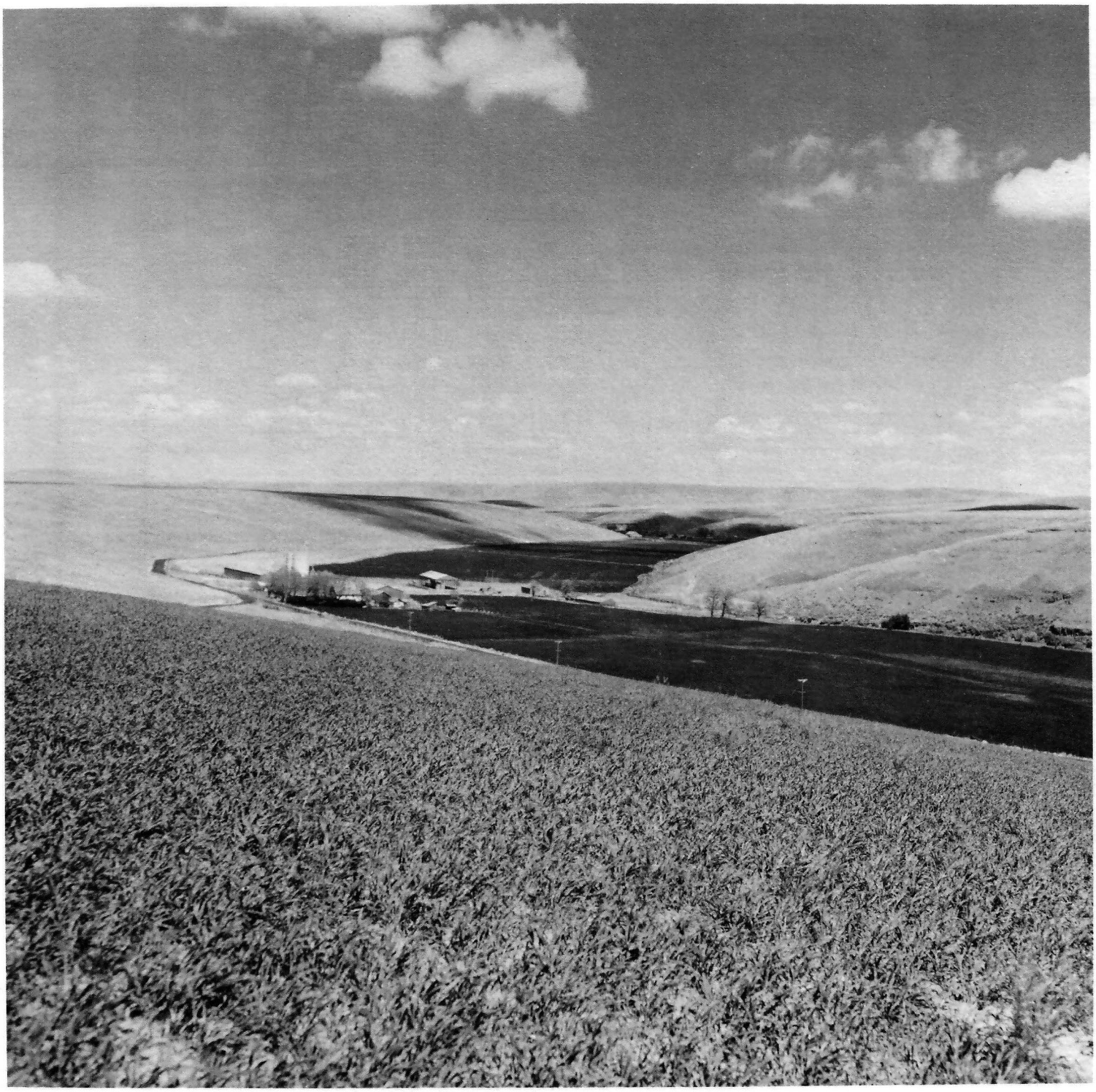
United States
Department of
Agriculture

Soil
Conservation
Service

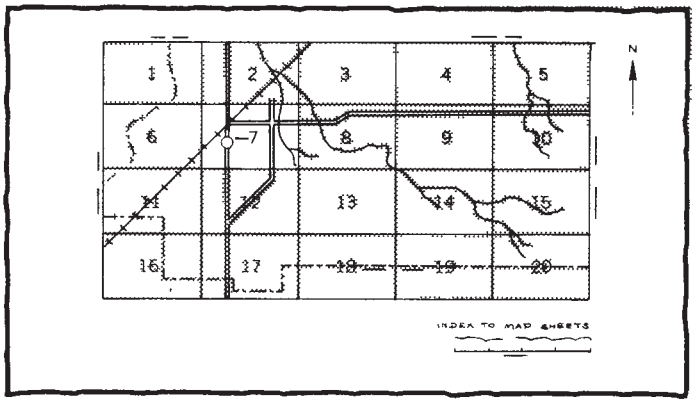
In Cooperation with
Oregon Agricultural
Experiment Station

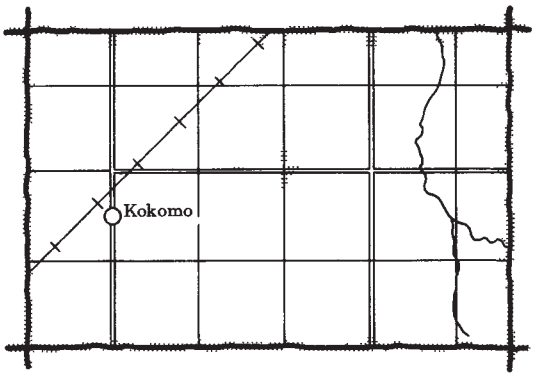
Soil Survey of Morrow County Area, Oregon



HOW TO USE

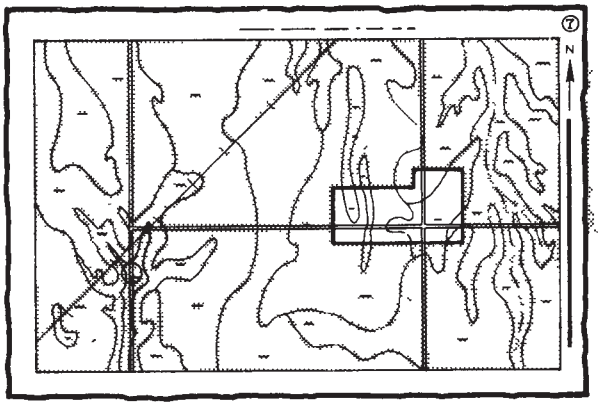
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

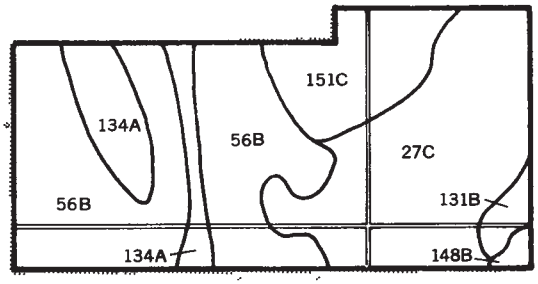




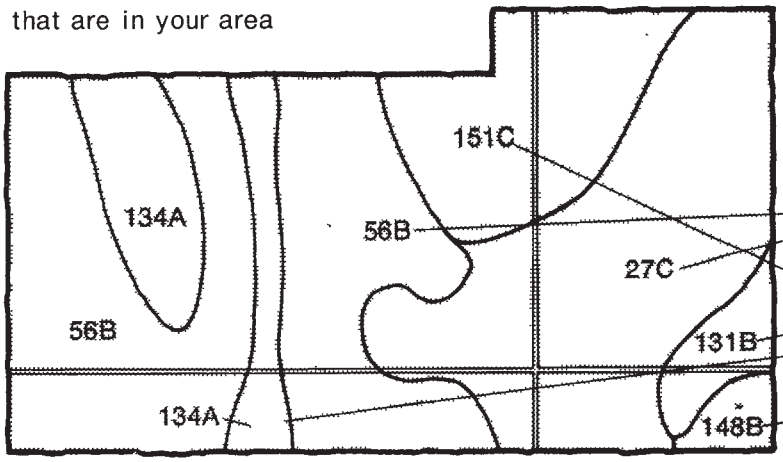
2. Note the number of the map sheet and turn to that sheet.

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





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

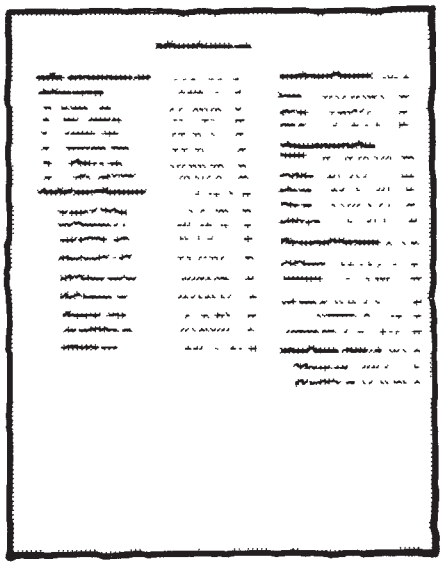


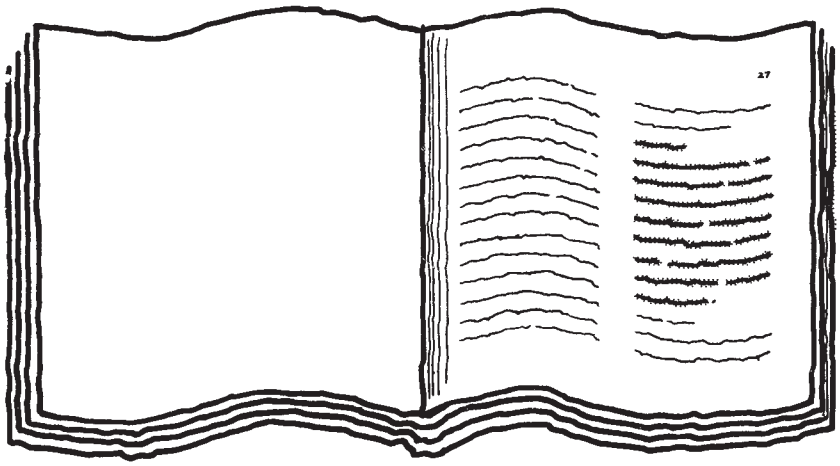
Symbols

27C
56B
131B
134A
148B
151C

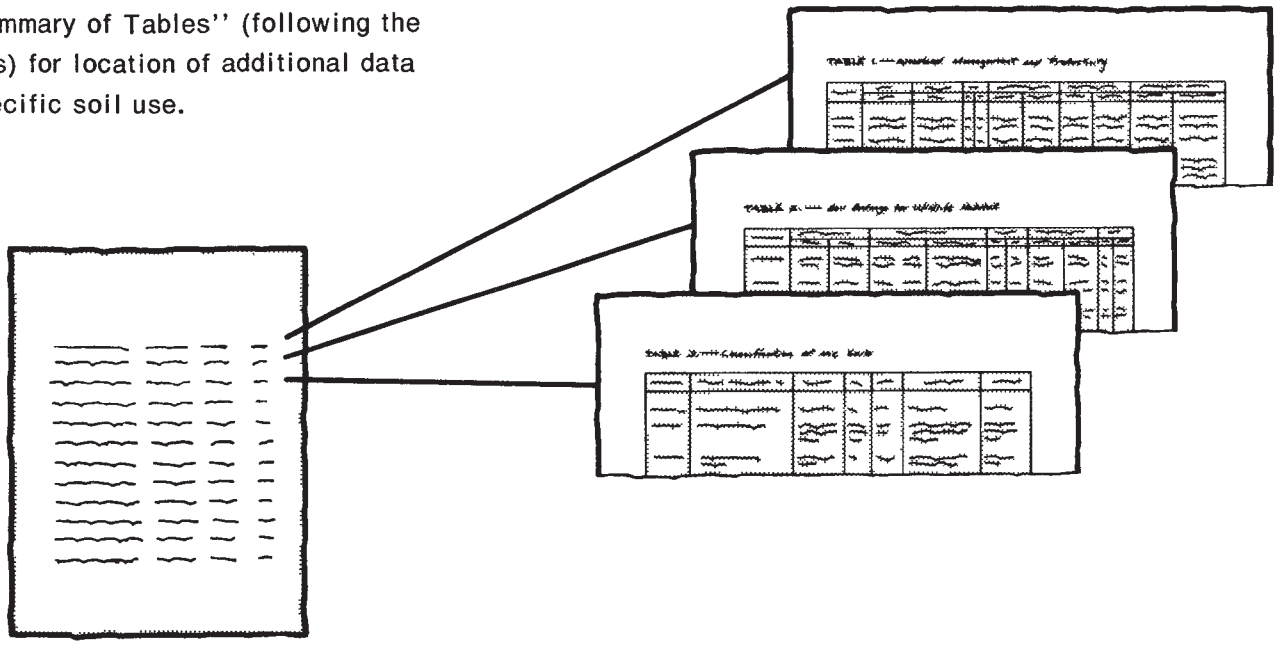
THIS SOIL SURVEY

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 1969-76. Soil names and descriptions were approved in 1976. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1976. This survey was made cooperatively by the Soil Conservation Service and the Oregon Agricultural Experiment Station. Morrow County provided funds during the course of the survey to accelerate the soil survey fieldwork. This survey is part of the technical assistance furnished to the Morrow County Soil and Water Conservation District.

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

Cover: Dark strip on bottom land along Little Butter Creek is Onyx silt loam. The crop is irrigated alfalfa. In the foreground is wheat on Ritzville silt loam, 12 to 20 percent slopes.

Contents

Soil series

Issued December 1983

Index to map units

Summary of tables

Foreword

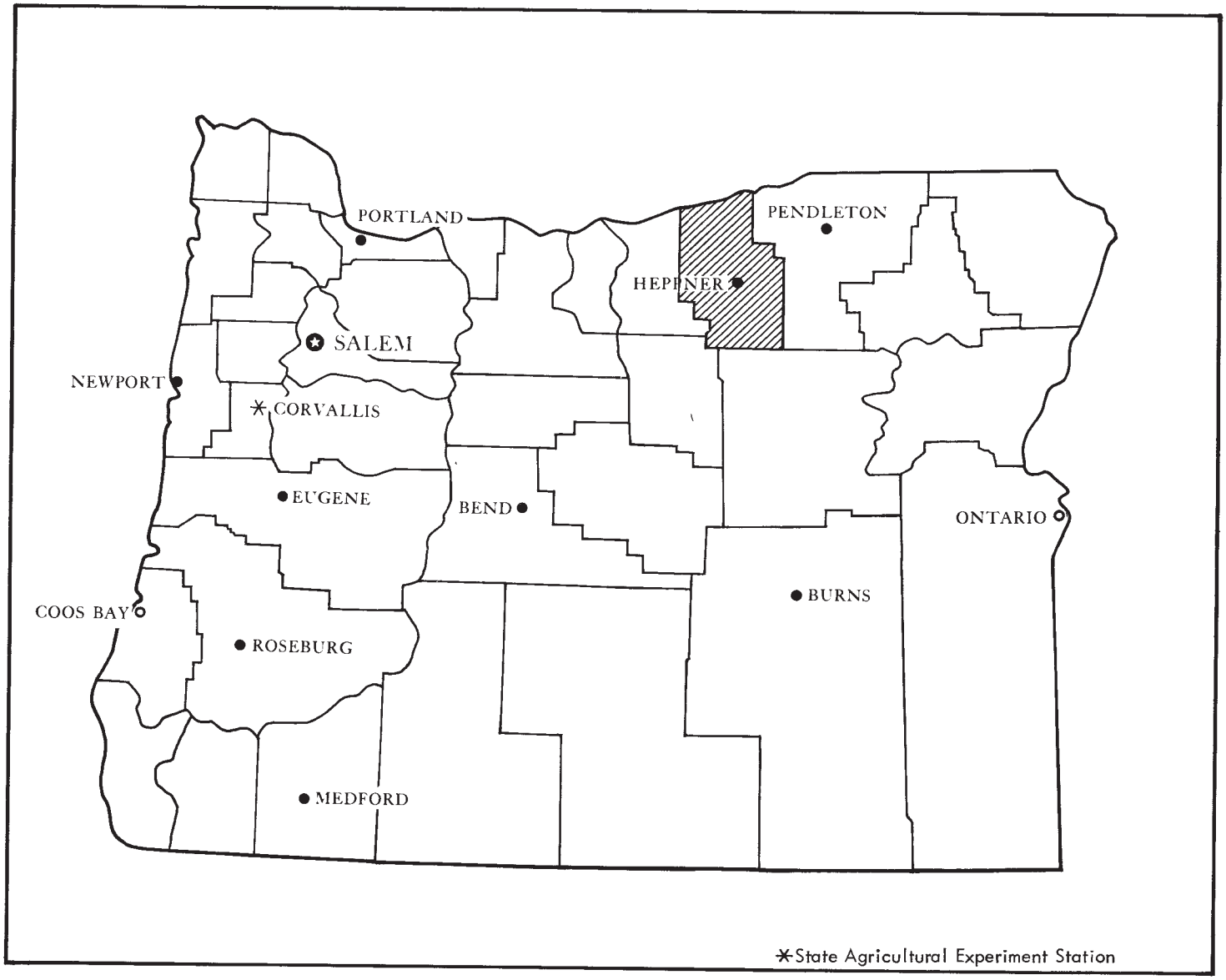
This soil survey contains information that can be used in land-planning programs in Morrow County Area, Oregon. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and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

Guy W. Nutt
State Conservationist
Soil Conservation Service



Location of Morrow County Area in Oregon.

Soil survey of
Morrow County Area, Oregon

By Richard E. Hosler, Soil Conservation Service

Fieldwork by Richard E. Hosler, David R. Johnson, Duane K. Monte, George L. Green, Terry A. Dallin, and Dal F. Ames, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Oregon Agricultural Experiment Station

The MORROW COUNTY AREA is in the north-central part of Oregon. Heppner, the county seat, has a population of 1,500. The county has a total land area of 1,317,700 acres. The area surveyed is 1,311,143.

General nature of the survey area

On the pages that follow is general information on the climate of the Morrow County Area, the physiography, relief, and drainage, the history and development, the natural resources, and the farming and ranching.

Climate

By Ben Davis, meteorologist, Statistical Climatology Branch, Environmental Data Service, National Oceanic and Atmospheric Administration, Asheville, N.C

The Rocky Mountains partly shield Morrow County from strong arctic winds. Winters are cold but are generally not too severe. In summer Pacific Ocean winds are partly blocked by the Coast and Cascade Mountain Ranges. Days are hot, but nights are fairly cool. Except in mountainous areas, precipitation is scant in summer. In many places, however, it is adequate during the cooler parts of the year for unirrigated small grain or rangeland. The snowpack accumulation at high elevations supplies irrigation water for intensive farming in parts of the lowland.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Arlington and Heppner, Oregon, in the period 1931 to 1973. 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.

Along the Columbia River in winter the average temperature is 37 degrees F, and the average daily minimum temperature is 30 degrees. The lowest temperature on record, which occurred at Arlington, Oregon, on January 27, 1957, is -22 degrees. In summer the average temperature is 73 degrees, and the average daily maximum temperature is 89 degrees. The highest recorded temperature, which occurred at Arlington, Oregon, a few miles west of Morrow County, on August 4, 1961, is 115 degrees. In winter farther south in the county where the elevation is about 2,000 feet, the average temperature is 36 degrees F, and the average daily minimum temperature is 28 degrees. The lowest temperature on record, which occurred at Heppner on January 26, 1957, is -15 degrees. In summer the average temperature is 66 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred on August 5, 1961, is 107 degrees.

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

Frost kills many crops at 32 degrees F. It kills some crops only if the temperature is 28 degrees or lower. The length of the period between the last killing frost in spring and the first killing frost in fall, at 32 degrees and at 28 degrees, is given in the descriptions of the soil map units in this report.

Of the total annual precipitation, 2 inches, or 25 percent, falls along the Columbia River in April through September, which includes the growing season for most crops. During this same period, 5 inches, or 40 percent, falls at elevations that are higher but are below the forest. In 2 years out of 10, the rainfall in April through September is less than 2 inches along the river and is less than 5 inches farther south. Thunderstorms occur on about 10 days each year. Most occur in summer.

Average seasonal snowfall ranges from 9 inches along the Columbia River to 17 inches at the higher elevations, but below the forest. The greatest snow depth at any one time during the period of record was 12 inches. On the average, 8 days have at least 1 inch of snow, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 50 percent. Humidity is higher at night, and the average at dawn is about 60 percent. The sun shines 80 percent of the time possible in summer and 30 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 11 miles per hour, in April.

Physiography, relief, and drainage

The survey area is within the Columbia Basin, the Columbia Plateau, and the Blue Mountain physiographic provinces. The area within the Columbia Basin Province is a lava-floored plain overlain by sand, gravel, and silt. This material, deposited during past flooding and damming of the Columbia River, was further reworked by wind. The Columbia River, which marks the northern survey boundary, has an average elevation of about 250 feet. Elevations in this region range from about 250 feet along the Columbia River to about 1,000 feet at the southern boundary. The terrain is dominated by a mixed rolling and nearly level relief.

The Columbia Plateau is a lava-floored plain that has been uplifted since molten basalt flooded the area. In Morrow County the basalt is overlain by wind deposited silt or loess. Elevations in this region range from about 500 feet on some bottom lands to about 4,300 feet where the plateau borders the Blue Mountains. This region is dominated by nearly level to rolling, stream-dissected terrain.

The Blue Mountain region is a tilted, folded, and faulted uplift of the Columbia River basalt and older underlying rocks. Topography is largely the result of erosion and stream cutting in the basalt. Flattopped ridges, broad flats, steep-walled canyons, and mountain slopes characterize this section of the county. Ash deposited during the past volcanic activity in the Cascades influences the soils in this region, especially the north-facing slopes. Elevations range from about 2,600 feet along some canyon bottoms to about 5,900 feet at the summit of Black Mountain.

The Blue Mountains, in the southeastern part of the county, divide the two main watersheds in Morrow County. North and west of the mountain summits, drainage is to the Columbia River, except for Rock Creek, which flows to the west into the main fork of the John Day River. South and east of the summits, drainage is to the north fork of the John Day.

