment for Douglas-fir trees 6.6 inches in diameter and larger at 80 years of age is 70 cubic feet per acre. The mean annual increment at culmination for lodgepole pine at 100 years of age is about 100 cubic feet per acre. However, the typical basal area of stands on this unit is about 85 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is the difficulty of using wheeled and tracked equipment where slopes are more than 30 percent. Use of wheeled and tracked equipment when the soil is moist can produce ruts, compact the soil, and damage tree roots. Unsurfaced roads and skid trails are soft and slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit. Steep skid trails and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting Douglas-fir and ponderosa pine seedlings. If seed trees are present, natural reforestation of cutover areas by grand fir and lodgepole pine occurs readily. This can delay establishment of planted seedlings.

The common forest understory plants are elk sedge, pinegrass, lupine, pachystima, and Oregon-grape. The crown density in the areas where the woodland site index was measured is 25 percent. This unit is well suited to grazing and browsing. Seeding to adapted

grazable vegetation following logging or burning late in summer or in fall generally is most successful.

This map unit is in capability subclass VIIs, nonirrigated.

167—Tumac very stony sandy loam, 45 to 65 percent slopes. This very deep, well drained soil is on south-facing mountainsides. It formed in colluvium derived from basalt and andesite and containing volcanic ash. The native vegetation is mainly conifers, grasses, forbs, and shrubs. Elevation is 4,100 to 5,200 feet. The average annual precipitation is 30 to 60 inches, the average annual air temperature is about 43 degrees F, and the average length of the growing season, at 28 degrees F, is 145 to 170 days.

Typically, the surface is covered with a mat of partially decomposed organic material about 2 inches thick. The upper part of the surface layer is brown very stony sandy loam about 4 inches thick, and the lower part is brown very gravelly loam about 11 inches thick. The upper part of the subsoil is yellowish brown very gravelly loam about 15 inches thick, and the lower part to a depth of 60 inches or more is yellowish brown and strong brown extremely gravelly loam. In some areas the subsoil is gravelly loam.

Included in this unit is about 10 percent Rock outcrop and Rubble land. Also included are areas of Tumac soils that have slopes of less than 45 percent.

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

This unit is used as grazable woodland and for wildlife habitat.

Lodgepole pine, grand fir, and Douglas-fir are the main woodland species on the soil in this unit. Among the trees of limited extent are ponderosa pine, western larch, Engelmann spruce, and subalpine fir. On the basis of a 100-year site curve, the mean site index is 88 for Douglas-fir, 87 for grand fir, 90 for lodgepole pine, and 73 for ponderosa pine. Yield tables for normal, even-aged, unmanaged stands of Douglas-fir indicate that the mean annual increment at culmination (CMAI) for trees 0.6 inch in diameter and larger at 40 years of age is 82 cubic feet per acre. The mean annual increment for Douglas-fir trees 6.6 inches in diameter and larger at 80 years of age is 70 cubic feet per acre. The mean annual increment at culmination is about 100 cubic feet per acre for lodgepole pine at 100 years of age. However, the typical basal area of stands on this unit is about 85 percent that of normal stands, and the total yield is correspondingly lower.

The main limitation for the harvesting of timber is steepness of slope, which restricts the use of wheeled and tracked equipment in skidding operations. Cable yarding systems generally are safer, and they disturb the soil less. Use of wheeled and tracked equipment when the soil is moist can produce ruts, compact the soil, and damage tree roots. Unsurfaced roads and skid trails are soft and slippery when wet, and they may be impassable during spring runoff or in rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is available in the included areas of Rock outcrop and Rubble land. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover.

Seedling establishment is the main concern in the production of timber. Reforestation can be accomplished by planting Douglas-fir and ponderosa pine seedlings. If seed trees are present, natural reforestation of cutover areas by grand fir and lodgepole pine occurs readily. This can delay establishment of planted seedlings.

The common forest understory plants are elk sedge, pinegrass, lupine, pachystima, and Oregon-grape. The crown density in the areas where the woodland site index was measured is 25 percent. This unit is suited to browsing. The main limitation for the production of forage is steepness of slope, which limits access by livestock. Seeding to adapted grazable vegetation following logging or burning late in summer or in fall generally is most successful. Because of the steepness of slope, broadcast seeding should be used.

This map unit is in capability subclass VIIs, nonirrigated.

168—Umapine silt loam, 0 to 5 percent slopes. This very deep, somewhat poorly drained, salt- and alkali-affected soil is on flood plains and low terraces. It formed in alluvium. The native vegetation is mainly salt- and alkali-tolerant grasses, forbs, and shrubs. Elevation is 650 to 900 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is light brownish gray, very strongly alkaline silt loam about 7 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray and light gray, very strongly alkaline and strongly alkaline silt loam. In some areas the surface layer is dark gray.

Included in this unit are areas of Esquatzel, Toppenish, and Warden soils. Also included are areas of soils that are underlain by a hardpan at a depth of 20 to 40 inches.

Permeability of this Umapine soil is moderate. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 12 to 42 inches from November to June. Runoff is very slow, and the hazard of water erosion is slight. The soil is subject to occasional periods of flooding in spring.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly basin wildrye, inland saltgrass, and black greasewood. The main limitations for the production of forage are seasonal soil wetness and the alkalinity of the soil. If the range is overgrazed, the proportion of preferred forage plants such as basin wildrye decreases and the proportion of less preferred forage plants such as inland saltgrass and quackgrass increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The unit should be seeded in fall using a drill. Grasses adapted to the alkaline condition of the soil should be seeded.

This map unit is in capability subclass VIw, nonirrigated.

169—Umapine silt loam, drained, 0 to 2 percent slopes. This very deep, artificially drained, salt- and alkali-affected soil is on flood plains and low terraces. It formed in alluvium. The native vegetation is mainly salt- and alkali-tolerant grasses, forbs, and shrubs. Elevation is 650 to 900 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is light brownish gray, very strongly alkaline silt loam about 7 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray and light gray, very strongly alkaline and strongly alkaline silt loam. In some areas the surface layer is dark gray.

Included in this unit are areas of Esquatzel, Toppenish, Kittitas, and Warden soils. Also included are areas of soils that are underlain by a hardpan at a depth of 20 to 40 inches and areas of Umapine soils that have not been artificially drained.

Permeability of this Umapine soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 24 to 48 inches from November to June. Runoff is very slow, and the hazard of water erosion is slight. The soil is subject to rare periods of flooding.

This unit is used for irrigated crops, wildlife habitat, and homesites. The main irrigated crops are asparagus, corn, hops, grain, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are wetness, alkalinity, and the hazard of water erosion. Reclamation of the soil in this unit may require the addition of such amendments as gypsum, sulfur, or ferric sulfate to facilitate leaching and reduce alkalinity. Unless drainage systems are maintained, the soil has a seasonal high water table during the irrigation season. Dikes need to be maintained to provide continuing protection from flooding.

Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation is used, the hazard of erosion can be minimized by keeping runs short. Sprinkler irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Proper timing of tillage, use of minimum tillage, and return of crop residue to the soil help to avoid compaction, help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is poorly suited to homesite development. The main limitations are the hazard of flooding and wetness. Flooding can be controlled by the use of dikes and channels that have outlets to bypass floodwater. Wetness can be reduced by installing drain tile around footings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is wetness. Deep drainage helps to overcome this limitation.

This map unit is in capability subclass IIIw, irrigated.

170—Umapine silt loam, drained, 2 to 5 percent slopes. This very deep, artificially drained, salt- and alkali-affected soil is on flood plains and low terraces. It formed in alluvium. The native vegetation is mainly salt- and alkali-tolerant grasses, forbs, and shrubs. Elevation is 650 to 900 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is light brownish gray, very strongly alkaline silt loam about 7 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray and light gray, very strongly alkaline and strongly alkaline silt loam. In some areas the surface layer is dark gray.

Included in this unit are areas of Esquatzel, Toppenish, and Warden soils. Also included are areas of soils that

are underlain by a hardpan at a depth of 20 to 40 inches and Umapine soils that have not been artificially drained.

Permeability of this Umapine soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 24 to 48 inches from November to June. Runoff is very slow, and the hazard of water erosion is moderate. This unit is subject to rare periods of flooding.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. The main irrigated crops are asparagus, corn, hops, peas, and grain. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are alkalinity and the hazard of water erosion. Reclamation of the soil in this unit may require the addition of such amendments as gypsum, sulfur, or ferric sulfate to facilitate leaching and reduce alkalinity. Unless drainage systems are maintained, the soil has a seasonal high water table during the irrigation season. Dikes need to be maintained to provide protection from flooding.

Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation is used, runs should be on the contour or across the slope. Sprinkler irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, application of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Growing mint in meadows rather than in rows greatly reduces erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

This unit is poorly suited to homesite development. The main limitations are the hazard of flooding and wetness. Flooding can be controlled by the use of dikes and channels that have outlets to bypass floodwater. Wetness can be reduced by installing drain tile around footings. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is wetness. Deep drainage helps to overcome this limitation.

This map unit is in capability subclass IIIw, irrigated.

171—Wanser loamy fine sand. This very deep, artificially drained, salt- and alkali-affected soil is on terraces in basins. It formed in sand. Slope is 0 to 5 percent. The native vegetation is mainly salt- and alkali-tolerant grasses and forbs. Elevation is 650 to 1,100 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 120 to 135 days.

Typically, the surface layer is grayish brown, moderately alkaline loamy fine sand about 6 inches thick. The upper part of the underlying material is dark grayish brown and grayish brown, moderately alkaline and strongly alkaline loamy fine sand about 51 inches thick, and the lower part to a depth of 60 inches or more is light brownish gray, strongly alkaline fine sand.

Included in this unit are areas of Hezel, Quincy, and Esquatzel soils and areas of Wanser soils that have not been artificially drained.

Permeability of this Wanser soil is rapid. Available water capacity is moderately high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. A seasonal high water table is at a depth of 42 to 60 inches from January to June. The soil is subject to rare periods of flooding.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. The main irrigated crops are grain and corn. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are wetness, low available water capacity, and the hazard of soil blowing. Deep-rooted crops are suited to areas where the drainage is adequate or where a drainage system has been installed and is maintained. Reclamation of the soil in this unit may require the addition of such amendments as gypsum, sulphur, or ferric sulfate to facilitate leaching. Unless drainage systems are maintained, the soil has a seasonal high water table during the irrigation season. Dikes need to be maintained to provide protection for flooding.

Sprinkler irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of irrigation water, reduces runoff, and minimizes the risk of water erosion. The type of irrigation system used depends on the kind of crop grown. To avoid leaching of plant nutrients and loss of water by deep percolation, the water application rate should be adjusted to the available water capacity, the water intake rate, and the crop needs. Frequent, light applications of irrigation water are needed because of the rapid permeability of the soil.

The high hazard of soil blowing makes tillage and residue management extremely important. The soil should not be left barren while it is subject to erosion in winter and spring. Winter cover crops should be planted early and at right angles to the prevailing wind. Fall grain, hay, and pasture should be seeded late in August or early in September to provide sufficient cover in winter. Seedbed preparation should be done when irrigation water is available to keep the soil surface moist. Sufficient crop residue should be left on the surface. Use of straw, manure, or other waste material as a mulch reduces soil blowing, helps to maintain or improve the organic matter content, and conserves moisture. Use of shelterbelts also reduces soil blowing.

This unit is poorly suited to homesite development. The main limitation is the hazard of flooding. Flooding can be controlled by use of dikes and channels that have outlets to bypass floodwater. Because of the high hazard of soil blowing, construction sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in.

The main limitations for septic tank absorption fields are wetness and seepage. Wetness increases the possibility of the failure of the septic tank absorption fields. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage.

This map unit is in capability subclass IVw, irrigated.

172—Warden fine sandy loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine sediment and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,000 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown fine sandy loam about 5 inches thick. The subsoil is pale brown silt loam about 14 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown, stratified silt loam, loam, and very fine sandy loam. In some areas the surface layer is silt loam, and in some areas the soil is calcareous throughout.

Included in this unit are areas of Shano, Burke, Harwood, Wiehl, and Esquatzel soils.

Permeability of this Warden soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used for irrigated field and orchard crops, for wildlife habitat, and as homesites. The main irrigated crops are corn, grain, grapes, hops, mint, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is the hazard of soil blowing. Furrow, corrugation, trickle, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of irrigation system used depends on the kind of crop grown. Use of sprinkler and drip irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and reduce soil blowing. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. The soil should be protected from erosion by growing a cover crop or by maintaining crop residue on the surface in spring or until the crops are well established. Crop rows and irrigation furrows should be placed at right angles to the prevailing wind where feasible to reduce soil blowing. Vegetative barriers and windbreaks also reduce soil blowing. Mulching may be needed to stabilize small areas where soil blowing begins. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduce the volume of sediment in the tailwater.

This unit is well suited to homesite development. Soil blowing can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This unit has few limitations for septic tank absorption fields.

This map unit is in capability subclass IIe, irrigated.

173—Warden fine sandy loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine sediment and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,000 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown fine sandy loam about 5 inches thick. The subsoil is pale brown silt loam about 14 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown, stratified silt loam, loam, and very fine sandy loam. In some areas the surface layer is silt loam.

Included in this unit are small areas of Shano, Harwood, Burke, Wiehl, Outlook, and Esquatzel soils and Warden soils that have slopes of less than 2 percent.

Permeability of this Warden soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

The unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and

homesites. The main irrigated crops are corn, grain, grapes, hops, mint, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are the hazards of soil blowing and water erosion. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If furrow and corrugation irrigation systems are used, runs should be on the contour or across the slope. The risk of water erosion can be minimized by keeping runs short. Use of sprinkler and drip irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of water erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and reduce soil blowing. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. The soil should be protected from erosion by growing cover crops or maintaining crop residue on the surface in spring or until the crop is well established. Crop rows and irrigation furrows should be established at right angles to the prevailing wind where feasible. Vegetative barriers and windbreaks reduce soil blowing. Mulching may be needed to stabilize small areas where soil blowing begins.

Growing mint in meadows rather than in rows greatly reduces water erosion. A plowpan develops in this soil; however, it can be broken by subsoiling. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

The main limitations for nonirrigated crops are low annual precipitation and the hazards of soil blowing and water erosion. Because precipitation is not sufficient for annual cropping, a cropping systems that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early and stubble mulching. Stripcropping and seeding at right angles to the prevailing wind reduce soil blowing. Drop structures are needed in a few places to stabilize the flow of runoff in waterways. Waterways may need to be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass and needleandthread. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The soil in this unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is well suited to homesite development. Soil blowing can be a concern during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This unit has few limitations for septic tank absorption fields.

This map unit is in capability subclasses IIe, irrigated, and IVe, nonirrigated.

174—Warden fine sandy loam, 5 to 8 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine sediment and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,000 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown fine sandy loam about 5 inches thick. The subsoil is pale brown silt loam about 14 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown, stratified silt loam, loam, and very fine sandy loam. In some areas the surface layer is silt loam.

Included in this unit are small areas of Shano soils.

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

This unit is used for irrigated field and orchard crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are corn, grain, grapes, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are steepness of slope and the hazards of soil blowing and water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and reduce soil blowing. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. The soil should be protected from soil blowing by maintaining crop residue on the surface in spring or until the crops

are well established. Crop rows and irrigation furrows should be established at right angles to the prevailing wind where feasible. Vegetative barriers and windbreaks also reduce soil blowing. Mulching may be needed to stabilize small areas where soil blowing begins. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when soil is dry.