The drainage pattern is controlled mainly by the underlying basalt. Channels have been modified but little by the mantle of loess. Stream gradients are determined by the tilt of the basalt.

Most of the area, about 1,072,000 acres, drains to the north into the Columbia River. The major waterways in this watershed are Butter Creek, Rhea Creek, Willow Creek, Eight Mile Canyon, and Sand Hollow. The Rock Creek Watershed, about 101,000 acres, drains to the west into the main fork of the John Day River. The rest, about 145,000 acres, drains to the south into the north fork of the John Day River. The major waterways in this watershed are Ditch Creek, Potamus Creek, Alder Creek, Wall Creek, and Johnson Creek.

Elevations of some of the towns are Irrigon, 300 feet; Boardman, 300 feet; Butter Creek Junction, 1,000 feet; Ione, 1,000 feet; Lexington, 1,440 feet; Heppner, 1,950 feet; and Hardman, 3,560 feet.

History and development

The Lewis and Clark expedition of 1805-06 on the Columbia River passed north of what is now Morrow County (*6*). The Oregon Trail, in the early 1840's, crossed the county about 15 miles south of the Columbia River.

The first permanent residents of the area arrived in the 1850's. They were mostly stockmen who grazed their cattle and sheep on the fine bunchgrass rangeland of the county.

In the 1870's and 1880's more settlers came. Most came as homesteaders. They planted and harvested wheat on the rolling hills from Ella in the north to Rawdog, now Hardman, in the south.

Morrow County was organized in 1885 from the western part of Umatilla County. In 1890, the population was 4,215. It increased to a high of 5,617 in 1920. In 1974, the population was 4,750.

Heppner, the county seat, has a population of 1,500. Boardman, the fastest growing town, has a population of 525. Ione has 435 people, Irrigon 335, and Lexington 245. Hardman still has a few inhabitants as does Cecil, the first settlement.

Natural resources

The major natural resources important to Morrow County are the soil, the waters of the Columbia River and other perennial streams, the underground water, the timber produced in the southern part of the county, the wildlife, and the recreation facilities. Mineral resources of value are scarce in Morrow County.

The Columbia River provides valuable irrigation water to northern Morrow County. As a result of irrigation, farming is more intensive, yields are higher, and droughty, formerly unproductive soils are now productive cropland. In addition, the Columbia River provides barge transportation of crops to larger ports and also provides hydroelectric power.

In the north-central part of the county, underground water supplies tapped by deep wells provide valuable irrigation water. Water in the few perennial streams in the central part of the county also provides irrigation water along their channels, increasing alfalfa and wheat yields. Rock Creek, Rhea Creek, Willow Creek, and Butter Creek are the major perennial streams in the central part of the county.

The southern part of Morrow County, an extension of the Blue Mountains, receives sufficient precipitation to support trees. Douglas-fir and ponderosa pine are the two dominant species. Conditions are favorable for good stands of marketable timber. The harvested logs are trucked to a mill at Heppner, as well as to mills in other areas. Also of value in this forested area are potential for recreation and wildlife habitat.

Morrow County has a wide variety of wildlife—another important natural resource. In the forested regions are Rocky Mountain elk, mule deer, black bear, blue and ruffed grouse along with a variety of other birds and mammals. Abundant throughout the rest of the county are mule deer, cottontail, coyote, badger, ring-necked pheasant, chukar, Hungarian partridge, hawk, owl, and golden eagle. Along the Columbia River and inland lakes in the northern part of the county, are large flocks of geese and ducks. The Columbia River and some of the main rivers in the forested region also provide habitat for a variety of fish, such as trout, salmon, and steelhead. Some of the lakes in northern Morrow County also support populations of panfish and bass.

The forests offer hunting, fishing, camping, hiking, horseback riding, swimming, and skiing. The rest of the county offers hunting, fishing, and boating.

Farming and ranching

The first settlers in Morrow County were mainly sheep and cattle ranchers. Homesteaders arrived in the 1870's. They settled on land extending from Ella in the north to the present community of Hardman in the south, breaking out the native bunchgrasses and growing mainly wheat in a crop-fallow rotation. Because of poor transportation and distances to market, most of the crop was consumed locally. In 1889, however, the railroad line along Willow Creek from the main line on the Columbia River was completed to Heppner (*6*).

Gasoline- and diesel-powered tillage and harvesting machinery has increased the size of operating units. Winter wheat and spring barley are grown almost exclusively in the dryland area.

A combination of the "black fallow," low crop-residue tillage, and the dry winds of the 1930's resulted in severe wind erosion, poor crops, and dust bowl conditions. In 1937 the Lexington Blow District, the first conservation district in the United States, was formed. On October 4, 1941, the Heppner Soil Conservation District was founded. It was bounded on the north by the Willamette baseline. It incorporated the Lexington Blow District. In the north, the Boardman Soil Conservation District was organized on May 5, 1947. On September 20, 1972, the two districts were combined forming the Morrow County Soil and Water Conservation District.

The dry northern part of Morrow County is not arable without irrigation. The mean annual precipitation is only 7 to 9 inches. In 1975, about 60,000 acres was irrigated, mainly by center pivot irrigation systems supplied by deep wells. The main crop is potatoes. Wheat, beans, corn, and hay are also grown. The irrigated acreage in this part of the county has increased rapidly in recent years. A wide range of crops can be grown under irrigation.

About 433,000 acres, or 33 percent, of the survey area is cropland. About 175,000 acres of this land is fallowed each year. About 45 percent of the survey area is pasture and rangeland. About 19 percent is forest and woodland of which 58 percent, or 136,000 acres, is national forest.

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 (*12*). 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 "Soil maps for detailed planning."

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.

Descriptions of map units

Areas dominated by moderately deep to very deep, well drained to excessively drained soils

These soils are on terraces near the Columbia River. The slope is mainly 0 to 20 percent. About three-fourths of the acreage is excessively drained and somewhat excessively drained. The rest is well drained. Soil blowing is a severe hazard.

Irrigation is commonly needed because precipitation is low. If irrigated, these soils produce a wide variety of crops.

Six map units are in this group.

1. Winchester

Very deep, excessively drained sands

This map unit consists of nearly level to hilly, hummocky, and dunelike soils on terraces. The soils formed in alluvial sand over alluvial deposits of gravel or material weathered from basalt bedrock. The vegetation is Indian ricegrass, bitterbrush, shrubs, grasses, and forbs. The elevation ranges from 300 to 700 feet. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 150 to 200 days at 32 degrees F. and 180 to 215 days at 28 degrees.

This unit makes up about 1 percent of the survey area. It is about 85 percent Winchester soils and 15 percent Burbank soils, Quincy soils, and Dune land.

Winchester soils, on hummocky terraces, are excessively drained. They have a surface layer of very dark grayish brown sand and a subsoil and substratum of very dark gray coarse sand. Depth to bedrock is more than 60 inches.

This unit is used for range and wildlife habitat and, where irrigated, for pasture, small grain, corn, and potatoes. The sparse vegetation is a limitation for wildlife. Birds and small mammals are common. The unit supports small populations of mule deer. In areas of irrigated crops, it provides habitat for upland game birds, such as ring-necked pheasant. Because it is near the Columbia River, it also provides habitat for waterfowl.

Runoff is medium on the steeper slopes and slight in the more level areas because of the coarse texture. It is not a serious limitation. Sediment from runoff is low. The hazard of soil blowing is high. A maximum plant cover on rangeland and timely seeding, cultivation, and irrigation minimize the hazard of erosion.

2. Quincy-Koehler

Moderately deep and very deep, somewhat excessively drained loamy fine sands

This map unit consists of gently sloping to hilly soils on terraces. The soils formed in alluvial sand over alluvial gravel deposits, a hardpan, or basalt. The vegetation is needleandthread, Indian ricegrass, shrubs, grasses, and forbs. The elevation ranges from 250 to 800 feet. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 140 to 200 days at 32 degrees F. and 180 to 230 days at 28 degrees.

This unit makes up about 8 percent of the survey area. It is about 70 percent Quincy soils, 25 percent Koehler soils, and 5 percent Burbank, Hezel, and Royal soils and Dune land.

Quincy soils, on terraces, are somewhat excessively drained. They are dark brown loamy fine sand throughout. Depth to bedrock is more than 60 inches.

Koehler soils, also on terraces, are somewhat excessively drained. They have a surface layer of very dark grayish brown loamy fine sand and underlying material of dark brown and brown loamy fine sand. A hardpan is at a depth of 20 to 40 inches.

This unit is used for range and, where irrigated, for pasture, small grain, corn, and potatoes. It also provides wildlife habitat. It supports small populations of mule deer. Birds and small mammals are common. In areas of irrigated crops, the unit provides habitat for upland game birds, such as ring-necked pheasant. Because it is near the Columbia River, this unit, especially the cropland, is utilized by waterfowl.

Runoff is slight. The hazard of soil blowing is high. Sediment from runoff is low. A maximum plant cover on rangeland and timely seeding, cultivation, and irrigation minimize the hazard of erosion.

3. Prosser

Moderately deep, well drained silt loams

This map unit consists of soils on nearly level terraces and rolling to hilly uplands. The soils formed in loess over basalt bedrock. The vegetation is needleandthread, bluebunch wheatgrass, and rabbitbrush. The elevation ranges from 300 to 600 feet. The average annual precipitation is 7 to 9 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 140 to 180 days at 32 degrees F. and 180 to 215 days at 28 degrees.

This unit makes up about 2 percent of the survey area. It is about 50 percent Prosser soils, 35 percent Quinton soils and Rock outcrop, and 15 percent Taunton, Warden, and Gravden soils.

Prosser soils, on bedrock terraces, are well drained. They have a surface layer of very dark grayish brown silt loam and a subsoil of dark brown silt loam. Depth to bedrock is 20 to 40 inches.

This unit is used mainly for range. A few areas are irrigated and used for pasture. The unit is also used for wildlife habitat. It supports small populations of mule deer. Birds and small mammals are common. In areas of irrigated crops, the unit provides habitat for upland game birds, such as ring-necked pheasant. The Rock outcrop and the steeper slopes along the Columbia River provide habitat for chukar. Because the unit is near the Columbia River, it provides habitat for an abundant variety of waterfowl.

Runoff is slight, and sediment from runoff is low. A maximum plant cover on rangeland, proper irrigation, and good stands in irrigated pasture minimize the hazard of erosion.

4. Sagehill-Taunton

Moderately deep and very deep, well drained and somewhat excessively drained fine sandy loams

This map unit is on terraces and terrace fronts. The soils formed in loess over lacustrine silt or a hardpan. The vegetation is bluebunch wheatgrass, needleandthread, Indian ricegrass, shrubs, and forbs. The elevation ranges from 500 to 1,200 feet. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is about 50 degrees F. The frost free period is 150 to 200 days at 32 degrees F. and 180 to 215 days at 28 degrees.

This unit makes up about 6 percent of the survey area. It is about 55 percent Sagehill soils, 15 percent Taunton soils, 20 percent Royal soils and Dune land, and 10 percent Ellum, Irrigon, Quincy, and Warden soils, and Xeric Torriorthents.

Sagehill soils, on terraces, are well drained. They have a surface layer of dark grayish brown fine sandy loam and a subsoil of dark brown fine sandy loam. Stratified lacustrine silt loam is at a depth of 20 to 40 inches. Depth to bedrock is more than 60 inches.

Taunton soils, also on terraces, are well drained. They have a surface layer of dark grayish brown fine sandy loam and a subsoil of dark brown fine sandy loam. A hardpan is at a depth of 20 to 40 inches.

This unit is used for range and wildlife habitat and, where irrigated, for pasture, hay, small grain, corn, and potatoes. It supports small populations of mule deer. Birds and small mammals are common. In areas of irrigated crops and along the major bottom lands, it provides habitat for upland game birds, such as ring-necked pheasant and valley quail. The scattered steeper canyon breaks throughout this unit provide habitat for chukar.

Runoff is medium on the steeper slopes and slight elsewhere. Sediment from runoff is low to moderate. Soil blowing is a moderate hazard. A maximum plant cover on rangeland and timely seeding, cultivation, and irrigation minimize the hazard of erosion.

5. Warden

Very deep, well drained silt loams and very fine sandy loams

This map unit is on terraces. The soils formed in loess over lacustrine silt. The vegetation is bluebunch wheatgrass, Sandberg bluegrass, shrubs, and forbs. The elevation ranges from 500 to 1,200 feet. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is about 51 degrees F. The frost free period is 140 to 180 days at 32 degrees F. and 180 to 215 days at 28 degrees.

This unit makes up about 5 percent of the survey area. It is about 90 percent Warden soils and 10 percent Ritzville, Sagehill, and Gravden soils, and Xeric Torriorthents.

Warden soils, on terraces, are well drained. They have a surface layer of dark brown silt loam or very fine sandy loam, a subsoil of brown silt loam, and a substratum of brown, strongly calcareous silt loam or very fine sandy loam. Depth to bedrock is more than 60 inches.

This unit is used for dryfarmed small grain, range, and wildlife habitat. Where irrigated, small grain, hay, and potatoes are grown. Birds and an assortment of small mammals are common. The unit supports small

populations of mule deer. Along the major bottom lands, it provides habitat for game birds, such as ring-necked pheasant and valley quail. The scattered steeper canyon breaks throughout the unit provide habitat for chukar.

Runoff is mainly from the steep terrace fronts. Sediment from runoff is low to moderate. Stubble mulch tillage, stripcropping, and diversions on dryfarmed cropland, timely irrigation, and a maximum plant cover on rangeland minimize the hazard of erosion.

6. Xeric Torriorthents-Kimberly

Very deep, well drained and somewhat excessively drained sandy loams

This map unit consists of soils formed in recent mixed alluvium on stream bottoms. In areas that are not cultivated, the vegetation is giant wildrye shrubs, and forbs. The elevation ranges from 200 to 1,200 feet. The average annual precipitation is 8 to 12 inches, and the average annual air temperature is 51 to 53 degrees F. The frost free period is 140 to 180 days at 32 degrees F. and 180 to 200 days at 28 degrees.

This unit makes up about 1 percent of the survey area. It is about 50 percent Xeric Torriorthents, 40 percent Kimberly soils, and 10 percent Esquatzel soils.

Xeric Torriorthents soils, on stream bottoms, are somewhat excessively drained. They have a surface layer of dark brown sandy loam. The underlying material is dark brown fine sandy loam over dark grayish brown gravelly sandy loam and very gravelly loamy sand. Depth to bedrock is more than 60 inches.

Kimberly soils, on stream bottoms, are well drained. They have a surface layer of dark brown fine sandy loam and a subsoil and substratum of moderately calcareous, brown and dark grayish brown sandy loam. Depth to bedrock is more than 60 inches.

Most of this unit is irrigated. It is used for alfalfa hay and aftermath grazing. It provides good food cover for upland game birds, such as ring-necked pheasant and valley quail. This unit and the adjacent slopes provide habitat for chukar. It also provides food and limited cover for mule deer and smaller mammals.

Streambanks should be shaped properly and stabilized to minimize the hazards of bank cutting and the sediment pollution of streams during heavy runoff.

Areas dominated by shallow to very deep, well drained and somewhat excessively drained soils

These soils are on stream bottoms and the tops and sides of ridges throughout the central part of the survey area. Nearly all are well drained. Water erosion is a hazard in most areas.

Many of the soils are farmed, mostly in a grain-fallow rotation.

Seven map units are in this group.

7. Onyx-Endersby

Very deep, well drained and somewhat excessively drained silt loams and fine sandy loams

This map unit consists of soils formed in recent mixed alluvium on stream bottoms. In areas that are not cultivated, the vegetation is giant wildrye grass and bluebunch wheatgrass. If drainage is restricted, it is saltgrass. The elevation ranges from 1,000 to 2,500 feet. The average annual precipitation is 12 to 13 inches, and the average annual air temperature is about 50 degrees F. The frost free period is 130 to 170 days at 32 degrees F. and 170 to 210 days at 28 degrees.

This map unit makes up about 1 percent of the survey area. It is about 35 percent Onyx soils, 30 percent Endersby soils, 20 percent Pedigo soils, and 15 percent Snow soils.

Onyx soils, on stream bottoms, are well drained. They have a surface layer of very dark brown silt loam. The underlying layers are very dark brown very fine sandy loam and very dark grayish brown very fine sandy loam over very gravelly sandy loam. Depth to bedrock is more than 60 inches.

Endersby soils, also on stream bottoms, are somewhat excessively drained. They have a surface layer of dark brown fine sandy loam over dark brown and very dark grayish brown fine sandy loam. Depth to bedrock is more than 60 inches.

Most of this unit is irrigated. It is used for alfalfa hay and aftermath grazing. It provides good food and cover for upland game birds, such as ring-necked pheasant and valley quail. This unit and the adjacent slopes provide habitat for chukar. It also provides food and limited cover for mule deer and smaller mammals.

Streambanks should be properly shaped and stabilized to minimize the hazards of bank cutting and the sediment pollution of streams during heavy runoff.

8. Ritzville-Mikkalo-Willis

Moderately deep and very deep, well drained silt loams

This map unit consists of soils formed in loess on uplands. In areas that are not cultivated, the vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, shrubs, and forbs. The elevation ranges from 1,000 to 2,500 feet. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees F. and 150 to 200 days at 28 degrees.

This unit makes up about 18 percent of the survey area. It is about 60 percent Ritzville soils, 20 percent Mikkalo soils, 10 percent Willis soils, and 10 percent Gravden, Bakeoven, and Lickskillet soils.

Ritzville soils, on the tops and sides of ridges and dominantly on north-facing slopes, are well drained. They have a surface layer of dark brown silt loam, a subsoil of dark brown and brown silt loam, and a substratum of

calcareous, brown silt loam. Depth to bedrock is more than 60 inches.

Mikkalo soils, on ridgetops and dominantly south-facing slopes, are well drained. They have a surface layer of dark brown silt loam, a subsoil of brown silt loam, and a substratum of calcareous, pale brown silt loam. Depth to basalt bedrock is 20 to 40 inches.

Willis soils, on smooth and slightly concave ridgetops, are well drained. They have a surface layer of dark brown silt loam, a subsoil of brown silt loam, and a substratum of calcareous, brown silt loam. A lime-silica cemented hardpan is at a depth of 20 to 40 inches.

This unit is used mainly for wheat and barley in a grain-summer fallow system. Areas too steep for cultivation are used for range. A few irrigated areas produce wheat and beans.

This unit provides food and cover for mule deer and smaller mammals. The major bottom lands throughout this unit provide food and cover for upland game birds, such as ring-necked pheasant and valley quail. The steeper breaks and areas along creeks provide suitable habitat for chukar.

Runoff is a problem from all but the more nearly level areas. Sediment from runoff is moderate to high. Stubble mulch tillage, stripcropping, and diversions in cropped areas and a maximum plant cover on rangeland minimize the hazard of erosion.

9. Lickskillet-Wrentham

Shallow and moderately deep, well drained very stony loams and silt loams

This map unit consists of soils formed in loess mixed with colluvium from basalt. These soils are on steep north-facing slopes and gently sloping to steep south-facing slopes. The vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, shrubs, and forbs. The elevation ranges from 1,000 to 3,500 feet. The average annual precipitation is 10 to 14 inches, and the average annual air temperature is about 49 degrees F. The frost-free period is 60 to 150 days at 32 degrees F. and 100 to 210 days at 28 degrees.

This unit makes up about 1 percent of the survey area. It is about 45 percent Lickskillet soils, 30 percent Wrentham soils, 10 percent Nansene soils, and 15 percent Mikkalo, Ritzville, Bakeoven, Valby, Rhea, and Morrow soils.

Lickskillet soils, generally on south-facing slopes, are well drained. They have a surface layer of very dark grayish brown very stony loam and a subsoil of dark brown very cobbly loam. Depth to basalt bedrock is 12 to 20 inches.

Wrentham soils, on steep north-facing slopes, are well drained. They have a surface layer of very dark brown silt loam and a subsoil of very gravelly silt loam. Depth to basalt bedrock is 20 to 40 inches.

This unit is used for range and wildlife habitat. The steep slopes in this unit along with the adjacent bottom land unit provide good habitat for chukar and other upland game birds, such as ring-necked pheasant and valley quail. Mule deer use the Wrentham part of this unit in summer and fall because of the cooler temperatures and proximity to cover. The Lickskillet part of this unit is used in spring and winter because of the warmer temperatures and proximity to cover. A variety of smaller mammals are also common.

The hazard of erosion is high. Sediment from runoff is low to moderate. Maintaining maximum plant cover on rangeland minimizes the hazard of erosion.

10. Valby-Lickskillet-Bakeoven

Very shallow to moderately deep, well drained silt loams, very stony loams, and very cobbly loams

This map unit is on the ridgetops and sides of ridges. The soils formed in loess and colluvium from basalt. In areas that are not cultivated the vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, shrubs, and forbs. The elevation ranges from 1,400 to 3,500 feet. The average annual precipitation is 10 to 14 inches, and the average annual air temperature is 48 to 52 degrees F. The frost free period is 100 to 150 days at 32 degrees F. and 150 to 210 days at 28 degrees.

This unit makes up 5 percent of the survey area. It is about 45 percent Valby soils, 35 percent Lickskillet soils (fig. 1), 15 percent Bakeoven soils, and 5 percent Rhea, Nansene, and Wrentham soils.

Valby soils, on the tops and sides of ridges, are well drained. They have a surface layer of very dark grayish brown silt loam, a subsoil of very dark grayish brown and dark brown silt loam, and a substratum of dark brown, calcareous silt loam. Depth to basalt bedrock is 20 to 40 inches.

Lickskillet soils, generally on south-facing slopes, are well drained. They have a surface layer of very dark grayish brown very stony loam and a subsoil of dark brown very cobbly loam. Depth to basalt bedrock is 12 to 20 inches.

Bakeoven soils, on ridgetops, are well drained. They have a thin surface layer of dark brown very cobbly loam and a subsoil of dark brown very cobbly loam. Depth to basalt bedrock is 5 to 12 inches.

This unit is used for wheat and barley in a crop-fallow system. It is also used for range and wildlife habitat.

The unit provides food and cover for mule deer and smaller mammals. The bottom land and adjacent slopes provide good sources for food and cover for upland game birds, such as chukar, ring-necked pheasant, and valley quail.

Runoff is mainly from the steep slopes of Lickskillet soils and the steeper, dryfarmed slopes of Valby soils. Sediment from runoff is low to moderate. A maximum plant cover on rangeland and stubble mulch tillage,

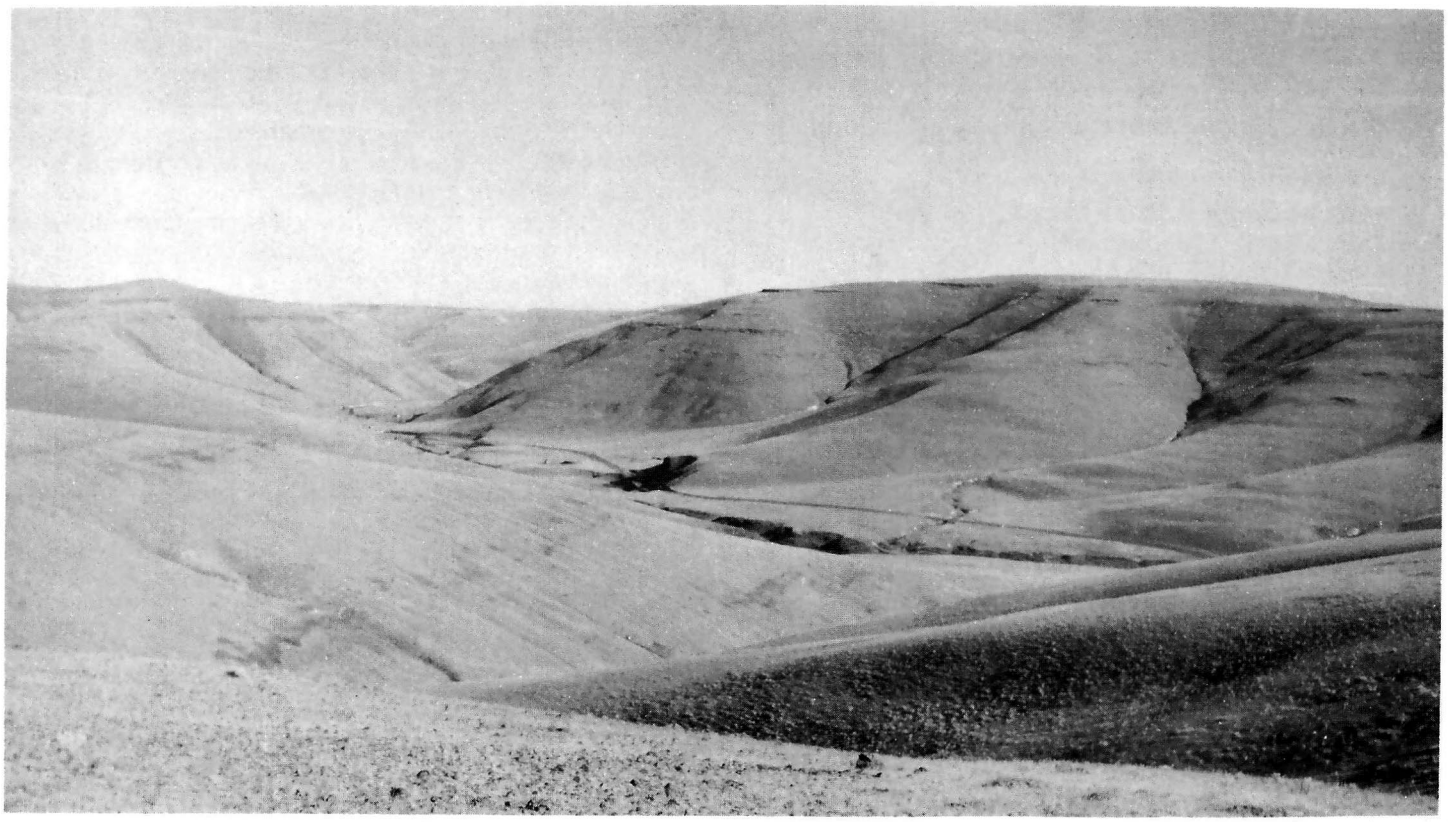


Figure 1.—Shallow very stony Lickskillet soils in left foreground. On the ridgetops are the moderately deep Valby soils

stripcropping, and diversions in dryfarmed cropland minimize the hazard of erosion.

11. Valby-Rhea

Moderately deep and very deep, well drained silt loams

This map unit consists of soils formed in loess on the tops and sides of ridges. In areas that are not cultivated, the vegetation is bluebunch wheatgrass, Idaho fescue, shrubs, and forbs. The elevation ranges from 1,600 to 3,200 feet. The average annual precipitation is 10 to 14 inches, and the average annual air temperature is 47 to 51 degrees F. The frost free period is 100 to 150 days at 32 degrees F. and 150 to 200 days at 28 degrees.

This unit makes up 10 percent of the survey area. It is about 40 percent Valby soils, 20 percent Rhea soils, 30 percent Bakeoven and Lickskillet soils, and 10 percent Nansene and Wrentham soils.

Valby soils, on the tops and sides of ridges, are well drained. They have a surface layer of very dark grayish brown silt loam, a subsoil of very dark grayish brown and dark brown silt loam, and a substratum of calcareous, dark brown silt loam. Depth to basalt bedrock is 20 to 40 inches.

Rhea soils, on ridgetops and mainly north-facing slopes, are well drained. They have a surface layer of very dark brown and very dark grayish brown silt loam, a subsoil of dark brown silt loam, and a substratum of calcareous, dark brown silt loam. Depth to basalt bedrock is more than 60 inches.

This unit is used almost entirely for wheat and barley in a crop-fallow system. It is also used for wildlife habitat.

This unit provides food and cover for mule deer and smaller mammals. The major bottom lands throughout the unit provide food and cover for upland game birds, such as ring-necked pheasant and valley quail. The steeper breaks and areas along drainageways provide suitable habitat for chukar.

Runoff is mainly from steeper dryfarmed areas. Sediment from runoff is moderate to high. Stubble mulch tillage, stripcropping, and diversions in cropped areas and a maximum plant cover on rangeland minimize the hazard of erosion.

12. Morrow-Lickskillet-Bakeoven

Very shallow to moderately deep, well drained silt loams, very stony loams, and very cobbly loams

This map unit consists of soils formed in loess and colluvium from basalt. It is on the tops and sides of ridges. In areas that are not cultivated, the vegetation is bluebunch wheatgrass, Idaho fescue, Sandberg bluegrass, shrubs, and forbs. The elevation ranges from 2,000 to 3,500 feet. The average annual precipitation is 11 to 16 inches, and the mean annual air temperature is 46 to 53 degrees F. The frost free period is 110 to 150 days at 32 degrees F. and 150 to 210 days at 28 degrees.

This unit makes up 7 percent of the survey area. It is about 40 percent Morrow soils, 35 percent Lickskillet soils, 20 percent Bakeoven soils, and 5 percent Wrentham soils.

Morrow soils, on the tops and sides of ridges, are well drained. They have a surface layer of very dark brown silt loam, a subsoil of dark brown silty clay loam, and a substratum of calcareous, dark brown silt loam. Depth to basalt is 20 to 40 inches.

Lickskillet soils, generally on south-facing slopes, are well drained. They have a surface layer of very dark grayish brown very cobbly loam and a subsoil of dark brown very cobbly loam. Depth to basalt is 12 to 20 inches.

Bakeoven soils, on ridgetops, are well drained. They have a thin surface layer of dark brown very cobbly silt loam and a subsoil of dark brown very cobbly silty clay loam. Depth to basalt is 4 to 12 inches.

This unit is used for wheat and barley in a crop-fallow system. It is also used for range and wildlife habitat.

This unit provides food and cover for mule deer and smaller mammals. The major bottom lands throughout this unit provide food and cover for upland game birds, such as ring-necked pheasant and valley quail. The steeper breaks and areas along drainageways provide suitable habitat for chukar.

Runoff is mainly from the steeper dryfarmed areas of Morrow soils and steeper areas of Lickskillet soils. Sediment from runoff is moderate. Stubble mulch tillage, stripcropping, and diversions in cropped areas and a maximum plant cover on rangeland minimize the hazard of erosion.

13. Morrow

Moderately deep, well drained silt loams

This map unit consists of soils formed in loess. It is on the tops and sides of ridges. In areas that are not cultivated, the vegetation is bluebunch wheatgrass, Idaho fescue, shrubs, and forbs. The elevation ranges from 2,200 to 3,500 feet. The average annual precipitation is 12 to 16 inches, and the average annual air temperature is 46 to 50 degrees F. The frost free period is 110 to 150 days at 32 degrees F. and 150 to 200 days at 28 degrees.

This unit makes up 4 percent of the survey area. It is about 80 percent Morrow soils and 20 percent Lickskillet, Bakeoven, and Wrentham soils.

Morrow soils, on the tops and sides of ridges, are well drained. They have a surface layer of very dark brown silt loam, a subsoil of dark brown silty clay loam, and a substratum of calcareous, dark brown silt loam. Depth to basalt bedrock is 20 to 40 inches.

This unit is used for wheat and barley in a crop-fallow system. It is also used for range and wildlife habitat.

This unit provides food and cover for mule deer and smaller mammals. The steeper slopes that dissect the unit provide good sources of food and cover for chukar and other game birds.

Runoff is mainly from steeper dryfarmed areas and from overgrazed rangeland. Stubble mulch tillage, stripcropping, and diversions in dryfarmed areas and a maximum plant cover on rangeland minimize the hazard of erosion.

Areas dominated by shallow to very deep, well drained soils

These soils are in the southern part of Morrow County, mainly on plateaus and peaks dissected by deep, steep walled canyons. The slope range is 0 to 75 percent. The elevation ranges from 2,200 to 6,000 feet. The average annual precipitation is 13 to 30 inches. Erosion is a major hazard.

Except for two areas that are used mainly for dryfarmed crops and irrigated hay and pasture, the soils are used for timber and range. Ponderosa pine and Douglas-fir are the principal trees. These soils are a major source of water supply.

Five map units are in this group.

14. Waha-Waterbury-Rockly

Very shallow to moderately deep, well drained silt loams, extremely stony silt loams, and very gravelly loams

This map unit consists of soils formed in loess and in colluvium and residuum from basalt. In areas that are not cultivated, the vegetation is Idaho fescue, bluebunch wheatgrass, Sandberg bluegrass, shrubs, and forbs. The elevation ranges from 2,600 to 4,300 feet. The average annual precipitation is 14 to 30 inches, and the average annual air temperature is 46 to 49 degrees F. The frost free period is 80 to 150 days at 32 degrees F. and 120 to 170 days at 28 degrees.

This unit makes up 12 percent of the survey area. It is about 45 percent Waha soils, 30 percent Waterbury soils, 15 percent Rockly soils, and 10 percent Snell and Klicker soils.

Waha soils, on ridgetops and mainly north-facing slopes, are well drained. They have a surface layer of

black silt loam and a subsoil of dark brown silty clay loam. Depth to basalt is 20 to 40 inches.

Waterbury soils, on south-facing slopes, are well drained. They have a surface layer of black very cobbly silt loam and a subsoil of dark brown cobbly clay. Depth to basalt is 12 to 20 inches.

Rockly soils, on ridgetops, are well drained. They have a thin surface layer of very dark grayish brown very gravelly silt loam and a subsoil of dark brown very gravelly silt loam. Depth to basalt is 5 to 12 inches.

This unit is used for wheat and barley in a crop-fallow system. It is also used for range and wildlife habitat.

This unit provides food and cover for mule deer and smaller mammals. The major bottom lands throughout this unit provide food and cover for upland game birds, such as ring-necked pheasant and valley quail. The steeper breaks provide suitable habitat for chukar.

Runoff is mainly from steeper dryfarmed areas of Waha soils and steeper areas of Waterbury soils. Stubble mulch tillage and diversions in dryfarmed areas and a maximum plant cover on rangeland minimize the hazard of erosion.

15. Hankins-Klicker-Boardtree

Moderately deep and very deep, well drained silt loams and stony silt loams

This map unit consists of soils formed in clayey sediment, in volcanic ash, in loess, and in colluvium and residuum from basalt. The vegetation is sedges, shrubs, grasses, Douglas-fir, ponderosa pine, and grand fir. The elevation ranges from 3,500 to 4,600 feet. The average annual precipitation is 18 to 25 inches, and the average annual air temperature is 42 to 45 degrees F. The frost free period is 30 to 90 days at 32 degrees F. and 80 to 110 days at 28 degrees.

This unit makes up 4 percent of the survey area. It is about 30 percent Hankins soil, 25 percent Klicker soils, 20 percent Boardtree soils, and 25 percent Bocker, Hall Ranch, and Tolo soils and Aquolls and Aquepts.

Hankins soils, generally on south-facing slopes, are well drained. They have a surface layer of very dark gray and very dark grayish brown silt loam, a subsoil of dark brown and yellowish brown clay, and a substratum of yellowish brown and light yellowish brown clay loam. Depth to bedrock is more than 60 inches.

Klicker soils, on ridgetops and south-facing slopes, are well drained. They have a surface layer of dark reddish brown stony silt loam and a subsoil of dark reddish brown and dark brown very cobbly silty clay loam. Depth to basalt is 20 to 40 inches.

Boardtree soils, on north-facing slopes, are well drained. They have a surface layer of dark brown loam, a subsoil of brown loam, and substratum of brown clay and clay loam. Depth to bedrock is more than 60 inches.

This unit is used for timber, range, recreation, and wildlife habitat. It supports large populations of mule deer and Rocky Mountain elk. Game birds, such as blue and ruffed grouse, are common.

Runoff is mainly from the steep and very steep soils, particularly in recently logged areas. Sediment from runoff is low to moderate. The most serious concern in erosion control after logging is on the ashy Boardtree soils. Soil and water conservation in such areas minimizes the hazard of erosion.

16. Klicker-Bocker-Hall Ranch

Very shallow and moderately deep, well drained stony silt loams, loams, and extremely cobbly silt loams

This map unit consists of soils formed in loess and small amounts of volcanic ash and in colluvium and residuum from basalt and andesite. The vegetation is sedges, shrubs, grasses, Douglas-fir, ponderosa pine, and grand fir. The elevation ranges from 3,500 to 4,600 feet. The average annual precipitation is 18 to 25 inches, and the average annual air temperature is 42 to 45 degrees F. The frost free period is 40 to 90 days at 32 degrees F. and 80 to 110 days at 28 degrees.

This unit makes up 3 percent of the survey area. It is about 35 percent Klicker soils, 20 percent Bocker soils, 15 percent Hall Ranch soils, and 30 percent Gwin, Hankins, Tolo, and Wrightman soils.

Klicker soils, on ridgetops and south-facing slopes, are well drained. They have surface layer of dark reddish brown stony silty loam and a subsoil of dark reddish brown and dark brown very cobbly silty clay loam. Depth to basalt bedrock is 20 to 40 inches.

Bocker soils, on narrow to broad ridgetops, are well drained. They have a surface layer of dark reddish brown extremely cobbly silt loam. Depth to basalt is 4 to 12 inches.

Hall Ranch soils, generally on broad ridgetops and south-facing slopes, are well drained. They have a surface layer of dark reddish brown loam and a subsoil of dark reddish brown loam. Depth to andesite bedrock is 20 to 40 inches.

This unit is used for timber, range, recreation, and wildlife habitat. It supports large populations of mule deer and Rocky Mountain elk. Game birds, such as blue and ruffed grouse, are common.

Runoff is mainly from the steep and very steep soils, particularly in recently logged areas. Sediment from runoff is low. Soil and water conservation in logged areas minimizes the hazard of erosion.

17. Tolo-Klicker-Hall Ranch

Moderately deep and very deep, well drained silt loams, stony silt loams, and loams

This map unit consists of soils formed in loess and volcanic ash and in colluvium and residuum from basalt and andesite. The vegetation is sedges, shrubs, grasses, Douglas-fir, ponderosa pine, grand fir, and western larch. The elevation ranges from 3,500 to 4,600 feet. The

average annual precipitation is 18 to 25 inches, and the average annual air temperature is 42 to 45 degrees F. The frost free period is 30 to 90 days at 32 degrees F. and 60 to 110 days at 28 degrees.

This unit makes up 5 percent of the survey area. It is about 30 percent Tolo soils, 25 percent Klicker soils, 20 percent Hall Ranch soils, and 25 percent Boardtree, Bocker, Gwin, Hankins, Labuck, and Utley soils.

Tolo soils, on ridgetops and north-facing slopes, are well drained. They have a surface layer of very dark brown silt loam, a subsoil of yellowish brown and very pale brown silt loam, and a substratum of dark brown loam and very cobbly silty clay loam. Depth to bedrock is more than 60 inches.

Klicker soils, on ridgetops and south-facing slopes, are well drained. They have a surface layer of dark reddish brown stony silt loam and a subsoil of dark reddish brown and dark brown very cobbly silty clay loam. Depth to basalt is 20 to 40 inches.

Hall Ranch soils, generally on broad ridgetops and south-facing slopes, are well drained. They have a surface layer of dark reddish brown loam and a subsoil of dark reddish brown loam. Depth to andesite bedrock is 20 to 40 inches.

This unit is used for timber, range, recreation, and wildlife habitat. It supports large populations of mule deer and Rocky Mountain elk. Game birds, such as blue and ruffed grouse, are common.

Runoff is mainly from the steep and very steep soils, particularly in recently logged areas. Sediment from runoff is low to moderate. The hazard of erosion after logging is most severe on the ashy Tolo soils. Soil and water conservation in such areas minimizes the hazard of erosion.

18. Helter-Klicker-Hall Ranch

Moderately deep and deep, well drained silt loams, stony silt loams, and loams

This map unit consists of soils formed in loess and volcanic ash and in colluvium and residuum from basalt and andesite. The vegetation is sedges, shrubs, grasses, Douglas-fir, ponderosa pine, grand fir, western larch, and lodgepole pine. The elevation ranges from 4,600 to 6,000 feet. The average annual precipitation is 24 to 30 inches, and the average annual air temperature is 40 to 43 degrees F. The frost free period is 20 to 60 days at 32 degrees F. and 50 to 80 days at 28 degrees.

This unit makes up 7 percent of the survey area. It is about 65 percent Helter soils, 20 percent Klicker soils, 10 percent Hall Ranch soils, and 5 percent Bocker and Labuck soils and Aquepts and Aquolls.

Helter soils, on ridgetops and north-facing slopes, are well drained. They have a surface layer of brown silt loam, a subsoil of yellowish brown and light yellowish brown loam and silt loam, and a substratum of yellowish brown loam and very gravelly loam. Depth to basalt or granitic bedrock is 40 to 60 inches.

Klicker soils, on ridgetops and south-facing slopes, are well drained. They have a surface layer of dark reddish brown stony silt loam and a subsoil of dark reddish brown and dark brown very cobbly silty clay loam. Depth to basalt is 20 to 40 inches.

Hall Ranch soils, generally on broad ridgetops and south-facing slopes, are well drained. They have a surface layer of dark reddish brown loam and a subsoil of dark reddish brown loam. Depth to andesite bedrock is 20 to 40 inches.

This unit is used for timber, range, recreation, and wildlife habitat. It supports large populations of mule deer and Rocky Mountain elk. Game birds, such as blue and ruffed grouse, are common.

Runoff is mainly from the steep and very steep soils, particularly in recently logged areas. Sediment from runoff is low to moderate. The most serious concern in erosion control after logging is on the ashy Tolo soils. Soil and water conservation in such areas minimizes the hazard of erosion.

Broad land use considerations

Irrigated farming in the northern part of the survey area is the most recent change in land use. See map units 1, 2, 3, and 4 on the general soil map at the back of this publication. Before the availability of irrigation water and the development of the center pivot irrigation system, the droughty sandy soils in map units 1, 2, and 4 were suitable only for limited winter grazing. Under irrigation, they are well suited to many vegetable, grain, hay, and specialty crops. A large acreage is developed for irrigation each year, and the trend is expected to continue so long as Columbia River water is available and electric power is available to pump it at an economically feasible rate.

Some soils in map units 2 and 4 are underlain by bedrock or a hardpan within a depth of 40 inches. If these soils or the soils to the north are overirrigated, they readily develop a high water table. This problem has occurred in the areas south of Boardman and near Irrigon.

With the increase of irrigated farming in the Boardman and Irrigon areas and the development of electric power plants near Boardman, the population in the northern part of Morrow County is expected to increase significantly. Industrial activity, especially the processing of farm products, is also expected to increase. The soils in map units 1, 2, 3, and 4 are generally well suited to community uses. The soils in units 1, 2, and 4, however, are subject to blowing and related damage caused by drifting sand, for example, blockage of roads and streets and sandblasting of homes and buildings. In addition, for the soils in units 1, 2, 3, and 4 that are moderately deep

over bedrock or a hardpan, some design modification is needed for sanitary facilities.

The soils in unit 5 and the deep soils in unit 8 have good potential for a large variety of crops under irrigation. Some areas are now irrigated from deep wells, and some with water pumped from the Columbia River. The irrigation of extensive areas in units 5 and 8 depends on an adequate available water supply at an economically feasible cost, especially from the Columbia River.

Approximately 50,000 acres in map units 2, 4, and 5 is within the Boardman Bombing Range, a U. S. Naval Reservation. This acreage is available only for limited winter livestock grazing.

Until an adequate supply of water is available for irrigation, no major change in land use is expected on the arable soils in map units 5, 8, 10, 11, 12, 13, and 14.

The nearly level areas of the deeper soils in units 8 and 11 are well suited to most community and recreation uses. They will probably continue to be used for grain-fallow cropping. The soils in unit 9 are steep and rocky and are poorly suited to any use other than their present use, which is rangeland and wildlife habitat.

Map units 6 and 7 are mainly on flood plains along streams in the area north of the Blue Mountains—Willow Creek, Rhea Creek, Butter Creek, and Sand Hollow. Nearly all these soils are deep and well drained, but they are subject to rare flooding and are not considered well suited to community and sanitary facilities. Almost the entire acreage of the Kimberly and Esquatzel soils in unit 6 is irrigated and is well suited to a wide variety of crops. At present, however, these soils are used mainly for alfalfa hay and pasture. The Xeric Torriorthents in unit 6 are used mostly for range. If irrigation water becomes available, they could be used for a wide variety of crops.

The soils in unit 7 are well suited to a variety of crops under irrigation, but they are used almost entirely for irrigated alfalfa hay and pasture. The Snow soils in unit 6 have a shorter growing season than other soils in the unit, and in some areas they lack a reliable source of irrigation water.