The potential native vegetation is mainly bluebunch wheatgrass and needleandthread. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The soil in this unit should be seeded in the fall using a drill. Adapted grasses and legumes should be seeded.

This unit is well suited to homesite development. Soil blowing is a concern during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This unit has few limitations for septic tank absorption fields.

This map unit is in capability subclasses IIIe, irrigated, and IVe, nonirrigated.

175—Warden fine sandy loam, 8 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine sediment and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,000 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown fine sandy loam about 5 inches thick. The subsoil is pale brown silt loam about 14 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown, stratified silt loam, loam, and very fine sandy loam. In some areas the surface layer is silt loam.

Included in this unit are small areas of Shano soils, soils that have a salt- and alkali-affected surface layer, and Warden soils that have slopes of less than 8 percent.

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

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain, grapes, and tree fruit. Grasses and legumes are grown for pasture, hay, and seed. A cover crop is grown in orchards.

The main limitations for irrigated crops are steepness of slope and the hazards of soil blowing and water erosion. A rotation of grain followed by alfalfa and grass commonly is used. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and reduce the risk of soil blowing. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. The soil should be protected from soil blowing by maintaining crop residue on the surface in spring or until the crops are well established. Crop rows and irrigation furrows should be established at right angles to the prevailing wind where feasible. Vegetative barriers and windbreaks also reduce soil blowing. Mulching may be needed to stabilize small areas where soil blowing begins. Cover crops reduce erosion in orchards and vineyards. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

The main limitations for nonirrigated crops are low annual precipitation and the hazards of soil blowing and water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, stripcropping, and seeding at right angles to the prevailing wind. Drop structures are needed in a few areas to stabilize the flow of runoff in waterways. Waterways may need to be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass and needleandthread. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The soil in this unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is suited to homesite development. The main limitation for use as homesites and septic tank absorption fields is steepness of slope. Slope can cause lateral seepage and surfacing of effluent in downslope areas. Lateral seepage can be avoided by installing absorption lines on the contour. Soil blowing may be a

problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

176—Warden silt loam, 0 to 2 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine sediment and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,000 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown silt loam about 5 inches thick. The subsoil is pale brown silt loam about 14 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown, stratified silt loam, loam, and very fine sandy loam. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of Shano, Harwood, Wiehl, Burke, and Esquatzel soils and areas of salt- and alkali-affected soils.

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

This unit is used for irrigated field and orchard crops, for wildlife habitat, and as homesites. The main irrigated crops are corn, grain, grapes, hops, mint, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

This unit has few limitations for crops. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Cover crops reduce erosion in orchards and vineyards. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is well suited to homesite development. Dustiness is a concern during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This unit has few limitations for septic tank absorption fields.

This map unit is in capability class I, irrigated.

177—Warden silt loam, 2 to 5 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine sediment and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,000 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown silt loam about 5 inches thick. The subsoil is pale brown silt loam about 14 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown, stratified silt loam, loam, and very fine sandy loam. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of Shano, Harwood, Burke, Wiehl, and Esquatzel soils. Also included are areas of salt- and alkali- affected soils and areas of Warden soils that have slopes of less than 2 percent or more than 5 percent.

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

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are corn, grain, grapes (fig. 7), hops, mint, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is the hazard of water erosion. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If furrow or corrugation systems are used, runs should be on the contour or across the slope. The risk of erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion.

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and

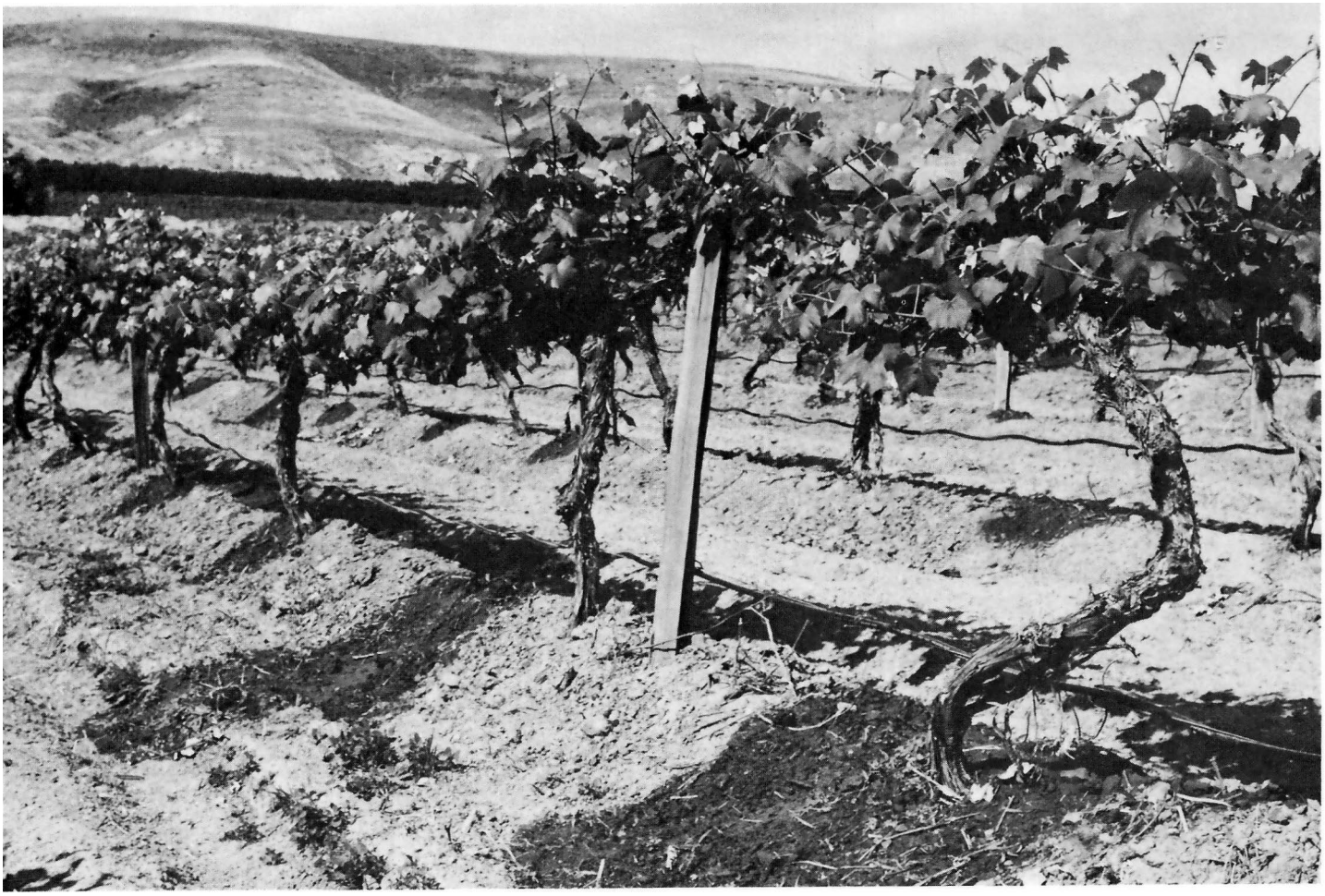


Figure 7.—Vineyard under drip irrigation on Warden silt loam, 2 to 5 percent slopes.

leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and reduce ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Growing mint in meadows rather than in rows greatly reduces erosion. Growing cover crops reduces erosion in orchards and vineyards. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, and shaping waterways and seeding them to perennial grass. Drop structures are needed in a few areas to stabilize the flow of runoff in waterways.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are

heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The soil in this unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is well suited to homesite development. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This unit has few limitations for septic tank absorption fields.