Map units 15, 16, 17, and 18 are mainly wooded. About two-thirds of the acreage in these units is National Forest. The chief uses are timber production, livestock grazing, and recreation. No major change in land use seems likely in the near future, but with the increase in population, the acreage used for recreation is expected to increase. The number of seasonal recreation cabins is increasing on privately owned land, which is about one-third the acreage in these map units. The need for camp grounds and parks on National Forest land and possibly on private land is also increasing. On most soils in units 15, 16, 17, and 18, limitations are severe for sanitary facilities and dwellings. Design modification is needed. Avoiding the steep slopes greatly lessens these limitations.

Soil maps for detailed planning

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, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

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, Ritzville silt loam, 2 to 7 percent slopes, is one of several phases in the Ritzville series.

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

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. Bakeoven-Valby complex, 2 to 20 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in a mapped area are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Aquepts and Aquolls, nearly level, is an undifferentiated group in this survey area.

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. Dune land 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.

Soil descriptions

1—Aquepts and Aquolls, nearly level. This map unit consists of very deep, poorly drained soils formed in loess, volcanic ash, and alluvium. Aquolls are mainly along major drainageways in the forest. Aquepts are generally in mountain meadows. This pattern is fairly consistent, but it is also common to find both soils along drainageways or in meadows (fig. 2).

The elevation is 3,500 to 5,100 feet. The average slope is 2 percent. The mean annual precipitation is 20 to 28 inches, and the mean annual air temperature is 42 to 45 degrees F. The frost free period is 30 to 60 days at 32 degrees and 80 to 110 days at 28 degrees.

Aquepts have a silt loam surface layer. The upper 15 inches is black and very dark brown. The lower 12 inches is grayish brown. The subsoil is black and dark brown silty clay loam and silty clay about 17 inches thick. The substratum is silty clay loam. The upper 7 inches is dark grayish brown. The lower 9 inches is dark greenish gray.

Aquolls have a surface layer of black silt loam about 3 inches thick. The subsoil is black and very dark gray silty clay loam about 35 inches thick. The substratum is very

Figure 2.—Mountain meadow of poorly drained Aquepts and Aquolls, nearly level Helter silt loam, 15 to 35 percent slopes, is in the background.

dark gray and very dark grayish brown silty clay about 22 inches thick.

About 20 percent of this unit is included areas of similar soils that are less than 60 inches thick. About 2 percent is Boardtree and Helter soils.

Permeability is very slow. Available water capacity is 9 to 13 inches. Water supplying capacity is 10 to 14 inches. Effective rooting depth is 30 to 50 inches. Runoff is slow, and the hazard of water erosion is slight.

These soils are used for range, recreation, and wildlife habitat.

The native vegetation is a wet meadow plant community dominated by tufted hairgrass. Redtop, Kentucky bluegrass, Nebraska sedge, and a variety of forbs are prominent throughout the stand.

If range condition deteriorates, the proportion of tufted hairgrass decreases and the proportion of sedge and sodforming grasses, such as redtop and Kentucky bluegrass, increases. If deterioration is severe, forbs are abundant and the plant community becomes weedy. As a result, the sod cover is broken in places and erosion channels form.

If the range is in poor condition and excess water can be controlled, complete meadow renovation including seedbed preparation and seeding is practical. Reed canarygrass, meadow foxtail, tall fescue, and alsike clover are suitable for seeding. Vegetation along streams and water courses, if left undisturbed, provides valuable streambank protection and wildlife cover. This unit supports large populations of mule deer and Rocky Mountain elk.

Roads built on this unit require a maximum amount of ballast if they are to be used during wet periods. The subgrade material is poor. Driving off-road vehicles should be avoided when these soils are wet.

Because of the seasonally high water table, high shrink-swell potential, and low strength, all community and recreation uses are severely limited.

The capability subclass is Vw.

2D—Bakeoven very cobbly loam, 2 to 20 percent slopes. This is a very shallow, well drained soil (fig. 3) formed in loess and residuum from basalt. It is on ridgetops at elevations of 1,600 to 3,500 feet. The average slope is 5 percent. The average annual

precipitation is 10 to 14 inches, and the average annual air temperature is 48 to 52 degrees F. The frost free period is 110 to 140 days at 32 degrees and 140 to 180 days at 28 degrees.

In a representative profile the surface layer is dark brown very cobbly loam about 2 inches thick. The subsoil is dark brown extremely cobbly loam about 5 inches thick. Basalt is at a depth of about 7 inches.

About 10 percent of this unit is included areas of Lickskillet soils and 5 percent is Morrow and Valby soils.

Permeability is moderately slow. Effective rooting depth is 4 to 12 inches. Available water capacity is 0.5 to 1.5 inches. Water supplying capacity is less than 2.5 inches. Runoff is slow to medium, and the hazard of erosion is moderate.

This soil is used for livestock grazing and wildlife habitat.

The major concern is maintaining an adequate plant cover for control of water erosion.

The native plant community is dominated by very shallow rooted plants, principally Sandberg bluegrass. Stiff sagebrush occurs in varying amounts but generally is prominent. It is an important browse plant in areas where it is fairly abundant. Perennial forbs, such as serrated balsamroot, snow eriogonum, and phlox commonly occur in small amounts.

If range condition deteriorates, Sandberg bluegrass and stiff sagebrush decrease and the proportion of low value forbs increases. If deterioration is severe, most plants are nearly eliminated and a rock pavement forms.

Because the soil is very shallow and stony, seedbed preparation and range seeding are not practical.

Areas of this soil provide limited food and cover for mule deer, small mammals, and game birds and song birds.

The depth to bedrock and stoniness are limitations for community and recreation uses. Extensive design modifications are needed but in most places are not practical for dwellings, small buildings, and sanitary facilities.

The capability subclass is VIIs.

3D—Bakeoven-Morrow complex, 2 to 20 percent slopes. This map unit is on ridgetops at elevations of 2,200 to 3,500 feet. It is 40 to 60 percent the very shallow Bakeoven soil, 25 to 40 percent the moderately deep Morrow soil, and 10 percent Lickskillet soils. Both Bakeoven and Morrow soils formed in loess over basalt. Both are well drained. The unit occurs as patterned land, known locally as biscuit scabland (fig. 4). The Bakeoven soil occurs as scabland between and around areas of the Morrow soil. If the slope is less than 10 percent, the Morrow soil occurs as circular mounds, or biscuits, that have a convex surface and are deepest at the center. If

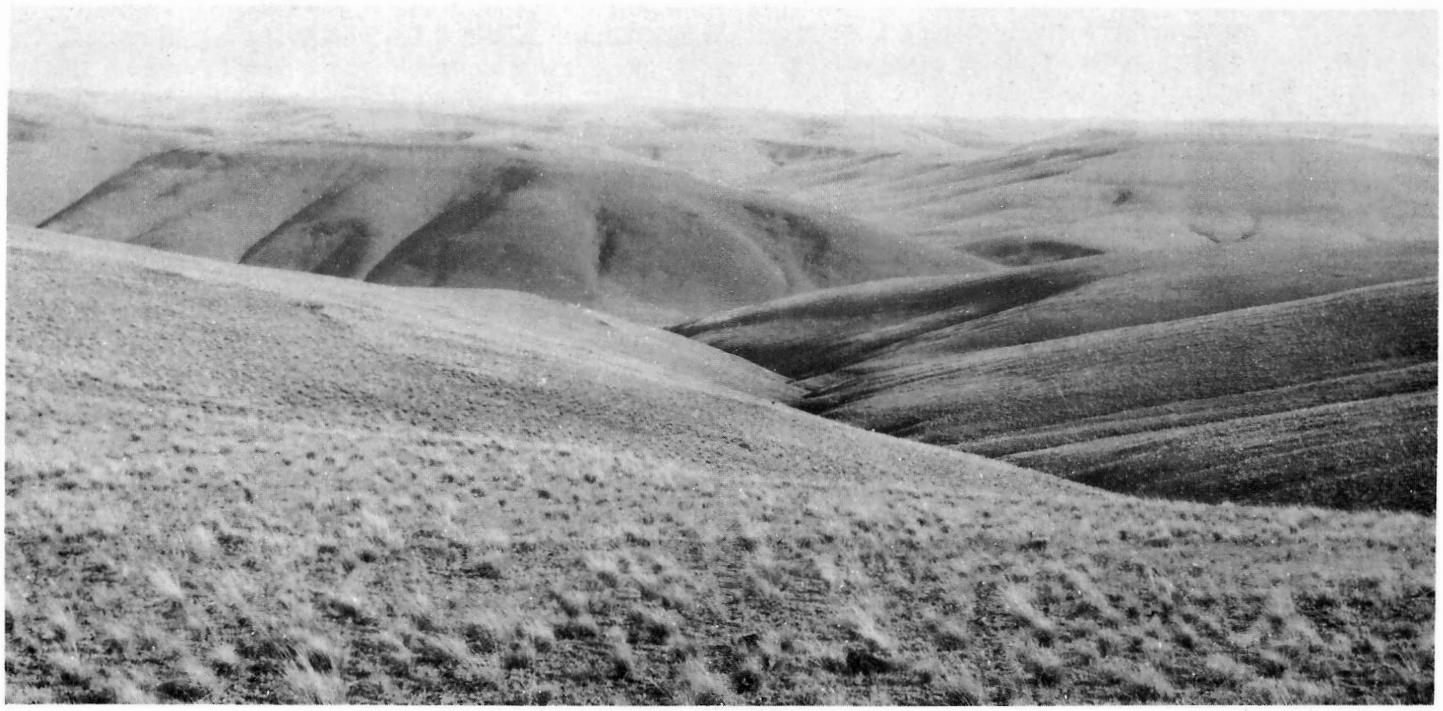


Figure 3.—Very shallow very cobbly Bakeoven soils in foreground.

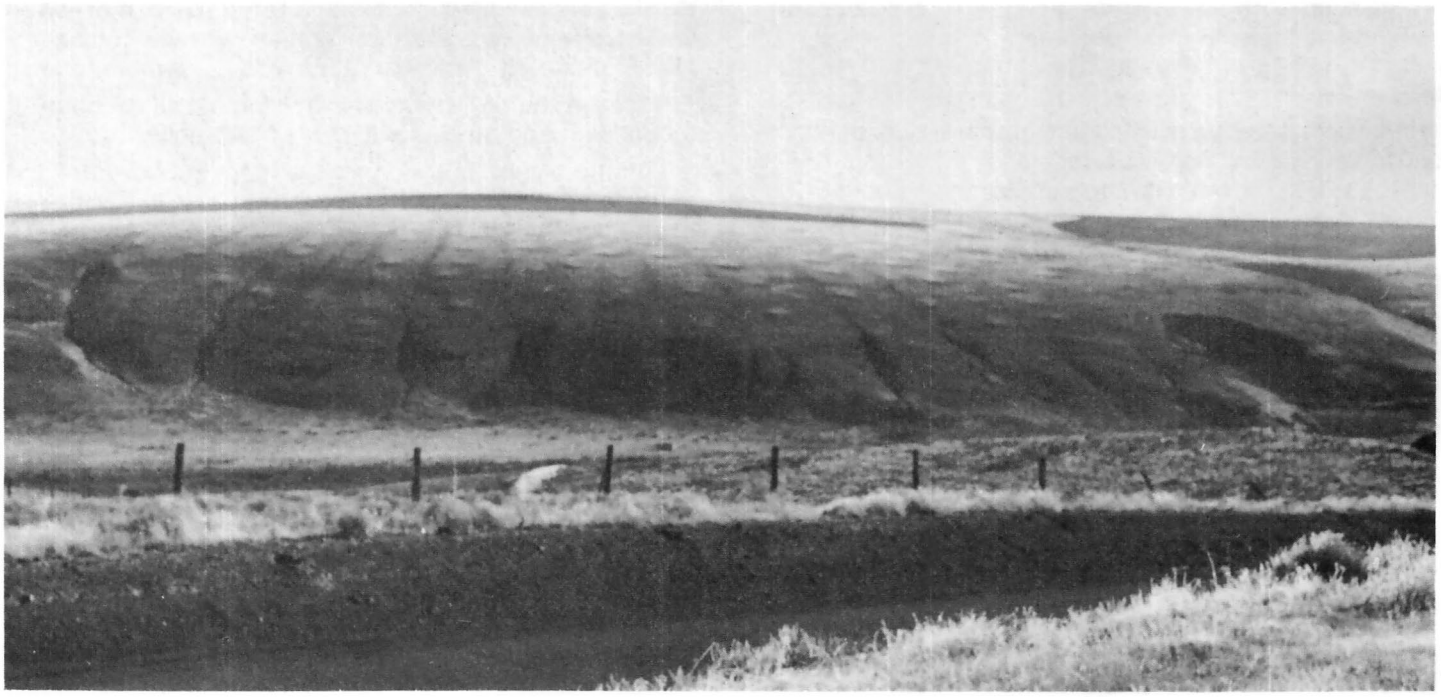


Figure 4—Area of patterned land, locally known as biscuit scabland, in background. The deeper soils in the "biscuits" are Morrow silt loam. They are surrounded by Bakeoven very cobbly loam "scabland."

the slope is more than 10 percent, it occurs as long mounds, the long axis parallel with the slope. The circular mounds are 20 to 50 feet in diameter and 20 to 40 feet apart. The long mounds are 100 to 300 feet long and 30 to 60 feet wide.

The average slope is 5 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 46 to 50 degrees F. The frost free period is 110 to 140 days at 32 degrees F. and 150 to 180 days at 28 degrees.

In a representative profile of Bakeoven very cobbly loam the surface layer is dark brown and is about 2 inches thick. The subsoil is dark brown extremely cobbly loam about 5 inches thick. Basalt is at a depth of about 7 inches.

In a representative profile of Morrow silt loam the surface layer is very dark brown and is about 9 inches thick. The subsoil is dark brown silty clay loam and silt loam about 10 inches thick. The substratum is dark brown silt loam about 7 inches thick. Fractured basalt is at a depth of about 26 inches.

The Bakeoven soil has moderately slow permeability. Effective rooting depth is 5 to 12 inches. Available water capacity is 0.5 to 1.5 inches. Water supplying capacity is less than 2.5 inches. Runoff is slow to medium, and the hazard of erosion is moderate.

The Morrow soil has moderately slow permeability. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Nearly all the unit is used for livestock grazing and wildlife habitat.

The major concern in management is maintaining an adequate plant cover for control of water erosion.

On the Morrow soil, the native plant community is dominated by bluebunch wheatgrass. Idaho fescue, Sandberg bluegrass, and a variety of perennial forbs are prominent. Shrubs are minor. On the Bakeoven soil, the plant community is dominated by Sandberg bluegrass and varying amounts of stiff sagebrush. It also includes a few low growing perennial forbs.

If range condition deteriorates, the productive bunchgrasses decrease and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe, the stand of bunchgrass on the Morrow soils and the stand of stiff sagebrush on the Bakeoven soil are nearly eliminated. As a result, annual weeds and a few shrubs occupy the deeper Morrow soil and a rock pavement forms on the interspersed Bakeoven soil.

Because of interspersed areas of the very shallow and stony Bakeoven soil, range seeding generally is not practical.

Most areas of this unit provide food and limited cover for mule deer, small mammals, game birds, and song birds.

Stoniness and depth to bedrock are limitations for community and recreation uses on the Bakeoven soil. Extensive design modifications are needed but in most places are not practical for dwellings, small buildings, and sanitary facilities.

Depth to bedrock and moderately slow permeability are limitations for community uses on the Morrow soil. Design modifications are needed for dwellings, small buildings, and sanitary facilities.

The capability subclass is VIIs.

4D—Bakeoven-Valby complex, 2 to 20 percent slopes. This map unit is on ridgetops at elevations of 1,600 to 3,000 feet. It is 40 to 60 percent the very shallow Bakeoven soil, which formed in loess; 25 to 45 percent the moderately deep Valby soil, which formed in loess mixed with some ash; 10 percent Lickskillet soils; and 5 percent Rhea soils. Both Bakeoven and Valby soils formed over basalt. Both are well drained. This unit occurs as patterned land, known locally as biscuit scabland. The Bakeoven soil occurs as scabland between and around areas of the Valby soil. If the slope is less than 10 percent, the Valby soil occurs as circular mounds, or biscuits, that have a convex surface and are deepest at the center. If the slope is more than 10 percent, it occurs as long mounds, the long axis parallel with the slope. The circular mounds are 20 to 50 feet in diameter and 20 to 40 feet apart. The long mounds are 100 to 300 feet long and 30 to 60 feet wide.

The average slope is 5 percent. The average annual precipitation is 10 to 14 inches, and the average annual air temperature is 48 to 52 degrees F. The frost free period is 110 to 140 days at 32 degrees F. and 150 to 180 days at 28 degrees.

In a representative profile of Bakeoven very cobbly loam the surface layer is dark brown and is about 2 inches thick. The subsoil is dark brown extremely cobbly loam about 5 inches thick. Basalt is at a depth of about 7 inches.

In a representative profile of Valby silt loam the surface layer is very dark grayish brown and is about 8 inches thick. The subsoil is very dark grayish brown and dark brown heavy silt loam about 17 inches thick. The substratum is dark brown, calcareous silt loam about 5 inches thick. Basalt is at a depth of about 30 inches.

The Bakeoven soil has moderately slow permeability. Effective rooting depth is 5 to 12 inches. Available water capacity is 0.5 to 1.5 inches. Water supplying capacity is less than 2.5 inches. Runoff is slow to medium, and the hazard of erosion is moderate.

The Valby soil has moderate permeability. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Nearly all the unit is used for livestock grazing and wildlife habitat.

The major concern in management is maintaining an adequate plant cover for control of water erosion.

On the Valby soil, the native plant community is dominated by bluebunch wheatgrass. Idaho fescue, Sandberg bluegrass, and a variety of perennial forbs are prominent. Shrubs are minor. On the Bakeoven soil, the plant community is dominated by Sandberg bluegrass and varying amounts of stiff sagebrush. It also includes a few low growing perennial forbs.

If range condition deteriorates, the productive bunchgrasses decrease and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe, the stand of bunchgrass on the Valby soil and the stand of stiff sagebrush on the Bakeoven soil are nearly eliminated. As a result, annual weeds and a few shrubs occupy the deeper Valby soil and a rock pavement forms on the interspersed Bakeoven soil.

Because of interspersed areas of the very shallow and stony Bakeoven soil, range seeding generally is not practical.

Most areas of this unit provide food and limited cover for mule deer, small mammals, game birds, and song birds.

Stoniness and depth to bedrock are limitations for community and recreation uses on the Bakeoven soil. Extensive design modifications are needed but in most places are not practical for dwellings, small buildings, and sanitary facilities.

Depth to bedrock is a limitation for community uses on the Valby soil. Design modifications are needed for dwellings, small buildings, and sanitary facilities.

The capability subclass is VIIs.

5E—Boardtree loam, 7 to 40 percent slopes. This is a very deep, well drained soil formed in volcanic ash over clay. It is generally on north-facing slopes at elevations of 3,500 to 4,600 feet. The average slope is 20 percent. The average annual precipitation is 18 to 25 inches. The average annual air temperature is 42 to 45 degrees F. The frost free period is 30 to 60 days at 32 degrees and 80 to 100 days at 28 degrees.

In a representative profile the surface layer is dark brown and brown loam about 14 inches thick. The subsoil is about 11 inches of brown loam over 15 inches of brown clay. Below this is brown clay loam that extends to 60 inches or more.

About 10 percent of this unit is included areas of Klicker stony silt loam, shallow very stony loam soils, and shallow very stony ashy soils; 10 percent is Hankins silt loam and Tolo silt loam; and 1 percent is basalt outcrop.

Permeability is moderately rapid in the ashy material and very slow below. Effective rooting depth is restricted

by the clay layer at a depth of 20 to 40 inches. Available water capacity is 8 to 12 inches. Water supplying capacity is 15 to 20 inches. Runoff is medium, and the hazard of erosion is moderate.

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

This soil is suited to the production of Douglas-fir. At a site index of 70 (*5*), it is capable of producing about 3,760 cubic feet of merchantable timber from a fully stocked stand at 40 years or 43,160 board feet (Scribner) of merchantable timber from a fully stocked stand at 130 years.

Slopes less than 30 percent are generally suitable for tractor logging. Cable logging is desirable on slopes of more than 30 percent. Excessive soil disturbance should be avoided because removing the overlying ash layer and exposing the infertile buried horizons adversely affect natural regeneration. If enough of this material is removed the productivity of the area affected may be lowered permanently. Excessive soil disturbance may also result in severe erosion and water quality deterioration. The 20- to 40-inch ash layer makes the construction and maintenance of roads difficult. This material provides poor subgrade for roads. It does not compact easily, and it has frost action potential and a high water holding capacity. The amount of ballast depends upon the number and type of vehicles using the road and the months of the year that the road is used. Use early in spring should be limited.

The native vegetation is ponderosa pine and Douglas-fir, but it is predominantly pine. In a moderately stocked mixed-age stand the canopy cover is 20 to 40 percent. Douglas-fir occurs in varying amounts and may dominate the tree regeneration in places. The understory is dominated by pinegrass and elk sedge. A variety of perennial forbs and a few shrubs occur throughout the stand.

If the understory deteriorates, the proportion of pinegrass and elk sedge decreases, principally elk sedge. If deterioration is severe, shrubs and tree reproduction proportionately increase and forbs become prominent.

Following fire or logging, broadcast seeding is advisable before fall rains settle the seedbed. A major objective of seeding is to stabilize disturbed soil areas. Plants suitable for seeding are intermediate wheatgrass, orchardgrass, timothy, and hard fescue.

Mule deer use the plant community for food and cover in summer and fall. Rocky Mountain elk use the plant community as winter range and as cover during winter storms. A variety of small mammals and birds, including game birds such as blue and ruffed grouse, also use this community.

Very few dwellings have been constructed on this soil. Most are used seasonally for recreation purposes. The slope, slow permeability, high shrink-swell potential, and low strength of the soil material limit all uses for community and recreation development and recreation facilities.

The capability subclass is VIe.

6C—Bocker extremely cobbly silt loam, 2 to 12 percent slopes. This is a very shallow, well drained soil formed in loess and in residuum from basalt. It is on ridgetops at elevations of 3,700 to 5,500 feet. The average slope is 5 percent. The average annual precipitation is 24 to 30 inches, and the average annual air temperature is 42 to 45 degrees F. The frost free period is 40 to 85 days at 32 degrees and 80 to 120 days at 28 degrees.