This map unit is in capability subclass IIe, irrigated and IVe, nonirrigated.

178—Warden silt loam, 5 to 8 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine sediment and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,000 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown silt loam about 5 inches thick. The subsoil is pale brown silt loam about 14 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown, stratified silt loam, loam, and very fine sandy loam. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of Shano soils and areas of Warden soils that have slopes of less than 5 percent or more than 8 percent.

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

This unit is used for irrigated field and orchard crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are corn, grain, grapes, peas, and tree fruit. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Cover crops reduce erosion in orchards and vineyards. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The soil in this unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is well suited to homesite development. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This unit has few limitations for septic tank absorption fields.

This map unit in is capability subclass IIIe, irrigated.

179—Warden silt loam, 8 to 15 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine sediment and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,000 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown silt loam about 5 inches thick. The subsoil is pale brown silt loam about 14 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown, stratified silt loam, loam, and very fine sandy loam. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of Harwood, Burke, Wiehl, Esquatzel, and Shano soils. Also included are areas of soils that have a salt- and alkali-affected surface layer and soils that have slopes of less than 8 percent or more than 15 percent.

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

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grapes and tree fruit. Grass and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are the steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Cultivation prior to irrigation improves the infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Cover crops reduce erosion in orchards and vineyards. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces and diversions, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The soil in this unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is suited to homesite development. The main limitation for use as homesites and septic tank absorption fields is steepness of slope. Slope can cause lateral seepage and surfacing of effluent in downslope areas. Lateral seepage can be reduced by installing absorption lines on the contour. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

180—Warden silt loam, 15 to 30 percent slopes. This very deep, well drained soil is on terraces. It formed in lacustrine sediment and has a mantle of loess. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 600 to 1,000 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 135 to 180 days.

Typically, the surface layer is brown silt loam about 5 inches thick. The subsoil is pale brown silt loam about 14 inches thick. The substratum to a depth of 60 inches or more is light gray and pale brown, stratified silt loam, loam, and very fine sandy loam. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of Shano, Scooteney, and Burke soils. Also included are areas of soils that have a salt- and alkali-affected surface layer and areas of Warden soils that have slopes of less than 15 percent or more than 30 percent.

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

This unit is used for irrigated field and orchard crops, nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are grain, grapes, and tree fruit. Grass and legumes are grown for hay, pasture, and seed. A cover crop is grown in orchards.

The main limitations for irrigated crops are steepness of slope and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Cultivation prior to irrigation increases the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to reduce runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Using a cropping system that includes close-growing, high-residue crops in the rotation reduces water erosion. Cover crops reduce erosion in orchards and vineyards. A plowpan develops in this soil from excessive tillage; however, it can be broken by chiseling or subsoiling when the soil is dry.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion.

Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, divided-slope farming, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass and Sandberg bluegrass. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The soil in this unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation for homesites and septic tank absorption fields is steepness of slope. Slope can cause lateral seepage and surfacing of effluent in downslope areas. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

This map unit is in capability subclass IVe, irrigated and nonirrigated.

181—Weirman sandy loam, channeled. This very deep, somewhat excessively drained soil is on low terraces and flood plains (fig. 8). The soil is dissected by intermittent and perennial streams. It formed in mixed alluvium. Slope is 0 to 5 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 1,700 feet. The average annual precipitation is 7 to 14 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is grayish brown sandy loam about 8 inches thick. The upper part of the underlying material is grayish brown and light brownish gray loamy fine sand about 13 inches thick, and the lower part to a depth of 60 inches or more is grayish brown extremely gravelly sand. In some areas the surface layer is fine sandy loam or is gravelly, cobbly, or stony sandy loam.

Included in this unit are areas of Zillah, Logy, and Yakima soils.

Permeability of this Weirman soil is rapid. Available water capacity is low. Effective rooting depth is limited by a seasonal high water table that is at a depth of 36 to 60 inches from April to November. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This unit is subject to frequent periods of flooding in spring.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly basin wildrye, bluebunch wheatgrass, big bluegrass, and willows. The main limitation for the production of forage is low available water capacity. If the range is overgrazed, the proportion of preferred forage plants such as basin wildrye and bluebunch wheatgrass decreases and the proportion of less preferred plants increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition, but seeding is difficult because of the areas that have cobbly or stony surface layer. The soil in this unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is limited for livestock watering ponds and other water impoundments because of seepage potential. Water tanks, springs, and pipeline systems are more effective and reliable means of providing water for livestock.

This map unit is in capability subclass VIw, nonirrigated.

182—Weirman fine sandy loam. This very deep, somewhat excessively drained soil is on low terraces and flood plains. It formed in mixed alluvium. Slope is 0 to 2 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 1,700 feet. The average annual precipitation is 7 to 14 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is grayish brown fine sandy loam about 8 inches thick. The upper part of the underlying material is stratified, grayish brown and light brownish gray loamy fine sand about 13 inches thick, and the lower part to a depth of 60 inches or more is grayish brown extremely gravelly sand.

Included in this unit are areas of Ashue, Zillah, Logy, and Yakima soils.

Permeability of this Weirman soil is rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. The soil is subject to rare periods of flooding.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. The main irrigated crops are corn, grain, grapes, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are the hazard of soil blowing and low available water capacity. Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation systems are used, the risk of erosion can be minimized by keeping