In a representative profile the surface layer is dark reddish brown extremely cobbly silt loam about 8 inches thick. Basalt is at a depth of about 8 inches.

About 5 percent of this unit is included areas of Hall Ranch, Klicker, and Wrightman soils, 5 percent is Helter and Tolo soils, and 5 percent is Gwin soils.

Permeability is moderate. Effective rooting depth is 4 to 10 inches. Available water capacity is 0.5 to 1.5 inches. Water supplying capacity is 1 to 4 inches. Runoff is slow to medium, and the hazard of erosion is moderate.

Nearly all the acreage is used for livestock grazing and wildlife habitat.

The major concern is maintaining an adequate plant cover for control of water erosion.

The native plant community is dominated by very shallow rooted plants, such as Sandberg bluegrass and Oregon bluegrass. In places Idaho fescue and bluebunch wheatgrass occur in small amounts. Low growing perennial forbs, such as pussytoes and phlox, are common.

If range condition deteriorates, small bluegrasses decrease and the proportion of low value forbs increases. If deterioration is severe, most plants are nearly eliminated and a barren rock pavement forms.

Because the soil is very shallow and stony, renovation by seedbed preparation and seeding is not practical.

Areas of this soil provide limited food and cover for mule deer, Rocky Mountain elk, small mammals, game birds, and song birds. The plant community provides green succulent feed for mule deer in winter and early spring when other areas are snow covered.

Stoniness and depth to bedrock are limitations for community and recreation uses. Extensive design modifications are needed but in most places are not practical for dwellings, small buildings, and sanitary facilities.

The capability subclass is VIIs.

7C—Bocker-Wrightman complex, 2 to 12 percent slopes. This map unit is on ridgetops in the Blue Mountains at elevations of 3,700 to 5,500 feet. It is 50 percent the very shallow Bocker soil, which formed in loess and in residuum from basalt; 35 percent the

moderately deep Wrightman soil, which formed in material weathered from basaltic rock and reworked loess; 10 percent Hall Ranch, Klicker, and Gwin soils; and 5 percent Tolo and Helter soils. Both Bocker and Wrightman soils formed over basalt. Both are well drained. This unit occurs as patterned land, known locally as biscuit scabland. The Bocker soil occurs as scabland between and around areas of the Wrightman soil. Wrightman soils occur as circular mounds, or biscuits, that have a convex surface and are deepest at the center. The circular mounds are 20 to 50 feet in diameter and 20 to 40 feet apart.

The average slope is 10 percent. The average annual precipitation is 22 to 26 inches, and the average annual air temperature is 42 to 45 degrees F. The frost free period is 40 to 85 days at 32 degrees and 80 to 120 days at 28 degrees.

In a representative profile of Bocker extremely cobbly silt loam the surface layer is dark reddish brown and is about 8 inches thick. Basalt is at a depth of about 8 inches.

In a representative profile of Wrightman silt loam the surface layer is dark brown and is about 12 inches thick. The upper 9 inches of the subsoil is dark brown silt loam, and the lower 5 inches is dark brown gravelly silt loam. Fractured basalt is at a depth of about 26 inches.

The Bocker soil has moderate permeability. Effective rooting depth is 4 to 10 inches. Available water capacity is 0.5 to 1.5 inches. Water supplying capacity is 1 to 4 inches. Runoff is slow to medium, and the hazard of erosion is moderate.

The Wrightman soil has moderate permeability. Effective rooting depth is 20 to 40 inches. Available water capacity is 3 to 7 inches. Water supplying capacity is 13 to 16 inches. Runoff is medium, and the hazard of erosion is moderate.

Nearly all this unit is used for livestock grazing and wildlife habitat.

The major concern in management is maintaining an adequate plant cover for control of water erosion.

On the Bocker soil, the native plant community is dominated by very shallow rooted plants, such as Sandberg bluegrass or Oregon bluegrass. Idaho fescue and bluebunch wheatgrass occur in small amounts. Low growing perennial forbs, such as pussytoes and phlox, are common. On the Wrightman soil, the plant community is dominated by Idaho fescue. Bluebunch wheatgrass and Sandberg bluegrass are prominent. Various perennial forbs, such as arrowleaf balsamroot, milkvetch, and yarrow, occur throughout the stand in small amounts. There are few or no shrubs.

If range condition deteriorates, plant vigor is greatly reduced. The proportion of bluebunch wheatgrass and other desirable grasses decreases on the Wrightman soil. The stand of small bluegrasses decreases and the proportion of low value forbs increases on the Bocker soil. If deterioration is severe on the Wrightman soil, cheatgrass and other low value plants are predominant and the erosion potential is high. If deterioration is severe on the Bocker soil, plants are nearly eliminated and a barren rock pavement forms.

Because of interspersed areas of the very shallow and stony Bocker soil, range seeding generally is not practical.

Most areas of this unit provide food and limited cover for mule deer, small mammals, game birds, and song birds.

Slope, depth to bedrock, and the small size of the biscuits, or circular mounds, are limitations for community developments and recreation facilities. Variations in design, which are not very practical, must be carefully implemented.

The capability subclass is VIIs.

8B—Burbank loamy fine sand, 2 to 5 percent slopes. This is a very deep, excessively drained soil formed in gravelly alluvial deposits and wind worked material. It occurs on terraces at elevations of 300 to 800 feet. The average slope is 3 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 160 to 200 days at 32 degrees and 180 to 215 days at 28 degrees F.

In a representative profile the surface layer is very dark grayish-brown loamy fine sand about 5 inches thick. The substratum is about 15 inches of dark brown, loamy fine sand over 14 inches of dark brown, very cobbly loamy fine sand. Below this is very cobbly sand and gravel that extends to a depth of 60 inches or more.

About 15 percent of this unit is included areas of Hezel loamy fine sand, Quincy loamy fine sand, and Winchester sand.

Permeability is rapid. Effective rooting depth is restricted by the underlying gravel at a depth of 20 to 40 inches. Available water capacity is 1.5 to 3.5 inches. Water supplying capacity is 5 to 6.5 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. A large part of the acreage is used for range and wildlife habitat, particularly where the soil occurs within the Boardman Naval Reservation. Major irrigated crops include potatoes, annual wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the low water holding capacity and the hazard of soil blowing. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the low water holding capacity and high water consumption, light to medium, frequent applications of irrigation water are needed. Plant nutrients are readily leached from the rooting zone because of the very rapid permeability. Split applications of fertilizer are desirable.

Deep cuts should be avoided because they expose the cobbly substratum, which adversely affects plant growth.

The hazard of soil blowing is high because of the loamy fine sand surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and hummocks in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Practices needed to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Blowout areas require special treatment, such as disked-in straw mulching and seeding to suitable grasses. Doublecropping and stripcropping are needed in places. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation systems before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on nonirrigated odd areas are the practices and precautions needed.

The native plant community is dominated by needleandthread and Indian ricegrass. Antelope bitterbrush commonly occurs and is prominent in places. Perennial forbs, such as Columbia milkvetch and Carey balsamroot, are common. Other shrubs, such as big sagebrush and rabbitbrush, occur sporadically.

If range condition deteriorates, the proportion of Indian ricegrass decreases and the proportion of needleandthread and low value forbs increases. If deterioration is severe, cheatgrass invades and strongly dominates the stand. As a result, the potential for soil blowing during the growing season is high and sand movement may be difficult to control.

If the range is in poor condition, total protection of the existing plant cover is practical. Standard methods of seedbed preparation and seeding present special problems because of the critical soil blowing hazard. Direct drill seeding of crested wheatgrass or Siberian wheatgrass is advisable after a fire.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

This soil is generally well suited to community and recreation uses. Sewage lagoons and sanitary landfills may require variations in design because of seepage. Playgrounds may require levelling.

The capability subclass is VIIe dryland, IVe irrigated.

8C—Burbank loamy fine sand, 5 to 12 percent slopes. This is a very deep, excessively drained soil formed in gravelly alluvial deposits and wind worked material. It occurs on terraces at elevations of 300 to 800 feet. The average slope is 8 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 160 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown loamy fine sand about 5 inches thick. The substratum is about 15 inches of dark brown loamy fine sand over 14 inches of dark brown very cobbly loamy fine sand. Below this is gravel that extends to a depth of 60 inches or more.

About 15 percent of this unit is included areas of Hezel loamy fine sand, Quincy loamy fine sand, and Winchester sand.

Permeability is rapid. Effective rooting depth is restricted by the underlying gravel at a depth of 20 to 40 inches. Available water capacity is 1.5 to 3.5 inches. Water supplying capacity is 5 to 6.5 inches. Runoff is slow, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is high.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. A large part of the acreage is used for range and wildlife habitat, particularly where the soil occurs within the Boardman Naval Reservation. Major irrigated crops include potatoes, annual wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the low water holding capacity and the hazard of soil blowing. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the low water holding capacity and high water consumption, light to medium, frequent applications of irrigation water are needed. Plant nutrients are readily leached from the root zone because of the very rapid permeability. Split applications of fertilizer are desirable.

Deep cuts should be avoided because they expose the cobbly substratum, which adversely affects plant growth.

The hazard of soil blowing is high because of the loamy fine sand surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and hummocks in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures

needed to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Blowout areas require special treatment, such as disked-in straw mulching and seeding to suitable grasses. Doublecropping and stripcropping are needed in places. Protection from soil blowing is critical when rangeland is converted to cropland. Completely developing the irrigation systems before any land is broken out, limiting new disturbance to the period of March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is dominated by needleandthread and Indian ricegrass. Antelope bitterbrush is common and is prominent in places. Perennial forbs, such as Columbia milkvetch and Carey balsamroot, are common. Other shrubs, such as the big sagebrush and rabbitbrush, occur sporadically.

If range condition deteriorates, the proportion of Indian ricegrass decreases and the proportion of needleandthread and low value forbs increases. If deterioration is severe, cheatgrass invades and strongly dominates the stand. As a result, the potential for soil blowing during the growing season is severe and sand movement may be difficult to control.

If the range is in poor condition, total protection of the existing plant cover is practical. Standard methods of seedbed preparation and seeding present special problems because of the critical soil blowing hazard. Direct drill seeding to crested wheatgrass or Siberian wheatgrass is advisable after a fire.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

This soil generally is well suited to community uses. The slope is a limitation for dwellings, recreation facilities, commercial buildings, and roads and streets. Modifications in the design of sanitary facilities may be required because of the seepage and the slopes.

The capability subclass is VIIe dryland, IVe irrigated.

9—Dune land. This map unit is excessively drained sandy eolian material. It is grayish brown or brown loamy sand, sand, or fine sand 60 inches or more thick. The slope is 5 to 60 percent. Elevation is 300 to 900 feet. Average annual precipitation is 7 to 9 inches, and average annual air temperature is 49 to 54 degrees F. The average frost-free period is 150 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

About 15 percent of this unit is Burbank, Hezel, Koehler, Quincy, Quinton, Royal, Sagehill, Taunton, and Winchester soils.

Permeability is rapid to very rapid. Available water capacity is 2 to 5 inches. Water supplying capacity is 2 to 3 inches. Effective rooting depth is about 60 inches. Runoff is slow. The hazard of water erosion is slight. The hazard of soil blowing is high.

The slope, rapid permeability, and soil blowing are limitations for community and recreation developments. Dune land is nearly devoid of vegetation. It is not suitable for grazing. It can be stabilized by planting improved perennial grasses or nursery grown plants or clones of Volga wild rye 20 inches apart in rows spaced 20 inches apart. It is used mainly as wildlife habitat.

The capability subclass is VIIIe.

10B—Ellum fine sandy loam, 2 to 5 percent slopes. This is a moderately deep, well drained soil formed in water deposited sand and gravel. It is on terraces at elevations of 300 to 800 feet. The average slope is 3 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 140 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark brown fine sandy loam about 5 inches thick. The substratum is 8 inches of dark brown fine sandy loam over 15 inches of dark brown very gravelly and extremely fine sandy loam. A calcareous very gravelly hardpan is at a depth of 28 inches.

About 20 percent of this unit is included areas of Irrigon and Taunton soils and 10 percent is Burbank and Sagehill soils.

Permeability is moderately rapid. Effective rooting depth is restricted by the hardpan at a depth of 20 to 40 inches. Available water capacity is 2 to 4.5 inches. Water supplying capacity is 5 to 6.5 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

This soil is used as range and wildlife habitat.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally is dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrass decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses should be considered. Because of the hazard of soil blowing, seeding to grass presents special management problems. Direct drill seeding after a fire is a good method of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

Seepage and a cemented pan are limitations for sanitary facilities. Construction of dwellings may require

some design modification because of the pan. Playgrounds may require leveling.

The capability subclass is VIe dryland.

10C—Ellum fine sandy loam, 5 to 12 percent slopes. This is a moderately deep, well drained soil formed in water deposited sand and gravel. It is on terraces at elevations of 300 to 800 feet. The average slope is 8 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 140 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark brown fine sandy loam about 5 inches thick. The substratum is 23 inches thick. It is dark brown fine sandy loam over very gravelly and extremely gravelly fine sandy loam. A calcareous very gravelly hardpan is at a depth of 28 inches.

About 20 percent of this unit is included areas of Irrigon and Taunton soils and 10 percent is Burbank and Sagehill soils.

Permeability is moderately rapid. Effective rooting depth is restricted by the hardpan at a depth of 20 to 40 inches. Available water capacity is 2 to 4.5 inches. Water supplying capacity is 5 to 6.5 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

This soil is used as range and wildlife habitat.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally is dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrass decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses should be considered. Because of the moderate hazard of soil blowing, seeding to grass presents special management problems. Direct drill seeding after a fire is a good method of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The seepage and cemented pan are limitations for sanitary facilities. Construction of dwellings and buildings may require some design modifications because of the pan and slope. Playgrounds may require leveling.

The capability subclass is VIe dryland.

11—Endersby fine sandy loam. This is a very deep, somewhat excessively drained soil formed in alluvium derived from loess and volcanic ash. It is on alluvial bottom lands at elevations of 1,200 to 2,500 feet. The average slope is 1 percent. The average annual precipitation is 11 to 14 inches, and the average annual air temperature is 49 to 51 degrees F. The frost free period is 130 to 170 days at 32 degrees and 170 to 210 days at 28 degrees.

In a representative profile the surface layer is dark brown fine sandy loam about 12 inches thick. The substratum is dark brown and very dark grayish brown fine sandy loam about 24 inches thick. Below this is black heavy silt loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Onyx and Pedigo soils and 5 percent is Esquatzel, Kimberly, and Snow soils.

Permeability is moderately rapid. Effective rooting depth is more than 60 inches. Available water capacity is 7.5 to 12 inches. Water supplying capacity is 9 to 12 inches. Runoff is slow, and the hazard of erosion is slight. Flooding is rare.

Nearly all the acreage is used for dryfarmed and irrigated crops. Hay and pasture are the main crops. Some winter wheat is also grown. Some irregularly shaped areas are used as range.

The major needs in crop management are conserving soil moisture and stabilizing streambanks against cutting by water. The proper timing and rates of applying irrigation water should be considered. Where water is available, irrigation is by sprinklers, most commonly wheelline or handline systems.

A suitable cropping system under irrigation is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Because of the moderately rapid permeability and high water consumption, light, frequent applications of irrigation water are needed. Split applications of fertilizer are desirable because plant nutrients are leached out of the root zone by the irrigation water.

Stubble mulch and minimum tillage along with a crop-fallow system where wheat is grown help to conserve soil moisture in dryfarmed cropland.

Streambanks can be stabilized by maintaining streamside vegetation, especially giant wildrye and riparian shrubs. Such vegetation also serves as important wildlife cover and should be considered in planning management.

For dryland pasture and hay, suitable grasses grown alone or in various combinations are alfalfa, Siberian wheatgrass, crested wheatgrass, beardless wheatgrass, big bluegrass, intermediate wheatgrass, pubescent wheatgrass, and hard fescue (*3*).

Areas of this soil provide good food and cover for upland game birds, such as the ring-necked pheasant

and valley quail, and for mule deer and smaller mammals.

This soil occurs on stream flood plains and is subject to rare flooding, which results in limitations for many community developments.

The capability subclass is IIIs dryland and irrigated.

12—Esquatzel silt loam. This is a very deep, well drained soil formed in alluvium derived from loess and volcanic ash. It is on alluvial bottom lands at elevations of 600 to 2,000 feet. The average slope is 1 percent. The average annual precipitation is 8 to 12 inches, and the average annual air temperature is 51 to 53 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 200 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown silt loam about 17 inches thick. The subsoil is dark brown silt loam about 8 inches thick. The substratum is dark brown silt loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Kimberly soils and Xeric Torriorthents and is 5 percent Endersby and Onyx soils.

Permeability is moderate. Effective rooting depth is 60 inches or more. Available water capacity is 7.5 to 12 inches. Water supplying capacity is 5 to 9 inches. Runoff is slow, and the hazard of erosion is slight. Flooding is rare.

All the acreage is used for dryfarmed and irrigated crops. Hay and pasture are the main crops. Some winter wheat is also raised.

The major needs in crop management are conserving soil moisture and stabilizing streambanks against cutting by water. The proper timing and rates of applying irrigation water should be considered. Where water is available, irrigation is by sprinklers, most commonly wheelline or handline systems.

A suitable cropping system under irrigation is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Because of the high water consumption, light, frequent applications of irrigation water is needed. Split applications of fertilizer are desirable because plant nutrients are leached out of the root zone by the irrigation water.

Stubble mulch and minimum tillage along with a crop-fallow system where wheat is grown help to minimize erosion and help to conserve soil moisture in dryfarmed cropland.

Streambanks can be stabilized by maintaining streamside vegetation, especially giant wildrye and such riparian shrubs as lilac and willow. Such vegetation also serves as important wildlife cover and should be considered in planning management.

For dryland pasture and hay, suitable grasses grown alone or in various combinations are alfalfa, crested wheatgrass, Siberian wheatgrass, beardless wheatgrass, intermediate wheatgrass, and big bluegrass (*3*).

This soil provides important food and cover for upland game birds, such as the ring-necked pheasant and valley quail, and for mule deer and smaller mammals.

This soil occurs on stream flood plains and is subject to rare flooding, which results in limitations for many community developments.

The capability subclass is IIIc dryland, I irrigated.

13D—Gravden very gravelly loam, 5 to 20 percent slopes. This is a shallow, well drained soil formed in loess mixed with gravelly alluvium and colluvium. It is on south- and west-facing slopes at elevations of 500 to 1,700 feet. The average slope is 10 percent. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 50 to 54 degrees F. The frost free period is 150 to 190 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark brown very gravelly loam about 7 inches thick. The substratum is brown extremely gravelly loam about 7 inches thick. A very gravelly hardpan is at a depth of about 14 inches.

Included with this soil in mapping are areas of Ritzville and Warden soils.

Permeability is moderate. Effective rooting depth is restricted by the very gravelly hardpan at a depth of 10 to 20 inches. Available water capacity is 1 to 4 inches. Water supplying capacity is 3 to 4 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for range and wildlife habitat.

The native plant community is dominated by bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor in the stand.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is left bare.

If the range is in poor condition, seedbed preparation and seeding should be considered. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

This soil supports small populations of mule deer. Birds and small mammals are common.

The cemented pan is a severe limitation for septic tanks and sewage lagoons. Construction of dwellings and buildings may require variations in design because of the rare flooding and the pan. Recreation facilities are limited because of small stones.

The capability subclass is VIe dryland.

13E—Gravden very gravelly loam, 20 to 40 percent slopes. This is a shallow, well drained soil formed in loess mixed with alluvium and colluvium. It is on south- and west-facing slopes at elevations of 500 to 1,700 feet. The average slope is 25 percent. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 50 to 54 degrees F. The frost free period is 150 to 190 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark brown very gravelly loam about 7 inches thick. The substratum is brown extremely gravelly loam about 7 inches thick. A very gravelly hardpan is at a depth of about 14 inches.

Included with this soil in mapping are areas of Ritzville and Warden soils.

Permeability is moderate. Effective rooting depth is restricted by the very gravelly hardpan at a depth of 10 to 20 inches. Available water capacity is 1 to 4 inches. Water supplying capacity is 3 to 4 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for range and wildlife habitat.

The native plant community is dominated by bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs occurs throughout the stand in small amounts. Shrubs are minor in the stand.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and Thurber needlegrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated. As a result, much of the surface is bare and the potential for erosion is high.

Because this soil is shallow and stony, range seeding generally is not practical.

This soil supports small populations of mule deer. Birds and small mammals are common.

The slope and cemented pan are severe limitations for community development. The slope and small stones are severe limitations for recreation facilities.

The capability subclass is VIe dryland.

14E—Gwin extremely stony silt loam, 12 to 40 percent slopes. This is a shallow, well drained soil formed in loess, volcanic ash, and colluvium from basalt. It is on south-facing slopes (fig. 5) in the Blue Mountains at elevations of 2,600 to 4,400 feet. The average slope is 25 percent. The average annual precipitation is 16 to 25 inches, and the average annual air temperature is 45 to 49 degrees F. The average frost free period is 80 to 110 days at 32 degrees and 110 to 140 days at 28 degrees.

In a representative profile the surface layer is very dark brown extremely stony silt loam about 3 inches thick. The subsoil is very dark brown and dark brown very cobbly and extremely cobbly silt loam and clay loam about 12 inches thick. Basalt is at a depth of about 15 inches.

About 15 percent of this unit is included areas of Bocker and Waterbury soils and 10 percent is Klicker, Hall Ranch, and Tolo soils.

Permeability is moderately slow. Effective rooting depth is 10 to 20 inches. Available water capacity is 1.5 to 2.5 inches. Water supplying capacity is 7 to 14 inches. Runoff is medium, and the hazard of water erosion is moderate.

This soil is used for livestock grazing and wildlife habitat. The major concern is maintaining an adequate plant cover for control of water erosion.

The native vegetation is a plant community dominated by bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent. Various perennial forbs, such as arrowleaf balsamroot, milkvetch, and yarrow, occur throughout the stand in small amounts. There are few or no shrubs.

If range condition deteriorates, plant vigor is greatly reduced and the proportion of bluebunch wheatgrass and other desirable grasses decreases. If deterioration is severe, cheatgrass and other low value plants predominate and the potential for erosion is high.

Because this soil is stony and shallow, range seeding is not practical.

The plant community is used by Rocky Mountain elk and mule deer in winter and early in spring when other areas are snow covered.

The depth to bedrock, stoniness, and steep slopes are severe limitations for community and recreation uses. Extensive design modifications are needed but in most cases are not practical for dwellings, small buildings, and sanitary facilities.

The capability subclass is VIIs.

15F—Gwin-Rock outcrop complex, 40 to 70 percent slopes. This map unit is on south-facing slopes in the Blue Mountains at elevations of 2,600 to 4,400 feet. It is 55 percent Gwin soil, 25 percent Rock outcrop, 10 percent Bocker soil and Rubble land, and 10 percent Klicker and Hall Ranch soils.

The average slope is about 50 percent. The average annual precipitation is 16 to 25 inches, and the average annual air temperature is 45 to 49 degrees F. The frost free period is 80 to 110 days at 32 degrees and 110 to 140 days at 28 degrees.

In a representative profile of Gwin extremely stony silt loam the surface layer is very dark brown and is about 3 inches thick. The subsoil is very dark brown and dark brown very cobbly and extremely cobbly silt loam and clay loam about 12 inches thick. Basalt is at a depth of about 15 inches.

Rock outcrop is basalt bedrock.

The Gwin soil has moderately slow permeability. Effective rooting depth is 10 to 20 inches. Available

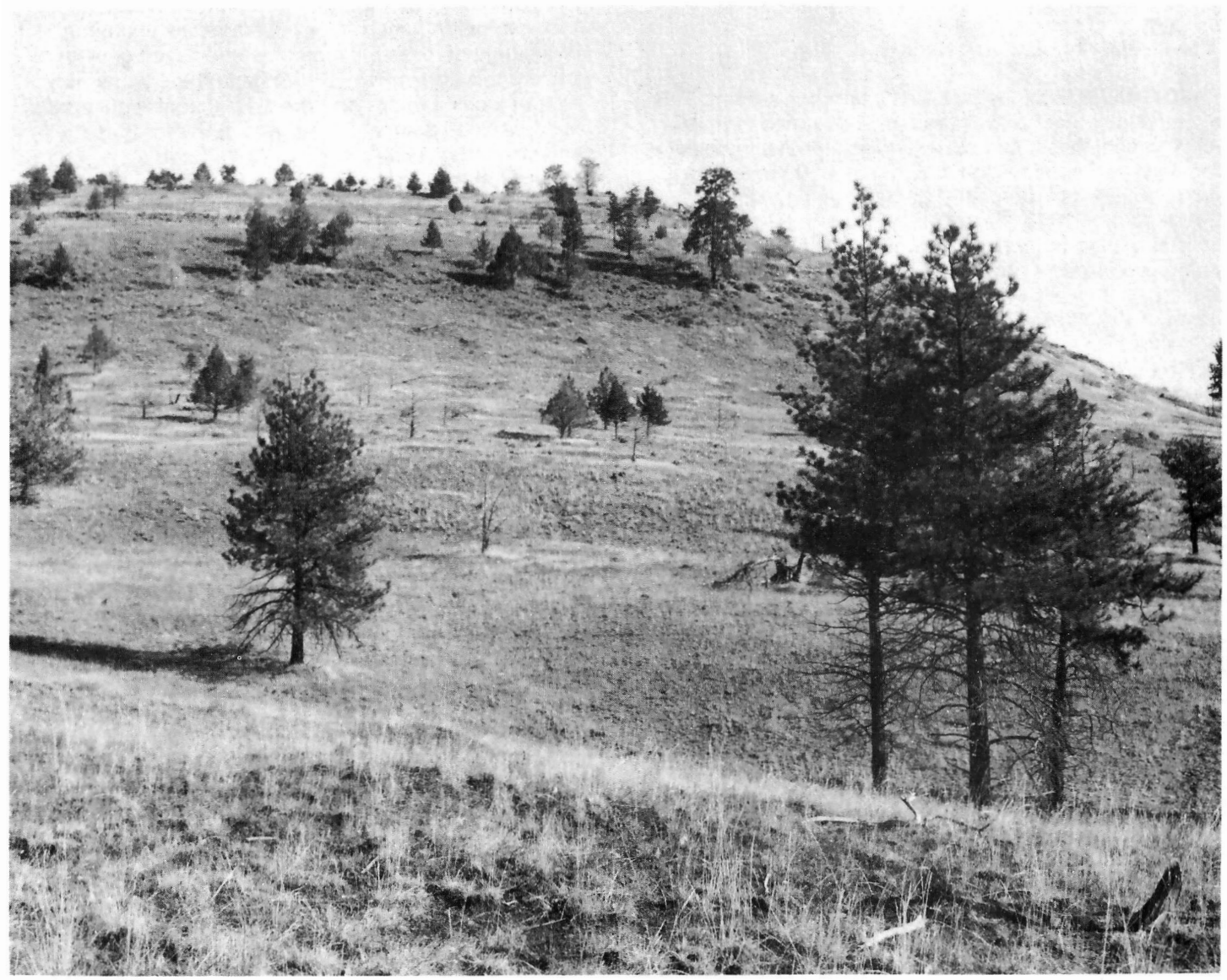


Figure 5.—Gwin extremely stony silt loam, 12 to 40 percent slopes, in background In the foreground is an area of Bocker-Wrightman complex, 2 to 12 percent slopes.

water capacity is 1.5 to 2.5 inches. Water supplying capacity is 7 to 14 inches. Runoff is medium, and the hazard of water erosion is high.

This unit is used for livestock grazing and wildlife habitat.

The native vegetation is a plant community dominated by bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs and a few shrubs are included.

If range condition deteriorates, plant vigor is greatly reduced and the proportion of bluebunch wheatgrass and other desirable grasses decreases. If deterioration is severe, the forage bunchgrasses are nearly eliminated. As a result, low value plants predominate, the soils are subject to erosion, and much of the surface is bare and rocky.

Because this unit is very stony and slopes are steep, range seeding is not practical. At the higher elevations, the plant community is used by Rocky Mountain elk and mule deer in winter and early in spring when other areas are snow covered.

Shallowness over bedrock, stones, rock outcrop, and very steep slopes are severe limitations for community and recreation uses. Extreme design modifications are

needed but are rarely practical for dwellings, small buildings, and sanitary facilities.

The capability subclass is VIIs.

16C—Hall Ranch loam, 2 to 12 percent slopes. This is a moderately deep, well drained soil formed in mixed volcanic ash, loess, and colluvium from granite, andesite, and rhyolite. The elevation is 3,500 to 4,800 feet. The average slope is 7 percent. The average annual precipitation is 18 to 28 inches, and the average annual air temperature is 43 to 45 degrees F. The frost-free period is 50 to 80 days at 32 degrees and 80 to 110 days at 28 degrees.

In a representative profile the surface layer is dark reddish brown loam about 7 inches thick. The subsoil is dark reddish brown loam about 16 inches thick. Soft andesite is at a depth of about 23 inches.

About 20 percent of this unit is included areas of Klicker soils and 10 percent is Boardtree, Hankins, and Tolo soils.

Permeability is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 3 to 7 inches. Water supplying capacity is 8 to 16 inches. Runoff is slight, and the hazard of erosion is slight.

This soil is used for timber production, range, and wildlife habitat.

This soil is suited to the production of ponderosa pine. At a site index of 79 (*8*), it is capable of producing about 3,350 cubic feet of merchantable timber from a fully stocked stand at 50 years or 35,040 board feet (Scribner) of merchantable timber from a fully stocked stand at 160 years.

Tractor logging is suitable on this soil. The soil provides only poor to fair subgrade for roads. The amount of ballast depends upon the number and type of vehicles using the road and the months of the year that the road is used. Use early in spring should be limited.

The native vegetation is ponderosa pine and Douglas-fir, but predominantly pine. In a moderately stocked, mixed-age stand, the canopy cover is 20 to 40 percent. Douglas-fir occurs in varying amounts and may dominate the tree regeneration in places. The understory is dominated by pinegrass and elk sedge. A variety of perennial forbs and a few shrubs occur throughout the stand.

If the understory deteriorates, the proportion of pinegrass and elk sedge decreases, principally elk sedge. If deterioration is severe, shrubs and tree production proportionately increase and forbs become prominent.

Following fire or logging, broadcast seeding is advisable before fall rains settle the seedbed. A major objective of seeding is to stabilize disturbed soil areas. Plants suitable for seeding are intermediate wheatgrass, orchardgrass, timothy, and hard fescue.

Mule deer use the plant community for food and cover in summer and autumn. Rocky Mountain elk use the plant community as winter range and as cover during winter storms. A variety of small mammals and birds, including game birds such as blue and ruffed grouse, also use this community. Openings in the canopy as a result of logging or fire and the subsequent regeneration provide a good source of food and cover for these various kinds of wildlife.

The depth to bedrock and, in some places, the slope are limitations in community development. Variations in design need to be carefully implemented for successful utilization of this soil. The slope is a limitation for campgrounds, picnic areas, and playgrounds.

The capability subclass is VIc.

17E—Hall Ranch gravelly loam, 12 to 35 percent slopes. This is a moderately deep, well drained soil formed in mixed volcanic ash, loess, and colluvium from granite, andesite, and rhyolite. The elevation is 3,500 to 4,800 feet. The average slope is 20 percent. The average annual precipitation is 18 to 28 inches, and the average annual air temperature is 43 to 45 degrees F. The frost free period is 50 to 80 days at 32 degrees and 80 to 110 days at 28 degrees.

In a representative profile, the surface layer is dark reddish brown gravelly loam about 7 inches thick. The subsoil is dark reddish brown loam about 16 inches thick. Soft andesite is at a depth of about 23 inches.

About 20 percent of this unit is included areas of Klicker soils and 10 percent is Boardtree, Hankins, and Tolo soils.

Permeability is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 3 to 7 inches. Water supplying capacity is 8 to 16 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for timber production, range, and wildlife habitat.

This soil is suited to the production of ponderosa pine. At a site index of 79 (*8*), it is capable of producing about 3,350 cubic feet of merchantable timber from a fully stocked stand at 50 years or 35,040 board feet (Scribner) of merchantable timber from a fully stocked stand at 160 years.

Tractor logging is suitable in most areas of this soil. Cable logging may be desirable on some of the steeper slopes. The soil provides only poor to fair subgrade for roads. The amount of ballast depends on the number and type of vehicles using the road and the months of the year that the road is used. Use early in spring should be limited.

The native vegetation is ponderosa pine and Douglas-fir, but predominantly pine. In a moderately stocked, mixed-age stand, the canopy cover is 20 to 40 percent. Douglas-fir occurs in varying amounts and may dominate tree regeneration in places. The understory is dominated by pinegrass and elk sedge. A variety of perennial forbs and a few shrubs occur throughout the stand.

If the understory deteriorates, the proportion of pinegrass and elk sedge decreases, principally elk sedge. If deterioration is severe, shrubs and tree reproduction proportionately increase and forbs become prominent.

Following fire or logging, broadcast seeding is advisable before fall rains settle the seedbed. A major objective of seeding is to stabilize disturbed soil areas. Plants suitable for seeding are intermediate wheatgrass, orchardgrass, timothy, and hard fescue.

Mule deer use the plant community for food and cover in summer and autumn. Rocky Mountain elk use the community as winter range and as cover during winter storms. A variety of small mammals and birds, including game birds such as blue and ruffed grouse, also use this community. Openings in the canopy as a result of logging or fire and the subsequent regeneration provide a good source of food and cover for these various kinds of wildlife.

The depth to bedrock and the slope are limitations for community development and recreation facilities. Variations in design should be carefully implemented for successful utilization of this soil.

The capability subclass is VIe.

18E—Hankins silt loam, 5 to 35 percent south slopes. This is a very deep, well drained soil formed in colluvium mixed with ash and fine textured sediment. It is on south-facing slopes in the Blue Mountains at elevations of 3,500 to 5,000 feet. The average slope is 20 percent. The average annual precipitation is 18 to 25 inches, and the average annual air temperature is 43 to 45 degrees F. The frost free period is 60 to 90 days at 32 degrees and 90 to 110 days at 28 degrees.

In a representative profile the surface layer is very dark gray and very dark grayish brown silt loam and heavy silt loam about 12 inches thick. The subsoil is dark brown and yellowish brown clay about 35 inches thick. The substratum is yellowish brown and light yellowish brown clay loam that extends to a depth of 60 inches or more.

About 15 percent of this unit is included areas of Boardtree, Klicker, and Tolo soils.

Permeability is slow. Effective rooting depth is 40 to 60 inches. Available water capacity is 6 to 9 inches. Water supplying capacity is 13 to 16 inches. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

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

This soil is suited to the production of ponderosa pine. At a site index of 71 (*8*), it is capable of producing about 2,800 cubic feet of merchantable timber from a fully stocked stand at 50 years or 28,300 board feet (Scribner) of merchantable timber from a fully stocked stand at 160 years.

Tractor logging is suitable in most areas of this soil. Cable logging may be desirable where slopes are more than 30 percent. When wet, this soil is sticky and plastic. Tractor logging in spring when the soil is likely to be saturated may compact the soil severely, reducing natural regeneration and increasing runoff. The soil material provides only poor to fair subgrade for roads. The amount of ballast depends upon the number and type of vehicles using the road and the months of the year that the road is used. Use early in spring should be limited.

The native vegetation is ponderosa pine. In a moderately stocked, mixed-age stand, the tree canopy cover generally is less than 30 percent. Douglas-fir occurs in minor amounts but it may increase as the elevation increases. The understory is dominated by elk sedge. Pinegrass is prominent. A variety of perennial forbs and a few shrubs occur throughout the stand.

As the understory deteriorates, elk sedge decreases and the proportion of forbs and shrubs increases. If deterioration is severe, elk sedge is nearly eliminated and the stand becomes weedy. "Dog-hair" thickets of pine may occur as the understory deteriorates.

Following fire or logging, broadcast seeding is advisable before fall rains. A major objective of seeding is to stabilize disturbed soil areas. Plants suitable for seeding are intermediate wheatgrass, smooth brome, hard fescue, and white clover.

This plant community is used in summer and fall by mule deer and is part of the winter range for Rocky Mountain elk. A variety of small mammals and birds, including game birds such as blue and ruffed grouse, also use this community.

The slope, the high content of clay, and the slow permeability are limitations for community developments and recreation facilities. Modifications in design should be carefully implemented for successful utilization of this soil.

The capability subclass is VIe.

19C—Helter silt loam, bedrock substratum, 3 to 15 percent slopes. This is a deep, well drained soil formed in volcanic ash and wind laid silt mixed with granite and basalt colluvium. It occurs in the Blue Mountains at elevations of 4,500 to 5,500 feet. The average slope is about 6 percent. The average annual air temperature is 40 to 44 degrees F. The frost free period is 20 to 50 days.

In a representative profile the surface layer is dark grayish brown loam about 3 inches thick. The subsoil is 52 inches thick. The upper 23 inches is yellowish brown and light yellowish brown silt loam, the next 11 inches is a buried subsoil of dark yellowish brown loam, and the lower 18 inches is a buried subsoil of yellowish brown very gravelly loam. Andesite is at a depth of about 55 inches.

About 10 percent of this unit is included areas of Hall Ranch and Klicker soils, 1 percent is Aquepts and Aquolls, and 1 percent is Bocker and Gwin soils.

Permeability is moderately slow. Available water capacity is 9 to 17 inches. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 40 to 60 inches. Runoff is slow, and the hazard of water erosion is slight.

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

This soil is suited to the production of Douglas-fir. At a site index of 78 (*8*), it is capable of producing about 3,250 cubic feet of timber from a fully stocked stand at 50 years or 34,240 board feet (Scribner) of merchantable timber from a fully stocked stand at 160 years.

Lodgepole pine also grows on this soil. At a site index of 80 (*9*), the soil is capable of producing 3,450 cubic feet of merchantable timber from a fully stocked, even-aged stand at 70 years or 19,700 board feet (Scribner) of merchantable timber from a fully stocked, even-aged stand at 100 years.

This soil is suited to tractor logging. Excessive soil disturbance, however, should be avoided because removing the overlying ash layer and exposing the less fertile buried horizons adversely affect natural regeneration. If enough of this ashy material is removed, the productivity of the affected area is lowered permanently. Excessive soil disturbance may also result in severe erosion and water quality deterioration. The 20- to 40-inch ash layer makes the construction and maintenance of roads difficult. This material provides poor subgrade for roads. It does not compact easily, and it has high potential frost action and a high water holding capacity. The amount of ballast depends upon the number and type of vehicles using the road and the months of the year that the road is used. Use early in spring should be limited.

The native vegetation is a mixed fir forest. The tree canopy is 40 to 70 percent. Western larch is subordinate in the stand. Under this canopy cover the foliar understory is dominated by plants that do not provide significant forage for domestic livestock. It is about 20 percent small red huckleberry and princes pine, 10 percent twinflower, 5 percent pachistima, and 5 percent lupine, false Solomons-seal, and heartleaf arnica. Lodgepole pine occurs in some areas that have been affected by fire. The trees in these stands range from 75 to 100 years. The canopy cover generally is more than that in the mixed fir forest. The understory of shade tolerant shrubs, forbs, and grasses decreases as the tree cover increases. This understory provides considerable forage as long as the canopy remains open.

Following fire or logging, broadcast seeding is advisable before fall rains. A major objective of seeding is to stabilize disturbed soil areas. Suitable for seeding are orchardgrass, timothy, hard fescue, and white clover.

Mule deer use this plant community for food and cover in summer and autumn. Rocky Mountain elk use it for winter range and for cover during daytime and winter storms.

Because this soil is in a remote location and the climate is severe, most anticipated developments are likely to be for recreation. The moderately slow permeability and depth to rock are severe limitations for septic tank absorption systems.

The capability subclass is VIe.

19E—Helter silt loam, bedrock substratum, 15 to 35 percent slopes. This is a deep, well drained soil formed in volcanic ash and wind laid silt mixed with granite and basalt colluvium. It occurs on north-facing slopes in the Blue Mountains at elevations of 4,500 to 5,500 feet. The average slope is about 20 percent. The average annual precipitation is 24 to 30 inches, and the average annual air temperature is 40 to 44 degrees F. The frost free period is 20 to 50 days.

In a representative profile the surface layer is dark grayish brown silt loam about 3 inches thick. The subsoil is 52 inches thick. The upper 23 inches is yellowish brown and light yellowish brown silt loam, the next 11 inches is a buried subsoil of dark yellowish brown loam, and the lower 18 inches is a buried subsoil of yellowish brown very gravelly loam. Andesite is at a depth of about 55 inches.

About 10 percent of this unit is included areas of Hall Ranch and Klicker soils, 1 percent is Aquepts and Aquolls, and 1 percent is Bocker and Gwin soils.

Permeability is moderately slow. Available water capacity is 9 to 17 inches. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 40 to 60 inches. Runoff is medium, and the hazard of water erosion is slight.

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

This soil is suited to the production of Douglas-fir (fig. 6). At a site index of 78 (*5*), it is capable of producing about 3,250 cubic feet of timber from a fully stocked stand at 50 years or 34,240 board feet (Scribner) of merchantable timber from a fully stocked stand at 160 years.

Lodgepole pine also grows on this soil. At a site index of 80 (*9*), the soil is capable of producing 3,450 cubic feet of merchantable timber from a fully stocked, even-aged stand at 70 years or 19,700 board feet (Scribner) of merchantable timber from a fully stocked, even-aged stand at 100 years.

The slope and the ash content are the main equipment limitations in harvesting timber. Most conventional cable logging systems can be used for harvest. The use of roads early in spring should be limited because the ash layer does not compact easily, has high potential frost action and a high water holding capacity, and is generally poor roadbed material.

The native vegetation is a mixed fir forest. The canopy cover is 40 to 70 percent. Western larch is subordinate in the stand. Under this canopy cover, the foliar understory is dominated by plants that do not provide

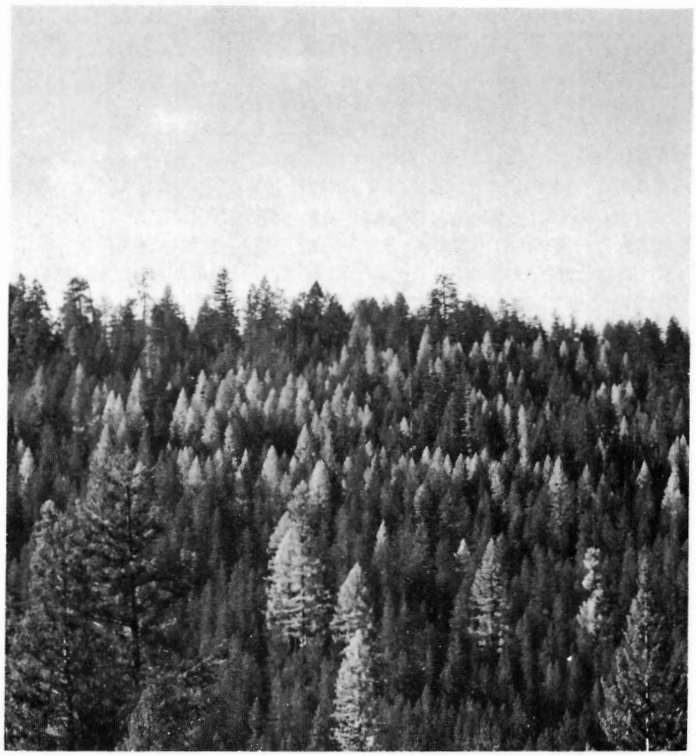


Figure 6.—Douglas-fir, western larch, and grand fir on Helter silt loam, bedrock substratum, 15 to 35 percent slopes.

significant forage for domestic livestock. It is about 20 percent small red huckleberry and princes pine, 10 percent twin flower, 5 percent pachistima, and 5 percent forbs, mainly lupine, false Solomons-seal, and heartleaf arnica. Lodgepole pine occurs in some areas that have been affected by fire. The trees in these stands range from 75 to 100 years. The canopy cover generally is more than that in the mixed fir forest. The understory of shade tolerant shrubs, forbs, and grasses decreases as the tree cover increases but provides considerable forage as long as the canopy remains open.

Following fire or logging, broadcast seeding is advisable before fall rains. A major objective of seeding is to stabilize disturbed soil areas. Suitable for seeding are orchardgrass, timothy, hard fescue, and white clover.