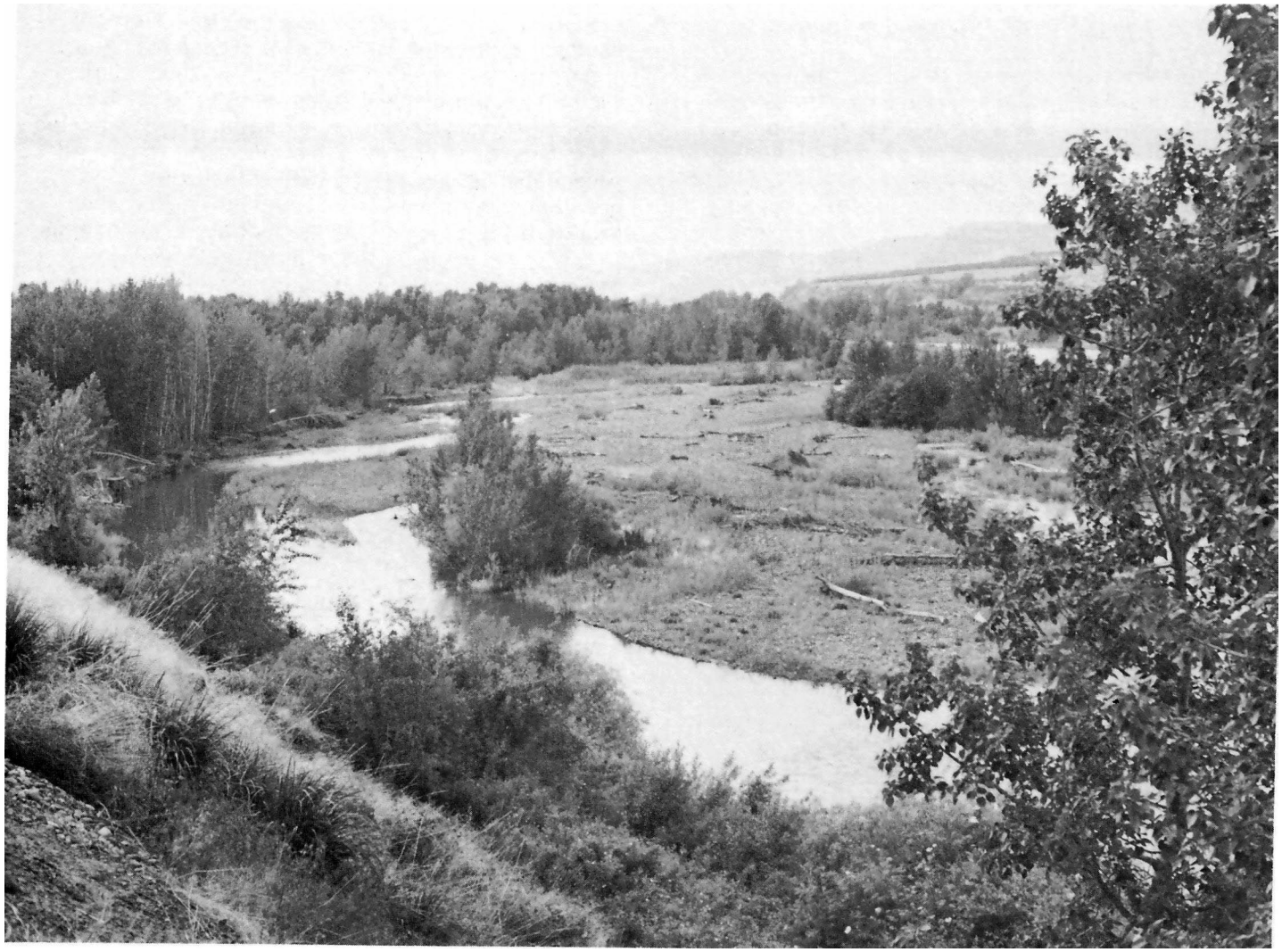


Figure 8.—Weirman sandy loam, channeled, with riparian vegetation

runs short. Use of sprinkler irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and reduce the risk of soil blowing. Using a cropping system that includes close-growing, high-residue crops in the rotation reduces erosion. The soil should be protected from erosion by maintaining crop residue on the surface until crops are well established in spring. Crop rows and irrigation furrows should be established at right angles to the prevailing wind where feasible. Vegetative barriers and windbreaks also reduce soil blowing. Mulching helps to stabilize small areas where soil blowing begins. Using vegetated filter strips at the end of rows reduces the volume of sediment in the tailwater. Exposing the extremely gravelly underlying material should be avoided when leveling fields. Shallow cuts are feasible in selected areas.

This unit is poorly suited to homesite development. The main limitation is the hazard of flooding. Flooding can be controlled by use of dikes and channels that have outlets to bypass floodwater. Soil blowing can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as

possible. Cutbanks are not stable and are subject to caving in.

The main limitation for septic tank absorption fields is seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability subclass IVe, irrigated.

183—Weirman gravelly fine sandy loam. This very deep, somewhat excessively drained soil is on low terraces and flood plains. It formed in mixed alluvium. Slope is 0 to 5 percent. The native vegetation is mainly grasses, forbs, and shrubs. Elevation is 700 to 1,700 feet. The average annual precipitation is 7 to 14 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is grayish brown gravelly fine sandy loam about 8 inches thick. The upper part of the underlying material is stratified, grayish brown and light brownish gray loamy fine sand about 13 inches thick, and the lower part to a depth of 60 inches or more is grayish brown extremely gravelly sand. In some areas the surface layer is sandy loam or fine sandy loam, or it is gravelly, cobbly, or stony

Included in this unit are areas of Zillah, Logy, and Yakima soils.

Permeability of this Weirman soil is rapid Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate. The soil is subject to rare periods of flooding.

The unit is used for irrigated crops, for wildlife habitat, and as homesites The main irrigated crops are corn, grain, and grapes Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are low available water capacity and the hazard of soil blowing Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit The type of system used depends on the kind of crop grown If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short and establishing them on the contour or across the slope. Use of sprinkler irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and reduce soil blowing. Using a cropping system that includes close-growing, high-residue crops in the rotation and using vegetative barriers and windbreaks also reduce soil blowing. The soil should be protected from soil blowing by maintaining crop residue on the surface until the crops are well established in spring. Crop rows and irrigation furrows should be established at right angles to the prevailing wind where feasible. Mulch can be used to stabilize small areas where soil blowing begins. Using vegetated filter strips at the end of rows reduces the volume of sediment in the tailwater. Exposing the extremely gravelly underlying material should be avoided when leveling fields Shallow cuts are feasible in some areas.

This unit is poorly suited to homesite development The main limitation is the hazard of flooding. Flooding can be controlled by the use of dikes and channels that have outlets to bypass floodwater. Soil blowing can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

The main limitation for septic tank absorption fields is seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage.

This map unit is in capability subclass IVe, irrigated.

184—Weirman fine sandy loam, wet. This very deep soil is on flood plains. It formed in mixed alluvium. Slope is 0 to 2 percent. The native vegetation is mainly water-tolerant sedges and rushes. Elevation is 700 to 1,700 feet. The average annual precipitation is 7 to 14 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is grayish brown fine sandy loam about 8 inches thick. The upper part of the underlying material is stratified, grayish brown and light brownish gray loamy fine sand about 13 inches thick, and the lower part to a depth of 60 inches or more is grayish brown gravelly sand. In some areas the surface layer is silt loam or is gravelly or cobbly

Included in this unit are areas of Zillah, Logy, and Yakima soils

Permeability of this Weirman soil is rapid Available water capacity is low. Effective rooting depth is limited by a seasonal high water table that is at a depth of 12 to 24 inches from April to November. Runoff is very slow, and the hazard of water erosion is slight The hazard of soil blowing is high The soil is subject to occasional periods of flooding in spring.

This unit is used for irrigated crops and as homesites Where the soil in the unit is drained and protected from flooding, the main irrigated crops are corn, grain, and peas Grasses and legumes are grown for hay and pasture.

The main limitations for irrigated crops are wetness, the hazard of soil blowing, and low available water capacity Deep-rooted crops are suited to areas where the natural drainage is adequate or where a drainage system has been installed. Dikes can be used to divert floodwater.

Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. Sprinkler irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Proper timing of minimum tillage reduces compaction Return of crop residue to the soil helps to maintain or improve the organic matter content, helps to maintain tilth, and reduces soil blowing. Using a cropping system that includes close-growing, high-residue crops in the rotation and using vegetative barriers and windbreaks also reduce soil blowing. The soil should be protected from soil blowing by maintaining crop residue on the surface until the crops are well established in spring Crop rows and irrigation furrows should be established at right angles to the prevailing wind where feasible. Mulch can be used to stabilize small areas where soil blowing begins.

Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry. Exposing the extremely gravelly substratum should be avoided when leveling fields Shallow cuts are feasible in some areas

This unit is poorly suited to homesite development The main limitations are the hazard of flooding and wetness. Flooding can be controlled by use of dikes and channels to bypass floodwater Deep drainage reduces the problem of wetness. Soil blowing can be a problem during construction on large building sites, therefore, these sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in.

The main limitations for septic tank absorption fields are the hazard of flooding, wetness, and seepage Wetness increases the possibility of failure of septic tank absorption fields. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage.

This map unit is in capability subclass IVw, irrigated.

185—Wenas silt loam. This very deep, artificially drained soil is on flood plains. It formed in alluvium Slope is 0 to 2 percent. The native vegetation is mainly water-tolerant grasses and forbs. Elevation is 1,100 to 1,800 feet. The average annual precipitation is 8 to 12 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is dark gray silt loam about 8 inches thick. The upper part of the subsoil is dark grayish brown silt loam about 20 inches thick, and the lower part is gleyed, gray silty clay loam about 9 inches thick. The upper part of the substratum is gleyed, grayish brown loam about 10 inches thick, and the lower part to a depth of 60 inches or more is gleyed, light brownish gray loamy sand and gravelly loamy sand. In some areas the soil is calcareous throughout the profile.