Mule deer use this plant community for food and cover in summer and autumn. Rocky Mountain elk use it for winter range and for cover during daytime and winter storms.

Because this soil is in a remote location and the climate is severe, most anticipated developments are likely to be for recreation. Some variation in design may be needed for dwellings and small buildings because of the slope. The moderately slow permeability and slope are severe limitations for septic tank absorption systems.

The capability subclass is VIe.

19F—Helter silt loam, bedrock substratum, 35 to 60 percent slopes. This is a deep, well drained soil formed in volcanic ash and wind laid silt mixed with granite and basalt colluvium. It occurs on north-facing slopes in the Blue Mountains at elevations of 4,500 to 5,500 feet. The average slope is about 50 percent. The average annual precipitation is 24 to 30 inches, and the average annual air temperature is 40 to 44 degrees F. The frost free period is 20 to 50 days.

In a representative profile the surface layer is dark grayish brown silt loam about 13 inches thick. The subsoil is 52 inches thick. The upper 23 inches is yellowish brown and light yellowish brown silt loam, the next 11 inches is a buried subsoil of dark yellowish brown loam, and the lower 18 inches is a buried subsoil of yellowish brown very gravelly loam. Andesite is at a depth of about 55 inches.

About 10 percent of this unit is included areas of Hall Ranch and Klicker soils.

Permeability is moderately slow. Available water capacity is 9 to 17 inches. Water supplying capacity is 12 to 16 inches. Effective rooting depth is 40 to 60 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate.

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

This soil is suited to the production of Douglas-fir. At a site index of 78 (*5*), it is capable of producing about 3,250 cubic feet of timber from a fully stocked stand at 50 years or 34,240 board feet (Scribner) of merchantable timber from a fully stocked stand at 160 years.

Lodgepole pine also grows on this soil. At a site index of 80 (*9*), the soil is capable of producing 3,450 cubic feet of merchantable timber from a fully stocked, even-aged stand at 70 years or 19,700 board feet (Scribner) of merchantable timber from a fully stocked, even-aged stand at 100 years.

The slope and ash content are the main equipment limitations in harvesting timber. High lead or other cable logging systems should be used for tree harvest. Use of roads early in spring should be limited because the ash layer does not compact easily, has high potential frost action and a high water holding capacity, and it is generally poor roadbed material.

The native vegetation is mixed fir forest. The canopy cover is 40 to 70 percent. Western larch is subordinate in the stand. Under this canopy cover, the foliar understory is dominated by plants that do not provide significant forage for domestic livestock. It is about 20 percent small red huckleberry and princes pine, 10 percent twin flower, 5 percent pachistima, and about 5 percent forbs, mainly lupine, false Solomons-seal, and heartleaf arnica. Lodgepole pine occurs in some areas that have been affected by fire. The trees in these stands range from 75 to 100 years. The canopy cover generally is more than that in the mixed fir forest. The understory of shade tolerant shrubs, forbs, and grasses

decreases as the tree cover increases but provides considerable forage as long as the tree stand remains open.

Following fire or logging, broadcast seeding is advisable before fall rains. A major objective of seeding is to stabilize disturbed soil areas. Suitable for seeding are orchardgrass, timothy, hard fescue, and white clover.

Mule deer use this plant community for food and cover in summer and autumn. Rocky Mountain elk use it for winter range and for cover during daytime and winter storms.

In most places community development is not practical because of the steep slopes.

The capability subclass is VIIe.

20B—Hezel loamy fine sand, 2 to 5 percent slopes. This is a very deep, somewhat excessively drained soil formed in water laid material. It is on terraces and uplands at elevations of 400 to 700 feet. The average slope is 3 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 150 to 200 days at 32 degrees and 185 to 285 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown loamy fine sand about 9 inches thick. The substratum is 21 inches of dark brown loamy fine sand over brown, compact, calcareous silt loam that extends to a depth of 60 inches or more.

About 15 percent of this unit is included areas of Burbank, Koehler, Quincy, and Royal soils and Dune land.

Permeability is rapid in the upper part of the substratum and moderately slow below. Effective rooting depth is 40 to 60 inches. Available water capacity is 4.5 to 9 inches. Water supplying capacity is 3 to 5 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. Some of the acreage is used for range and wildlife habitat. Major irrigated crops include potatoes, wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the proper application of irrigation water and protection against soil blowing. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the moderately low water holding capacity in the upper part of the soil and the high water consumption, light, frequent applications of irrigation water are needed. Irrigation rates should be carefully determined. In many areas, compact, slowly permeable lacustrine silt is at a moderate depth. If these areas are overirrigated, ponding may result. In steeper areas of this unit, excess irrigation water may run off and cause some erosion.

The hazard of soil blowing is high because of the loamy fine sand surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and hummocks in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures needed to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Blowout areas require special treatment, such as disked-in straw mulching and seeding to suitable grasses. Doublecropping and stripcropping are needed in places. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation system before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is bluebunch wheatgrass, Sandberg bluegrass, and needleandthread. Perennial forbs, such as Carey balsamroot, wooly Indianwheat, and western yarrow, occur in small amounts. Big sagebrush and rubber rabbitbrush are common.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass, low value forbs, and big sagebrush increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand.

If the range is in poor condition, seedbed preparation and seeding should be considered. Because the hazard of soil blowing is high, seeding to grass presents special management problems. Direct drill seeding after a fire is a good way to restore production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested or Siberian wheatgrass.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

This soil is generally well suited to community development. Construction of dwellings, commercial buildings, and roads and streets is limited somewhat because of the low strength of the soil. Septic tanks may require modification in design because the soil is moderately slowly permeable. Recreation facilities are limited because the surface layer is too sandy. Playgrounds may require leveling.

The capability subclass is VIIe dryland, IVe irrigated.

20C—Hezel loamy fine sand, 5 to 12 percent slopes. This is a very deep, somewhat excessively

drained soil formed in water laid material. It is on terraces and uplands at elevations of 400 to 700 feet. The average slope is 8 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost-free period is 150 to 200 days at 32 degrees and 185 to 215 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown loamy fine sand about 9 inches thick. The substratum is 21 inches of dark brown loamy fine sand over brown, compact, calcareous silt loam that extends to a depth of 60 inches or more.

About 15 percent of this unit is included areas of Burbank, Koehler, Quincy, and Royal soils and Dune land.

Permeability is rapid in the upper part of the substratum and moderately slow below. Effective rooting depth is 40 to 60 inches. Available water capacity is 4.5 to 9 inches. Water supplying capacity is 3 to 5 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. Some of the acreage is used for range and wildlife habitat. Major irrigated crops include potatoes, wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the proper application of irrigation water and protection from soil blowing. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the moderately low water holding capacity in the upper part of the soil and the high water consumption, light, frequent applications of irrigation water are needed. Irrigation rates should be carefully determined. In many areas, compact, slowly permeable lacustrine silt is at a moderate depth. If these areas are overirrigated, soil erosion may result from the runoff of excess water.

The hazard of soil blowing is high because of the loamy fine sand surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and hummocks in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Practices needed to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction Blowout areas require special treatment, such as disked-in straw mulching and seeding to suitable grasses. Doublecropping and stripcropping are needed in places. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation systems before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is bluebunch wheatgrass, Sandberg bluegrass, and needleandthread. Perennial forbs, such as Carey balsamroot, wooly Indianwheat, and western yarrow, occur in small amounts. Big sagebrush and rubber rabbitbrush are common.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass, low value forbs, and big sagebrush increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand.

If the range is in poor condition, seedbed preparation and seeding should be considered. Because the soil blowing hazard is high, seeding to grass presents special management problems. Direct drill seeding after a fire is a good way to restore production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested or Siberian wheatgrass.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

Construction of dwellings, commercial buildings, and roads and streets is limited somewhat because of the low strength of the soil and the slope. Septic tanks may require modification in design because the soil is moderately slowly permeable. Sewage lagoons are severely limited because of the slope. Recreation facilities are limited because the surface layer is too sandy. Playgrounds may require leveling.

The capability subclass is VIe dryland, IVe irrigated.

21B—Irrigon fine sandy loam, 2 to 5 percent slopes. This is a moderately deep, well drained soil formed in alluvial sand derived from basaltic and quartzitic material. It is on terraces at elevations of 400 to 700 feet. The average slope is 3 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 160 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown fine sandy loam about 3 inches thick. The subsoil is dark brown fine sandy loam and loam about 20 inches thick. Depth to semiconsolidated sandy sediment is about 23 inches.

About 20 percent of this unit is included areas of Hezel soils and shallow fine sandy loams and 10 percent is Ellum and Quincy soils.

Permeability is moderate. Effective rooting depth is restricted by the semiconsolidated sandy sediment at a

depth of 20 to 40 inches. Available water capacity is 3 to 6.5 inches. Water supplying capacity is 2 to 5 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. Some of the acreage is used as range and wildlife habitat. Major irrigated crops include potatoes, corn, wheat, alfalfa hay, and pasture.

Major concerns in management are the hazard of soil blowing and the proper application of irrigation water. Where water is available, irrigation is by sprinklers, commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the high water consumption and moderate water holding capacity, light, frequent applications of irrigation water are needed. Overirrigation should be avoided because of the impervious material at a depth of 20 to 40 inches. Ponding may result, and in the steeper areas of this unit runoff may occur causing some erosion.

The hazard of soil blowing is moderate because of the fine sandy loam surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures that help control soil blowing are winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation systems before land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is dominated by bluebunch wheatgrass, Sandberg bluegrass, and needleandthread. Perennial forbs, such as Carey balsamroot, wooly Indianwheat, and western yarrow, occur in small amounts. Big sagebrush and rubber rabbitbrush commonly occur.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass, low value forbs, and big sagebrush increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand.

If the range is in poor condition, seedbed preparation and seeding should be considered. Because the soil blowing hazard is high, seeding to grass presents special management problems. Direct drill seeding after a fire is a good way to restore production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested or Siberian wheatgrass.

Livestock grazing should be limited primarily to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

Construction of sanitary facilities may require variation in design because of the depth to bedrock. Construction of dwellings, commercial buildings, and roads and streets is limited somewhat because of the depth to rock and low strength of the soil. Playgrounds may require leveling.

The capability subclass is VIe dryland, IIIe irrigated.

21C—Irrigon fine sandy loam, 5 to 12 percent slopes. This is a moderately deep, well drained soil formed in alluvial sand derived from basaltic and quartzitic material. It is on terraces at elevations of 400 to 700 feet. The average slope is 8 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 160 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown fine sandy loam about 3 inches thick. The subsoil is dark brown fine sandy loam and loam about 20 inches thick. Depth to semiconsolidated sandy sediment is about 23 inches.

About 20 percent of this unit is included areas of Hezel soils and shallow fine sandy loams, and 10 percent is Ellum and Quincy soils.

Permeability is moderate. Effective rooting depth is restricted by semiconsolidated sandy sediment at a depth of 20 to 40 inches. Available water capacity is 3 to 6.5 inches. Water supplying capacity is 2 to 5 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. Some of the acreage is used as range and wildlife habitat. Major irrigated crops include potatoes, corn, wheat, alfalfa hay, and pasture.

Major concerns in management are the hazard of soil blowing and the proper application of irrigation water. Where water is available, irrigation is by sprinklers, commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the high water consumption and moderate water holding capacity, light, frequent applications of irrigation water are needed. Overirrigation should be avoided because of the impervious material at a depth of

20 to 40 inches. Excess irrigation water may run off and result in some erosion.

The hazard of soil blowing is moderate because of the fine sandy loam surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered and applied chemicals are lost. Measures that help in controlling soil blowing are winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation systems before land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are practices and precautions needed.

The native plant community is dominated by bluebunch wheatgrass, Sandberg bluegrass, and needleandthread. Perennial forbs, such as Carey balsamroot, wooly Indianwheat, and western yarrow, occur in small amounts. Big sagebrush and rubber rabbitbrush are common.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass, low value forbs, and big sagebrush increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand.

If the range is in poor condition, seedbed preparation and seeding should be considered. Because soil blowing is a moderate hazard, seeding to grass presents special management problems. Direct drill seeding after a fire is a good way to restore production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested or Siberian wheatgrass.

Livestock grazing should be limited primarily to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

Construction of sanitary facilities may require variation in design because of the depth to bedrock. Construction of dwellings, commercial buildings, and roads and streets is limited somewhat because of the depth to rock, low strength of the soil, and slope. Recreation facilities are limited by the slope. Playgrounds may require leveling.

The capability subclass is VIe dryland, IVe irrigated.

22—Kimberly fine sandy loam. This is a very deep, well drained soil on alluvial bottom land adjacent to streams at elevations of 500 to 1,200 feet. It formed in a mixture of loess, silty alluvium, and volcanic ash. Slopes range from 0 to 3 percent but average 1 percent. The average annual precipitation is 8 to 12 inches, and the average annual air temperature is 51 to 53 degrees F. The frost free period is 140 to 180 days at 32 degrees.

In a representative profile the surface layer is dark brown and very dark grayish brown fine sandy loam about 15 inches thick. The subsoil is dark brown and brown fine sandy loam and sandy loam about 18 inches thick. The substratum is brown and dark grayish brown sandy loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Esquatzel soils and Xeric Torriorthents, and 5 percent is Endersby and Onyx soils.

Permeability is moderately rapid. Effective rooting depth is 40 to more than 60 inches. Available water capacity is 6 to 9 inches. Water supplying capacity is 8 to 11 inches. Runoff is slow, and the hazard of erosion is slight. The soil is subject to rare flooding.

All the acreage is used for irrigated crops. Hay and pasture are the main crops. Some winter wheat is also grown.

The major needs in irrigated crop management are the proper timing and rates of applying irrigation water. Stabilizing streambanks against cutting by water is also important. Irrigation is by sprinklers, most commonly wheelline or handline systems.

In irrigated areas, a suitable cropping system is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Because of the moderately rapid permeability and high water consumption, light, frequent applications of irrigation water are needed. Split applications of fertilizer are desirable because plant nutrients are leached out of the root zone by the irrigation water.

Streambanks can be stabilized by maintaining streamside vegetation, especially giant wildrye and riparian shrubs such as lilac or willow. Such vegetation also provides important wildlife cover.

Areas of this soil provide important food and cover for upland game birds, such as ring-necked pheasant and valley quail. Mule deer and small mammals use these areas for food and cover.

This soil occurs on stream flood plains and is subject to rare flooding, which results in limitations for many community developments. It is well suited to recreation facilities, except campgrounds, where flooding may be a problem, and playgrounds, where the slope is a limitation.

The capability subclass is I irrigated.

23D—Klicker stony silt loam, 2 to 20 percent slopes. This is a moderately deep, well drained soil formed in wind laid silt and volcanic ash mixed with basalt colluvium. It occurs at elevations of 3,500 to 5,300 feet in the Blue Mountains. The average slope is 9 percent. The average annual precipitation is 20 to 28 inches, and the average annual air temperature is 43 to

45 degrees F. The frost free period is 60 to 90 days at 32 degrees.

In a representative profile the surface layer is dark reddish brown stony silt loam that grades to cobbly silt loam. It is 11 inches thick. The subsoil is dark reddish brown and dark brown very cobbly silty clay loam about 15 inches thick. Fractured basalt is at a depth of about 26 inches.

About 20 percent of this unit is included areas of Hall Ranch soils; 10 percent is Tolo, Helter, Boardtree, and Hankins soils; and 5 percent is Bocker soils.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 3 to 6 inches. Water supplying capacity is 8 to 16 inches. Runoff is medium, and the hazard of erosion is slight to moderate.

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

This soil is suited to the production of ponderosa pine. At a site index of 68 (*8*), it is capable of producing about 2,650 cubic feet of timber from a fully stocked stand at 50 years or 31,540 board feet (Scribner) of merchantable timber from a fully stocked stand at 190 years.

This soil is well suited to tractor logging. Construction and maintenance of roads are fairly easy because slopes are gentle and the soil material is good subgrade for construction. The amount of ballast depends upon number and type of vehicles using the road and the months of the year that the road is used. Use early in spring should be limited.

The native vegetation is ponderosa pine. In a moderately stocked, mixed-age stand, the tree canopy cover is 10 to 40 percent. The understory is dominated by Idaho fescue and bluebunch wheatgrass. A variety of perennial forbs, such as peavine and arrowleaf balsamroot, occurs throughout the stand. A few shrubs occur in small amounts.

As the understory deteriorates, the proportion of forbs and less desirable grasses increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated, much of the surface is left bare, and the hazard of soil erosion is high, especially on the steeper slopes.

Following fire or logging, broadcast seeding is advisable before fall rains. A major objective of seeding is to stabilize disturbed soil areas. Plants suitable for seeding are intermediate wheatgrass, big bluegrass, crested wheatgrass, and hard fescue.

This plant community is used in summer and fall by mule deer. It is also an important part of the winter range of Rocky Mountain elk. A variety of small mammals and birds, including game birds such as the blue and ruffed grouse, use this community.

The depth to bedrock and the slope are limitations for community developments and recreation facilities. Variations in design should be carefully implemented for successful utilization of this soil.

The capability subclass is VIe.

24E—Klicker stony silt loam, 20 to 40 percent north slopes. This is a moderately deep, well drained soil formed in wind laid silt and volcanic ash mixed with basalt colluvium. It is on north-facing slopes in the Blue Mountains at elevations of 3,500 to 4,600 feet. The average slope is 30 percent. The average annual precipitation is 20 to 28 inches, and the average annual air temperature is 43 to 45 degrees F. The frost free period is 60 to 90 days at 32 degrees.

In a representative profile the surface layer is dark reddish brown stony silt loam about 11 inches thick. The subsoil is dark reddish brown and dark brown very cobbly clay loam about 15 inches thick. Fractured basalt is at a depth of about 26 inches.

About 20 percent of this unit is included areas of closely similar soils that are more than 40 inches thick; 5 percent is skeletal, ashy soils; 20 percent is Hall Ranch soils; and 15 percent Snell, Hankins, Boardtree, Tolo, and Helter soils.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 3 to 6 inches. Water supplying capacity is 8 to 16 inches. Runoff is medium, and the hazard of erosion is moderate.

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

This soil is suited to the production of ponderosa pine. At a site index of 79 (*8*), it is capable of producing about 3,350 cubic feet of timber from a fully stocked stand at 50 years or 35,040 board feet (Scribner) of merchantable timber from a fully stocked stand at 160 years.

Tractor logging is practical in the less steep areas of this unit. In most places, however, cable logging is desirable because of the slope. Steep slopes are concerns in the construction and maintenance of roads. The soil material provides good subgrade for roads. The amount of ballast depends upon the number and type of vehicles using the road and the months of the year that the road is used. Use early in spring should be limited.

The native vegetation is fir and ponderosa pine. Fir is predominant. Western larch commonly occurs in lesser amounts. The tree canopy is about 40 percent. Under this canopy, the foliar understory provides little forage for domestic livestock. It is about 40 percent elk sedge and about 2 percent each a variety of shrubs, such as snowberry and rose. It is about 5 percent peavine, a prominent forb. In open grown stands, elk sedge, pinegrass, and a variety of palatable forbs, such as peavine, provide considerable forage as long as the canopy remains open.

Following fire or logging, broadcast seeding is advisable before fall rains. A major objective of seeding is to stabilize disturbed soil areas. Plants suitable for seeding are orchardgrass, timothy, hard fescue, and white clover.

Mule deer use the plant community for food and cover in summer and fall. At the lower elevations, Rocky

Mountain elk use it as winter range, mainly as cover during daytime and winter storms. A variety of small mammals and birds, including game birds such as the blue and ruffed grouse, also use this plant community.

The depth to bedrock, the stones, and the slope are limitations to community development and recreation facilities. Extensive variations in design need to be carefully implemented for successful utilization of this soil.

The capability subclass is VIIs.

24F—Klicker stony silt loam, 40 to 75 percent north slopes. This is a moderately deep, well drained soil formed in wind laid silt and volcanic ash mixed with basalt colluvium. It is on north-facing slopes in the Blue Mountains at elevations of 3,500 to 4,600 feet. The average slope is 55 percent. The average annual precipitation is 20 to 28 inches, and the average annual air temperature is 43 to 45 degrees F. The frost free period is 60 to 90 days at 32 degrees F.

In a representative profile, the surface layer is dark reddish brown stony silt loam about 11 inches thick. The subsoil is dark reddish brown and dark brown very cobbly silty clay loam about 15 inches thick. Fractured basalt is at a depth of about 26 inches.

About 20 percent of this unit is included areas of closely similar soils that are more than 40 inches thick; 5 percent is skeletal, ashy soils; and 15 percent is Snell, Hankins, Boardtree, Tolo, and Helter soils.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 3 to 6 inches. Water supplying capacity is 8 to 16 inches. Runoff is rapid, and the hazard of erosion is high.

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

This soil is suited to the production of ponderosa pine. At a site index of 79 (*8*), it is capable of producing about 3,350 cubic feet of timber from a fully stocked stand at 50 years or 35,040 board feet (Scribner) of merchantable timber from a fully stocked stand at 160 years.

Because of the slope, the only practical method of logging is by cable. In some areas, outcrops of rock may interfere with logging. Steep slopes are the most serious concern in the construction and maintenance of roads. The soil material provides good subgrade for roads. The amount of ballast depends upon the number and type of vehicles using the road and the months of the year that the road is used. Use early in spring should be limited.

The native vegetation is fir and ponderosa pine. Fir is dominant. Western larch commonly occurs in lesser amounts. The tree canopy cover is about 40 percent. Under this canopy cover the foliar understory provides little forage for domestic livestock. It is about 40 percent elk sedge and about 4 percent a variety of shrubs, such as snowberry and rose. It is about 5 percent peavine, a prominent forb. In open grown stands, elk sedge, pinegrass, and a variety of palatable forbs, such as peavine, provide considerable forage as long as the canopy remains open.

Following fire or logging, broadcast seeding is advisable before fall rains. A major objective of seeding is to stabilize disturbed soil areas. Plants suitable for seeding are orchardgrass, timothy, hard fescue, and white clover.

Mule deer use this plant community for food and cover in summer and fall. At the lower elevations, Rocky Mountain elk use it as winter range, mainly as cover during daytime and winter storms. A variety of other mammals and birds, including game birds such as blue and ruffed grouse, also use this community.

The depth to bedrock, the surface stones, and the very steep slopes are limitations for community developments and recreation facilities, and such uses generally are not practical.