Included in this unit are about 5 percent Esquatzel soils, 5 percent Kittitas soils, and 5 percent Toppenish soils. Also included are areas of soils that are underlain by a hardpan at a depth of 20 to 40 inches and areas of Wenas soils that are not artificially drained.

Permeability of this Wenas soil is moderately slow Available water capacity is high Effective rooting depth is limited by a seasonal high water table that is at a depth of 24 to 42 inches from June to November Runoff is very slow, and the hazard of water erosion is slight The soil is subject to rare periods of flooding

This unit is used for irrigated crops, for wildlife habitat, and as homesites Where the soil in this unit is drained, the main irrigated crops are grain, hops, and peas. Grasses and legumes are grown for hay, pasture, and seed

The main limitation for irrigated crops is wetness Deep-rooted crops are suited to areas where a drainage system has been installed and is maintained. Dikes can be used to divert floodwater. Unless a drainage system is maintained, the soil in this unit has a seasonal high water table during the irrigation season.

Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Proper timing of minimum tillage and return of crop residue to the soil reduce compaction, help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater A plowpan develops in this soil, however, it can be broken by chiseling or subsoiling when the soil is dry.

This unit is poorly suited to homesite development The main limitations are the hazard of flooding and wetness. Flooding can be controlled by use of dikes and channels that have outlets to bypass floodwater. Deep drainage reduces the problem of wetness Dustiness can be a problem during construction on large building sites,

therefore, these sites should be disturbed as little as possible.

The main limitations for septic tank absorption fields are wetness and moderately slow permeability, which increase the possibility of failure of the absorption fields. Use of long absorption lines and sandy backfill for the trench helps to compensate for the moderately slow permeability.

This map unit is in capability subclass IIw, irrigated.

186—Willis fine sandy loam, 2 to 5 percent slopes. This well drained soil is on uplands. It is moderately deep over a hardpan. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 125 to 160 days.

Typically, the surface layer is grayish brown and brown fine sandy loam about 6 inches thick. The subsoil is brown silt loam about 16 inches thick. The substratum is brown and pale brown silt loam about 12 inches thick. A lime- and silica-cemented hardpan is at a depth of about 34 inches. Depth to the hardpan ranges from 20 to 40 inches. The hardpan generally is underlain by basalt, but in some areas it is underlain by gravel and sand or alternate layers of loess and hardpan. In some areas the surface layer is silt loam, and in some areas hardpan fragments are scattered throughout the profile and on the surface.

Included in this unit are areas of Harwood, Burke, Wiehl, Ritzville, Mikkalo, and Moxee soils and areas of Willis soils that have slopes of less than 2 percent.

Permeability of this Willis soil is moderate above the hardpan and very slow through it. Available water capacity is moderately high. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is high.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. The main irrigated crops are corn, grain, grapes, hops, mint, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are the hazard of soil blowing and depth to the hardpan. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. The risk of erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and reduce soil blowing. Using a cropping system that includes close-growing, high-residue crops in the rotation and using vegetative barriers and windbreaks also reduce soil blowing. The soil should be protected from soil blowing by maintaining crop residue on the surface until the crops are well established in spring. Crop rows and irrigation furrows should be established at right angles to the prevailing wind where feasible. Mulching helps to stabilize small areas where soil blowing begins. Growing mint in meadows rather than in rows greatly reduces erosion. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is poorly suited to homesite development. The main limitation for use as homesites is the moderate depth to the hardpan. The pan hinders excavation. Soil blowing can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, the moderate depth to the hardpan limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation.

This map unit is in capability subclass IIe, irrigated.

187—Willis silt loam, 2 to 5 percent slopes. This well drained soil is on uplands. It is moderately deep over a hardpan. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 125 to 160 days.

Typically, the surface layer is grayish brown and brown silt loam about 6 inches thick. The subsoil is brown silt loam about 16 inches thick. The substratum is brown and pale brown silt loam about 12 inches thick. A lime- and silica-cemented hardpan is at a depth of about 34 inches. Depth to the hardpan ranges from 20 to 40 inches. The hardpan generally is underlain by basalt, but in some areas it is underlain by sand and gravel or alternate layers of loess and hardpan. In some areas the surface layer is fine sandy loam, and in some areas hardpan fragments are throughout the profile and on the surface.

Included in this unit are small areas of Harwood, Burke, Wiehl, Ritzville, Mikkalo, and Moxee soils and areas of Willis soils that have slopes of less than 2 percent.

Permeability of this Willis soil is moderate above the hardpan and very slow through it. Available water

capacity is moderately high. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated and nonirrigated crops, as rangeland, for wildlife habitat, and as homesites. The main irrigated crops are corn, grain, grapes, hops, mint, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are the depth to the hardpan and the hazard of water erosion. Furrow, corrugation, drip, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used generally depends on the kind of crop grown. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. The risk of erosion can be minimized by keeping runs short. Use of sprinkler or drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion

Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Growing mint in meadows rather than in rows greatly reduces erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. Deep cuts should be avoided when leveling fields. Shallow cuts are feasible in some areas.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces and diversions, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grasses.

The potential native vegetation is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The soil in this unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation for use as homesites is the moderate depth to the hardpan, which hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, moderate depth to the hardpan limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation.

This map unit is in capability subclasses IIe, irrigated, and IIIe, nonirrigated.

188—Willis silt loam, 5 to 8 percent slopes. This well drained soil is on uplands. It is moderately deep over a hardpan. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 125 to 160 days.

Typically, the surface layer is grayish brown and brown silt loam about 6 inches thick. The subsoil is brown silt loam about 16 inches thick. The substratum is brown and pale brown silt loam about 12 inches thick. A lime- and silica-cemented hardpan is at a depth of about 34 inches. Depth to the hardpan ranges from 20 to 40 inches. The hardpan generally is underlain by basalt, but in some areas it is underlain by sand and gravel or alternate layers of loess and hardpan. In some areas the surface layer is fine sandy loam, and in some areas hardpan fragments are throughout the profile and on the surface.

Included in this unit are small areas of Harwood, Burke, Wiehl, Ritzville, Mikkalo, and Moxee soils.

Permeability of this Willis soil is moderate above the hardpan and very slow through it. Available water capacity is moderately high. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of water erosion is high.

This unit is used for irrigated and nonirrigated crops, rangeland, wildlife habitat, and homesites. The main irrigated crops are corn, grain, grapes, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are the depth to the hardpan, steepness of slope, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. Use of these irrigation systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, improve the water infiltration rate, and reduce erosion. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Cover crops reduce erosion in orchards and vineyards.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces and diversions, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grasses.

The potential native vegetation is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The soil in this unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitation for use as homesites is the moderate depth to the hardpan, which hinders excavation. Dustiness can be a problem during construction on large sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, the hardpan limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation.

This map unit is in capability subclass IIIe, irrigated.

189—Willis silt loam, 8 to 15 percent slopes. This well drained soil is on uplands. It is moderately deep over a hardpan. It formed in loess. The native vegetation is mainly grasses and shrubs. Elevation is 1,200 to 2,500 feet. The average annual precipitation is 9 to 12 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 125 to 160 days.

Typically, the surface layer is grayish brown and brown silt loam about 6 inches thick. The subsoil is brown silt loam about 16 inches thick. The substratum is brown and pale brown silt loam about 12 inches thick. A lime- and silica-cemented hardpan is at a depth of about 34 inches. Depth to the hardpan ranges from 20 to 40 inches. The hardpan commonly is underlain by basalt, but in some areas it is underlain by sand and gravel or alternate layers of loess and hardpan. In some areas hardpan fragments are throughout the profile and on the surface.

Included in this unit are areas of Harwood, Burke, Wiehl, Ritzville, Mikkalo, and Moxee soils.

Permeability of this Willis soil is moderate above the hardpan and very slow through it. Available water capacity is moderately high. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is moderate.

This unit is used for irrigated and nonirrigated crops, as rangeland, for wildlife habitat, and as homesites. The main irrigated crops are grain, corn, and grapes. Grass and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are depth to the hardpan, steepness of slope, and the hazard of water erosion. Sprinkler and drip irrigation systems are suited to the soil in this unit. Use of these systems permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. Cultivation prior to irrigation improves the water infiltration rate; however, the fine soil particles dislodged during cultivation are highly susceptible to water erosion. This makes the initial period of irrigation extremely critical. The water application rate should be reduced accordingly to help control runoff, erosion, and the production of sediment. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, improve the water infiltration rate, and reduce erosion. Tillage should be across the slope or on the contour. Using a cropping system that includes close-growing, high-residue crops in

the rotation and maintaining crop residue on the surface reduce water erosion. Annual or perennial cover crops reduce erosion in orchards and vineyards.

The main limitations for nonirrigated crops are low annual precipitation and the hazard of water erosion. Because precipitation is not sufficient for annual cropping, a cropping system that includes winter wheat and summer fallow is most suitable. Erosion can be reduced by seeding fall grain early, stubble mulching, using terraces and diversions, and stripcropping. Seeding on the contour or across the slope slows runoff and reduces erosion when the snow melts rapidly while the soil is still frozen. Drop structures are needed in places to control the flow of runoff in waterways. Waterways should be shaped and seeded to perennial grass.

The potential native vegetation is mainly bluebunch wheatgrass, Sandberg bluegrass, and big sagebrush. If the range is overgrazed, the proportion of preferred forage plants such as bluebunch wheatgrass decreases and the proportion of less preferred forage plants such as big sagebrush and rabbitbrush increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as chaining, railing, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. This unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is poorly suited to homesite development. The main limitations for use as homesites is the moderate depth to the hardpan and steepness of slope. The hardpan hinders excavation. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible.

If this unit is used for septic tank absorption fields, the moderate depth to the hardpan limits the capacity of the absorption fields. Use of long absorption lines helps to compensate for this limitation. Slope can cause lateral seepage and surfacing of the effluent in downslope areas. Absorption lines should be placed on the contour.

This map unit is in capability subclasses IVe, irrigated and IIIe, nonirrigated.

190—Yakima silt loam. This very deep, well drained soil is on flood plains. It formed in alluvium. Slope is 0 to 2 percent. The native vegetation is mainly grasses and shrubs. Elevation is 700 to 1,200 feet. The average annual precipitation is 9 to 14 inches, the average annual air temperature is about 54 degrees F, and the average frost-free season is 120 to 170 days.

Typically, the upper part of the surface layer is grayish brown silt loam about 13 inches thick. The lower part is dark grayish brown sandy loam and brown gravelly very fine sandy loam about 14 inches thick. The upper part of the underlying material is brown gravelly very fine sandy loam about 3 inches thick, and the lower part to a depth of 60 inches or more is dark grayish brown extremely gravelly coarse sand. In some areas the surface layer is gravelly or stony.

Included in this unit are areas of Logy, Esquatzel, and Weirman soils.

Permeability of this Yakima soil is moderate in the surface layer and very rapid in the underlying material. Available water capacity is moderately high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. This unit is subject to occasional periods of flooding in spring.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. The main irrigated crops are asparagus, grain, grapes, hops, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is the hazard of flooding. Dikes are effective in diverting floodwater. Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. Use of sprinkler irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should also be adjusted to the available water capacity and the crop needs. Pipe, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and reduce ditch erosion.

Proper timing of minimum tillage and return of crop residue to the soil reduce compaction, help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. A plowpan develops in this soil; however, it can be broken by chiseling or subsoiling when the soil is dry. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater. When leveling fields, care should be taken to avoid cutting into the very gravelly part of the substratum. Shallow cuts are feasible in some areas.

This unit is poorly suited to homesite development. The main limitation is the hazard of flooding. Flooding can be controlled by use of dikes and channels that have outlets to bypass floodwater. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in.

The main limitations for septic tank absorption fields are the hazard of flooding and seepage. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies

as a result of seepage from onsite sewage disposal systems.

This map unit is in capability subclass IIw, irrigated.

191—Zillah sandy loam. This very deep, artificially drained soil is on flood plains. It formed in recent alluvium. Slope is 0 to 2 percent. The native vegetation is mainly water-tolerant trees, sedges, and forbs. Elevation is 600 to 1,100 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is grayish brown sandy loam about 12 inches thick. The upper part of the underlying material is gray silt loam about 30 inches thick, and the lower part to a depth of 60 inches or more is gray loamy sand. In some areas the surface layer is silt loam, and in some areas the part of the underlying material below a depth of 40 inches is very gravelly.

Included in this unit are areas of Ashue, Esquatzel, Toppenish, and Weirman soils. Also included are areas of Zillah soils that have not been artificially drained and areas of salt- and alkali-affected soils.

Permeability of this Zillah soil is moderate. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 24 to 48 inches from April to November. Runoff is very slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. The soil is subject to rare periods of flooding.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. Where the unit is drained and protected from flooding, the main irrigated crops are asparagus, corn, grain, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitations for irrigated crops are wetness and the hazard of soil blowing. Dikes can be used to divert floodwater. Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. Use of sprinkler irrigation permits the even, controlled application of water and reduces runoff. To avoid loss of water and leaching of plant nutrients from overirrigation, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the crop needs.

Use of minimum tillage and return of crop residue to the soil help to maintain or improve the organic matter content, help to maintain tilth, and reduce soil blowing. Using a cropping system that includes close-growing, high-residue crops in the rotation and using vegetative barriers and windbreaks also reduce soil blowing. The soil should be protected from soil blowing by maintaining crop residue on the surface until the crops are well established in spring. Crop rows and irrigation furrows should be established at right angles to the prevailing wind where feasible. Mulch can be used to stabilize small areas where soil blowing begins.

This unit is poorly suited to homesite development. The main limitations are wetness and the hazard of flooding. Flooding can be controlled by use of dikes and channels that have outlets to bypass floodwater. Deep drainage reduces the problem of wetness. Soil blowing can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in.

The main limitation for septic tank absorption fields is wetness, which increases the possibility of failure of septic tank absorption fields. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage.

This map unit is in capability subclass IIw.

192—Zillah silt loam. This very deep, artificially drained soil is on flood plains. It formed in recent alluvium. Slope is 0 to 2 percent. The native vegetation is mainly water-tolerant trees, sedges, and forbs. Elevation is 600 to 1,100 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is grayish brown silt loam about 12 inches thick. The upper part of the underlying material is gray silt loam about 30 inches thick, and the lower part to a depth of 60 inches or more is gray loamy sand. In some areas the surface layer is sandy loam, and in some areas the part of the underlying material below a depth of 40 inches is very gravelly.

Included in this unit are areas of Ashue, Esquatzel, Toppenish, and Weirman soils. Also included are areas of soils that have not been artificially drained and areas of salt- and alkali-affected soils.

Permeability of this Zillah soil is moderate. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 24 to 48 inches during the months of April to November. Runoff is very slow, and the hazard of water erosion is slight. The soil is subject to rare periods of flooding.

This unit is used for irrigated crops, for wildlife habitat, and as homesites. Where the unit is drained and protected from flooding, the main irrigated crops are asparagus, corn, grain, grapes, and peas. Grasses and legumes are grown for hay, pasture, and seed.

The main limitation for irrigated crops is wetness. Dikes can be used to divert floodwater. Furrow, corrugation, and sprinkler irrigation systems are suited to the soil in this unit. The type of system used depends on the kind of crop grown. If surface irrigation systems are used, the risk of erosion can be minimized by keeping runs short. Use of sprinkler and drip irrigation permits the even, controlled application of water, reduces runoff, and minimizes the risk of erosion. To avoid loss of water and leaching of plant nutrients from overirrigation,

applications of irrigation water should also be adjusted to the available water capacity and the crop needs.

Proper timing of minimum tillage and return of crop residue to the soil reduce compaction, help to maintain or improve the organic matter content, help to maintain tilth, and improve the water infiltration rate. Using a cropping system that includes close-growing, high-residue crops in the rotation and maintaining crop residue on the surface reduce water erosion. Using vegetated filter strips at the end of rows or using sediment ponds, or both, reduces the volume of sediment in the tailwater.

This unit is poorly suited to homesite development. The main limitations are wetness and the hazard of flooding. Deep drainage reduces wetness. Flooding can be controlled by use of dikes and channels that have outlets to bypass floodwater. Dustiness can be a problem during construction on large building sites; therefore, these sites should be disturbed as little as possible. Cutbanks are not stable and are subject to caving in.

The main limitation for septic absorption fields is wetness, which increases the possibility of failure of absorption fields. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage.

This map unit is in capability subclass IIw, irrigated.

193—Zillah silt loam, channeled. This very deep, somewhat poorly drained soil is in ponded areas on flood plains. The soil is dissected by intermittent and perennial streams. It formed in recent alluvium. Slope is 0 to 2 percent. The native vegetation is mainly water-tolerant trees, sedges, and forbs. Elevation is 600 to 1,100 feet. The average annual precipitation is 6 to 9 inches, the average annual air temperature is about 49 degrees F, and the average frost-free season is 130 to 180 days.

Typically, the surface layer is grayish brown silt loam about 12 inches thick. The upper part of the underlying material is gray silt loam about 30 inches thick, and the lower part to a depth of 60 inches or more is gray loamy sand. In some areas the surface layer is cobbly or stony, in some areas the soil is cobbly or stony throughout, and in some areas the part of the underlying material below a depth of 40 inches is very gravelly.

Included in this unit are areas of Ashue, Esquatzel, and Weirman soils.

Permeability of this Zillah soil is moderate. Available water capacity is high. Effective rooting depth is limited by a seasonal high water table that is at a depth of 0 to 12 inches from April to November. Runoff is very slow. The soil is subject to frequent periods of flooding in spring.

This unit is used as rangeland and for wildlife habitat.

The potential native vegetation is mainly basin wildrye, tufted hairgrass, sedges, and willows. The main limitation for the production of forage is wetness. If the range is overgrazed, the proportion of preferred forage plants such as basin wildrye and bluebunch wheatgrass decreases and the proportion of less preferred forage plants increases. Areas that are heavily infested with undesirable vegetation can be improved by such methods as railing, chaining, beating, plowing, chemical treatment, and prescribed burning. Range seeding is a suitable practice if the range vegetation is in poor condition. The soil in this unit should be seeded in fall using a drill. Adapted grasses and legumes should be seeded.

This unit is limited for livestock watering ponds and other water impoundments because of the seepage potential. Water tanks are a more effective and reliable means of storing water for livestock.

This map unit is in capability subclass VIw, nonirrigated.

prime farmland

Prime farmland, as defined by the United States Department of Agriculture, is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It must either be used for producing food or fiber or be available for these uses. It has the soil quality, length of growing season, and moisture supply needed to economically produce a sustained high yield of crops when it is managed properly. Prime farmland produces the highest yields with minimal energy and economic resources, and farming it results in the least disturbance of the environment.

Prime farmland commonly has an adequate and dependable supply of moisture from precipitation or irrigation. It also has a favorable temperature and length of growing season and an acceptable level of acidity or alkalinity. It has few if any rock fragments and is permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods and is not flooded during the growing season. The slope is mainly 0 to 5 percent. Soils that are limited by a high water table, a hazard of flooding, or low rainfall may qualify for prime farmland if these limitations are overcome by practices such as drainage, flood control, or irrigation. Onsite investigation is needed to determine the extent of these limitations.

About 136,000 acres, or nearly 15 percent, of the survey area meets the soil requirements for prime farmland if irrigated. About 60 percent of this is in general soil map unit 4, in the east-central part of the area, and minor amounts are in map units 1, 7, 8, and 9. In addition, about 37,000 acres, or nearly 4 percent, of the survey area meets the requirements for prime farmland if the soils are adequately irrigated, adequately drained, and reclaimed. These soils are primarily in map units 4 and 8, in the east-central and southern parts of the area.

Crops grown on the prime farmland in this survey area are mainly corn, hops, asparagus, mint, and tree fruit such as apples, cherries, peaches, and pears. These crops support a sizeable light industry that includes processing, storing, and shipping the crops and marketing farm supplies.

A recent trend in land use in some parts of the area has been to convert areas of prime farmland to industrial and urban areas. The loss of prime farmland to these and other uses has made it necessary to farm areas that generally are more erodible, droughty, and difficult to cultivate and are less productive.

The following map units meet the requirements for prime farmland if irrigated. The practices needed in addition to irrigation to overcome the limitations, if any, are shown in parentheses after the map unit name. The extent of each map unit is given in table 4, the location is given on the detailed soil maps in the back of this publication, and the soil qualities that affect use and management are described in the section "Detailed soil map units." This list does not constitute a recommendation for a particular land use.

2 Ashue loam
4 Bickleton silt loam, 0 to 5 percent slopes
10 Burke silt loam, 2 to 5 percent slopes
18 Cleman very fine sandy loam, 0 to 2 percent slopes
19 Cleman very fine sandy loam, 2 to 5 percent slopes
24 Cowiche loam, 2 to 5 percent slopes
32 Esquatzel silt loam, 0 to 2 percent slopes
33 Esquatzel silt loam, 2 to 5 percent slopes
46 Harwood loam, 2 to 5 percent slopes
50 Harwood-Burke-Wiehl silt loams, 2 to 5 percent slopes
66 Kittitas silt loam (if artificially drained and reclaimed)
79 Mikkalo silt loam, 0 to 5 percent slopes
86 Naches loam
91 Outlook fine sandy loam (if artificially drained and reclaimed)
92 Outlook silt loam (if artificially drained and reclaimed)
97 Renslow silt loam, basalt substratum, 0 to 5 percent slopes
99 Ritzville silt loam, 2 to 5 percent slopes
104 Ritzville silt loam, basalt substratum, 0 to 5 percent slopes
124 Scooteney silt loam, 0 to 2 percent slopes
125 Scooteney silt loam, 2 to 5 percent slopes
128 Selah silt loam, 2 to 5 percent slopes
132 Shano silt loam, 2 to 5 percent slopes
139 Sinloc silt loam, 0 to 2 percent slopes (if artificially drained and reclaimed)
140 Sinloc silt loam, 2 to 5 percent slopes (if artificially drained and reclaimed)
156 Tieton fine sandy loam, 2 to 5 percent slopes
157 Tieton loam, 0 to 2 percent slopes
158 Tieton loam, 2 to 5 percent slopes
163 Toppenish silt loam
168 Umapine silt loam, 0 to 5 percent slopes (if artificially drained and reclaimed)
169 Umapine silt loam, drained, 0 to 2 percent slopes
170 Umapine silt loam, drained, 2 to 5 percent slopes
172 Warden fine sandy loam, 0 to 2 percent slopes
173 Warden fine sandy loam, 2 to 5 percent slopes
176 Warden silt loam, 0 to 2 percent slopes
177 Warden silt loam, 2 to 5 percent slopes
185 Wenas silt loam
186 Willis fine sandy loam, 2 to 5 percent slopes
187 Willis silt loam, 2 to 5 percent slopes
190 Yakima silt loam
192 Zillah silt loam