The capability subclass is VIIs.

25E—Klicker very stony silt loam, 20 to 40 percent south slopes. This is a moderately deep, well drained soil formed in wind laid silt and volcanic ash mixed with basalt colluvium. It occurs at elevations of 3,500 to 5,300 feet in the Blue Mountains. The average slope is 30 percent. The average annual precipitation is 20 to 28 inches, and the average annual air temperature is 43 to 45 degrees F. The frost-free period is 60 to 90 days at 32 degrees.

In a representative profile the surface layer is dark reddish brown very stony silt loam about 11 inches thick. The subsoil is dark reddish brown and dark brown very cobbly silty clay loam about 15 inches thick. Fractured basalt is at a depth of about 26 inches.

About 15 percent of this unit is included areas of Hall Ranch soils; 5 percent is Tolo, Helter, Boardtree, Hankins, and steep Klicker soils; and 10 percent is Gwin soils.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 3 to 6 inches. Water supplying capacity is 8 to 16 inches. Runoff is medium, and the hazard of erosion is moderate.

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

This soil is suited to the production of ponderosa pine. At a site index of 68 (*8*), it is capable of producing about 2,650 cubic feet of timber from a fully stocked stand at 50-years or 31,540 board feet (Scribner) of merchantable timber from a fully stocked stand at 190 years.

Tractor logging is practical on the less steep areas of this unit. In most cases, however, cable logging is desirable because of the slope. Steep slopes are the biggest concern in the construction and maintenance of roads. The soil provides good subgrade for construction. The amount of ballast depends upon the number and type of vehicles using the road and the months of the

year that the road is used. Use early in spring should be limited.

The native vegetation is a ponderosa pine woodland community. In a moderately stocked, mixed-age stand, the tree canopy cover is 10 to 40 percent. The understory is dominated by Idaho fescue and bluebunch wheatgrass. A variety of perennial forbs, such as peavine and arrowleaf balsamroot, occurs throughout the stand. A few shrubs occur in small amounts.

If the understory deteriorates, the proportion of forbs and less desirable grasses increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated, much of the surface is left bare, and the hazard of soil erosion is high, especially on the steeper slopes.

Following fire or logging, broadcast seeding is advisable before fall rains. A major objective of seeding is to stabilize disturbed soil areas. Plants suitable for seeding are intermediate wheatgrass, big bluegrass, crested wheatgrass, and hard fescue.

This plant community is used in summer and fall by mule deer. It is also an important part of the winter range of Rocky Mountain elk. A variety of small mammals and birds, including game birds such as blue and ruffed grouse, use this community.

The depth to bedrock, the surface stones, and the slope are limitations for community developments and recreation facilities. Extensive variations in design should be carefully implemented for successful utilization of this soil.

The capability subclass is VIIs.

25F—Klicker very stony silt loam, 40 to 75 percent south slopes. This is a moderately deep, well drained soil formed in wind laid silt and volcanic ash mixed with basalt colluvium. It occurs at elevations of 3,500 to 5,300 feet in the Blue Mountains. The average slope is 55 percent. The average annual precipitation is 20 to 28 inches, and the average annual air temperature is 43 to 45 degrees F. The average frost free period is 60 to 90 days at 32 degrees.

In a representative profile the surface layer is dark reddish brown very stony silt loam about 11 inches thick. The subsoil is dark reddish brown and dark brown very cobbly silty clay loam about 15 inches thick. Fractured basalt is at a depth of about 26 inches.

About 15 percent of this unit is included areas of Gwin soils, and 5 percent is Tolo and Helter soils.

Permeability is moderately slow. Effective rooting depth is 20 to 40 inches. Available water capacity is 3 to 6 inches. Water supplying capacity is 8 to 16 inches. Runoff is rapid, and the hazard of erosion is severe.

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

This soil is suited to the production of ponderosa pine. At a site index of 68 (*8*), it is capable of producing about 2,650 cubic feet of timber from a fully stocked stand at 50 years or 31,540 board feet (Scribner) of merchantable timber from a fully stocked stand at 190 years.

Because of the slope, the only practical method of logging is by cable. In some areas, outcrops of rock may interfere with logging. Steep slopes are the serious concern in the construction and maintenance of roads. The soil material provides good subgrade for construction. The amount of ballast depends upon the number and type of vehicles using the road and the months of the year that the road is used. Use early in spring should be limited.

The native vegetation is a ponderosa pine woodland community. In a moderately stocked, mixed-age stand, the canopy cover is 10 to 40 percent. The understory is dominated by Idaho fescue and bluebunch wheatgrass. A variety of perennial forbs, such as peavine and arrowleaf balsamroot, occurs throughout the stand. A few shrubs occur in small amounts.

If the understory deteriorates, the proportion of forbs and less desirable grasses increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated, much of the surface is left bare, and the hazard of soil erosion is high, especially on the steeper slopes.

Following fire or logging, broadcast seeding is advisable before fall rains. A major objective of seeding is to stabilize disturbed soil areas. Plants suitable for seeding are intermediate wheatgrass, big bluegrass, crested wheatgrass, and hard fescue.

This plant community is used in summer and fall by mule deer. It is also an important part of the winter range of Rocky Mountain elk. A variety of small mammals and birds, including game birds such as blue and ruffed grouse, also use this community.

The use of this soil for community developments and recreation facilities is impractical because of the depth to bedrock, the surface stones, and the very steep slopes.

The capability subclass is VIIs.

26B—Koehler loamy fine sand, 2 to 5 percent slopes. This is a moderately deep, excessively drained soil formed in mixed sand. It occurs at elevations of 400 to 800 feet. The average slope is 3 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 150 to 200 days at 32 degrees and 185 to 215 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown loamy fine sand about 4 inches thick. The substratum is about 20 inches of brown and dark brown loamy fine sand over 4 inches of dark grayish brown loamy fine sand. A calcareous hardpan is at a depth of about 28 inches.

About 20 percent of this unit is included areas of Quinton, Hezel, and Burbank soils and 5 percent is Quincy and Royal soils and Dune land.

Permeability is rapid above the pan. Effective rooting depth is restricted by the pan at a depth of 20 to 40

inches. Available water capacity is 2 to 4 inches Water supplying capacity is 2 to 4 inches. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is high.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. A large part of the acreage is used for range and wildlife habitat, particularly where the soil occurs within the Boardman Naval Reservation. Major irrigated crops include potatoes, wheat, corn, alfalfa hay, and pasture

Major concerns in management are the proper application of irrigation water and the hazard of soil blowing. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the moderately low water holding capacity and high water consumption, light, frequent applications of irrigation water are needed. Care should be taken not to overirrigate. In several areas of this soil near Boardman, overirrigation has resulted in a high water table.

The hazard of soil blowing is high because of the loamy fine sand surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and hummocks in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures needed to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Blowout areas require special treatment, such as disked-in straw mulching and seeding to suitable grasses. Doublecropping and stripcropping are needed in places. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation system before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is dominated by needleandthread and Indian ricegrass. Antelope bitterbrush is common and is prominent in places. Perennial forbs, such as Columbia milkvetch and Carey balsamroot, are common. Other shrubs, such as big sagebrush and rabbitbrush, occur here and there in small amounts.

If range condition deteriorates, the proportion of Indian ricegrass decreases and the proportion of needleandthread and low value forbs increases. If deterioration is severe, cheatgrass invades and strongly dominates the stand. As a result, the hazard of soil blowing during the growing season is severe, and sand movement may be difficult to control.

If the range is in poor condition, total protection of the existing plant cover should be considered. Standard methods of seedbed preparation and seeding present special problems because of the hazard of soil blowing. Direct drill seeding of crested wheatgrass or Siberian wheatgrass is advisable after a fire.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

This soil is limited for sanitary facilities by the cemented pan and seepage. It is generally well suited to construction of dwellings, roads and streets, and commercial buildings. Dwellings with basements, however, may require some variation in design because of the cemented pan. The soil is limited for recreation facilities because the surface layer is too sandy. Playgrounds may require leveling.

The capability subclass is VIIe dryland, IVe irrigated.

26C—Koehler loamy fine sand, 5 to 12 percent slopes. This is a moderately deep, excessively drained soil formed in mixed sand. It occurs at elevations of 400 to 800 feet. The average slope is 8 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 150 to 200 days at 32 degrees and 185 to 215 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown loamy fine sand about 4 inches thick. The substratum is about 20 inches of brown and dark brown loamy fine sand over 4 inches of dark grayish brown loamy fine sand. A calcareous hardpan is at a depth of 28 inches

About 20 percent of this unit is included areas of Quinton, Hezel, and Burbank soils and 5 percent is Quincy and Royal soils and Dune land.

Permeability is rapid above the pan. Effective rooting depth is restricted by the pan at a depth of 20 to 40 inches. Available water capacity is 2 to 4 inches. Water supplying capacity is 2 to 4 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. A large part of the acreage is used for range and wildlife habitat, particularly where the soil occurs in the Boardman Naval Reservation. Major irrigated crops include potatoes, wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the proper application of irrigation water and the hazard of soil blowing. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa. If wheat is grown more than 2 consecutive years or if potatoes follow

potatoes, serious weed and disease control problems are common.

Because of the moderately low water holding capacity and high water consumption, light, frequent applications of irrigation water are needed. Care should be taken not to overirrigate. In several areas of this soil near Boardman, overirrigation has resulted in a high water table.

The hazard of soil blowing is high because of the loamy fine sand surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and hummocks in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures needed to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind. Blowout areas require special treatment, such as disked-in straw mulching and seeding to suitable grasses. Doublecropping and stripcropping are needed in places. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation systems before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is dominated by needleandthread and Indian ricegrass. Antelope bitterbrush is common and is prominent in places. Perennial forbs, such as Columbia milkvetch and Carey balsamroot, are common. Other shrubs, such as big sagebrush and rabbitbrush, occur in small amounts.

If range condition deteriorates, the proportion of Indian ricegrass decreases and the proportion of needleandthread and low value forbs increases. If deterioration is severe, cheatgrass invades and strongly dominates the stand. As a result, the hazard of soil blowing during the growing season is severe, and sand movement may be difficult to control.

If the range is in poor condition, total protection of the existing plant cover is a practical consideration. Standard methods of seedbed preparation and seeding present special problems because of the hazard of soil blowing. Direct drill seeding of crested wheatgrass or Siberian wheatgrass is advisable.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

This soil is limited for sanitary facilities by the cemented pan and the seepage. It is generally well suited to construction of dwellings and roads and streets, but some modification in design may be needed because of the slope and the pan. Commercial buildings are limited by the slope. Recreation facilities are limited because the surface layer is too sandy. Playgrounds may require leveling.

The capability subclass is VIIe dryland, IVe irrigated.

27E—Labuck loam, 5 to 35 percent slopes. This is a moderately deep, well drained soil formed in colluvium from granodiorite. It is on ridgetops and south-facing slopes in the Blue Mountains at elevations of 3,500 to 4,500 feet. The average slope is 25 percent. The average annual precipitation is 20 to 25 inches, and the average annual air temperature is 42 to 45 degrees F. The frost free period is 50 to 90 days at 32 degrees and 80 to 110 days at 28 degrees.

In a representative profile the surface layer is dark brown loam about 6 inches thick. The subsoil is yellowish brown gravelly loam and loam about 15 inches thick. The substratum is dark yellowish brown gravelly sandy loam about 10 inches thick. Weathered granodiorite is at a depth of about 31 inches.

About 15 percent of this unit is included areas of Hall Ranch and Tolo soils and 2 percent is granitic Rock outcrop.

Permeability is moderate. Effective rooting depth is restricted by the granodiorite at a depth of 20 to 40 inches. Available water capacity is 2 to 6 inches. Water supplying capacity is 8 to 16 inches. Runoff is slow to rapid, and the hazard of water erosion is slight to high.

This soil is used for timber, range, recreation, and wildlife habitat.

This soil is suited to the production of ponderosa pine. At a site index of 61 (*8*), it is capable of producing about 2,350 cubic feet of timber from a fully stocked stand at 50 years or 25,300 board feet (Scribner) of merchantable timber from a fully stocked stand at 190 years.

Tractor logging is suitable in most areas. On slopes of more than 30 percent, cable logging may be desirable. The soil material provides fair subgrade for roads. If roads are not sealed and ballasted, however, they will erode easily, particularly if they are used in spring. The amount of ballast depends on the number and type of vehicles using the road and the months of the year that the road is used. Use early in spring should be limited. Some abandoned landings and skid roads require seeding to reduce erosion.

The native vegetation is ponderosa pine and Douglas-fir. Pine is dominant. In a moderately stocked, mixed-age stand, the canopy cover is 20 to 40 percent. Douglas-fir reproduction may dominate tree regeneration in places. The understory is a good stand of elk sedge, Idaho fescue, pinegrass, and a variety of perennial forbs. Shrubs, such as bearberry, snowberry, and shinyleaf spirea, are prominent.

If the understory deteriorates, elk sedge and the desirable bunchgrasses decrease and the proportion of forbs and shrubs increases. If deterioration is severe, the productive forage plants are nearly eliminated, much of

the surface is left bare, and the hazard of erosion is high, especially on steep slopes.

Following fire or logging, broadcast seeding is desirable before fall rains. A major objective of seeding is to stabilize disturbed areas. Plants suitable for seeding are intermediate wheatgrass, smooth bromegrass, and hard fescue.

This plant community is used in summer by mule deer. It is an important part of the winter range of Rocky Mountain elk. A variety of small mammals and birds, including game birds such as blue and ruffed grouse, also use this community.

Very few dwellings are on this soil, and the majority are used for seasonal recreation purposes. Because of the slope and depth to rock, construction of dwellings, buildings, and sanitary and recreation facilities may require modifications for successful development.

The capability subclass is VIe.

28E—Lickskillet very stony loam, 7 to 40 percent slopes. This is a shallow, well drained soil formed in material weathered from loess and colluvium. It occurs on south- and west-facing slopes at elevations of 800 to 3,500 feet. The average slope is 20 percent. The average annual precipitation is 10 to 13 inches, and the average annual air temperature is 47 to 51 degrees F. The frost free period is 100 to 150 days at 32 degrees and 150 to 210 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown very stony loam about 2 inches thick. The subsoil is dark brown extremely cobbly heavy loam about 15 inches thick. Fractured basalt is at a depth of about 17 inches.

About 20 percent of this unit is included areas of Bakeoven soils and basalt outcrop and 10 percent is Mikkalo, Valby, Morrow, and Wrentham soils.

Permeability is moderate. Effective rooting depth is 12 to 20 inches. Available water capacity is 1 to 3 inches. Water supplying capacity is 2 to 5 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for livestock grazing and wildlife habitat.

The major concern is maintaining an adequate plant cover for control of water erosion.

The native plant community is dominated by bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. Various perennial forbs occur throughout the stand in small amounts. Shrubs are minor in the stand.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and Thurber needlegrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated. As a result, much of the surface is left bare and the hazard of soil erosion is high.

Because the soil is shallow and stony, seedbed preparation and range seeding generally are not practical.

Most areas of this soil provide some food and cover for mule deer, small mammals, and game birds.

The depth to bedrock, stoniness, and slope are severe limitations for community and recreation uses. Extensive design modifications are needed but in most cases are not practical for dwellings, small buildings, and sanitary facilities.

The capability subclass is VIIs.

29F—Lickskillet-Rock outcrop complex, 40 to 70 percent slopes. This map unit is on south-facing slopes of uplands at elevations of 800 to 3,500 feet. It is about 55 percent Lickskillet soil, 25 percent Rock outcrop, 15 percent Bakeoven soil and Rubble land, and 5 percent Nansene and Wrentham soils. The Lickskillet soil is shallow and well drained. It formed in material weathered from loess and colluvium. The average slope is about 50 percent. The average annual precipitation is 10 to 13 inches, and the average annual air temperature is 47 to 51 degrees F. The frost free period is 100 to 150 days at 32 degrees and 150 to 210 days at 28 degrees.

In a representative profile of the Lickskillet soil the surface layer is very dark grayish brown extremely stony loam about 2 inches thick. The subsoil is dark brown extremely cobbly heavy loam about 15 inches thick. Fractured basalt is at a depth of about 17 inches.

Rock outcrop is basalt bedrock.

The Lickskillet soil has moderate permeability. Effective rooting depth is 12 to 20 inches. Available water capacity is 1 to 3 inches. Water supplying capacity is 2 to 5 inches. Runoff is rapid, and the hazard of erosion is high.

This unit is used for livestock grazing and wildlife habitat.

The native vegetation is a plant community dominated by bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs and a few shrubs occur in small amounts.

If range condition deteriorates, plant vigor is greatly reduced and the proportion of bluebunch wheatgrass and other desirable grasses decreases. If deterioration is severe, the forage bunchgrasses are nearly eliminated. As a result, low value plants predominate, the soils are subject to erosion, and much of the surface is bare and rocky.

Because this unit is very stony and slopes are very steep, range seeding is not practical.

Most areas of this soil provide some food and cover for mule deer, small mammals, and game birds.

The shallow depth to bedrock, Rock outcrop, stoniness, and very steep slopes are severe limitations for community and recreation uses. Extreme design modifications are needed but are rarely practical for dwellings, small buildings, and sanitary facilities.

The capability subclass is VIIs.

30B—Mikkalo silt loam, 2 to 7 percent slopes. This is a moderately deep, well drained soil formed in loess. The elevation is 1,000 to 2,500 feet. The average slope is 4 percent. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 13 inches thick. The subsoil is brown and pale brown silt loam about 17 inches thick. The substratum is pale brown silt loam about 5 inches thick. Fractured basalt is at a depth of about 35 inches.

About 15 percent of this unit is included areas of Ritzville and Willis soils and 5 percent is Lickskillet and Bakeoven soils.

Permeability is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is slow, and the hazard of erosion is slight.

Nearly all areas of this soil are dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland and irrigated hay and pasture are grown. Other areas are used for range and wildlife habitat.

The major need in crop management is conserving soil moisture.

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Cross-slope tillage in the more level areas and diversions in the steeper areas are desirable, particularly where slopes are long.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

Suitable plants for seeding grassed waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass. For dryland hay and pasture, suitable grasses and legumes grown alone or in combination are alfalfa, crested wheatgrass, Siberian wheatgrass, beardless wheatgrass, and big bluegrass (*3*).

The native plant community is dominated by bluebunch wheatgrass and Sandberg wheatgrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is bare.

If the range is in poor condition, seeding is practical. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

The depth to bedrock is a limitation for community uses. Design modifications are needed for dwellings, small buildings, and sanitary facilities. This soil has no serious limitations for most recreation facilities. The depth to bedrock can be a limitation for playgrounds.

The capability subclass is IIIe dryland and irrigated.

30C—Mikkalo silt loam, 7 to 12 percent slopes. This is a moderately deep, well drained soil formed in loess. The elevation is 1,000 to 2,500 feet. The average slope is 9 percent. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 13 inches thick. The subsoil is brown and pale brown silt loam about 17 inches thick. The substratum is pale brown silt loam about 5 inches thick. Fractured basalt is at a depth of about 35 inches.

About 15 percent of this unit is included areas of Ritzville and Willis soils and 5 percent is Lickskillet and Bakeoven soils.

Permeability is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland and irrigated hay and pasture are grown. Other areas are used for range and wildlife habitat.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch, minimum tillage, and grassed waterways in combination with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Cross-slope tillage, contour tillage, and diversions are generally needed to prevent erosion during high intensity rainfall or snowmelt.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

Suitable for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass. For dryland hay, suitable grasses and legumes grown alone or in combination are alfalfa, crested wheatgrass, Siberian wheatgrass, beardless wheatgrass, and big bluegrass (*3*).

The native plant community is dominated by bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is left bare.

If the range is in poor condition, seeding is practical. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

The slope and depth to bedrock are limitations for community and recreation uses. Modifications in design are needed for dwellings, small buildings, sanitary facilities, and recreation facilities.

The capability subclass is IIIe dryland and irrigated.

30D—Mikkalo silt loam, 12 to 20 percent slopes. This is a moderately deep, well drained soil formed in loess. The elevation is 1,000 to 2,500 feet. The average slope is 15 percent. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 13 inches thick. The subsoil is brown and pale brown silt loam about 17 inches thick. The substratum is pale brown silt loam about 5 inches thick. Fractured basalt is at a depth of about 35 inches.

About 15 percent of this unit is included areas of Ritzville and Willis soils and 10 percent is Lickskillet and Bakeoven soils.

Permeability is moderate. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is medium, and the hazard of erosion is moderate.

About half the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland hay and pasture are grown. Other areas are used for range and wildlife habitat.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch and minimum tillage in combination with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Contour tillage and diversions help to prevent severe erosion during high intensity rainfall and snowmelt.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

For dryland hay and pasture, suitable grasses and legumes grown alone or in combination are alfalfa, crested wheatgrass, Siberian wheatgrass, beardless wheatgrass, and big bluegrass (*3*).

The native plant community is dominated by bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is bare.

If the range is in poor condition, seedbed preparation and seeding are practical. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, game birds, and songbirds.

The slope and depth to bedrock are limitations for community and recreation uses. Extensive design modifications are needed for dwellings, small buildings, and sanitary and recreation facilities.

The capability subclass is IVe dryland.

31B—Morrow silt loam, 1 to 7 percent slopes. This is a moderately deep, well drained soil on uplands at elevations of 2,200 to 3,500 feet. It formed in wind laid silt. The average slope is 4 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 46 to 50 degrees F. The frost free period is 110 to 140 days at 32 degrees and 150 to 190 days at 28 degrees.

In a representative profile the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is dark brown silty clay loam that grades to heavy silt loam. It is about 10 inches thick. The substratum is dark brown silt loam about 7 inches thick. Fractured basalt is at a depth of about 26 inches.

About 15 percent of this unit is included areas of Bakeoven and Lickskillet soils.

Permeability is moderately slow. Effective rooting depth is restricted by the underlying bedrock at a depth of 20 to 40 inches. Available water holding capacity is 4 to 8.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is slow, and the hazard of erosion is slight.

Nearly all the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland hay and pasture are grown. Other areas are used for range and wildlife habitat.

The major need in crop management is conserving soil moisture.

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system help to maintain soil moisture. Cross-slope tillage in the more level areas and contour tillage and diversions in the steeper areas are desirable, especially where slopes are long (fig. 7).

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

Figure 7.—Wheat stubble on Morrow silt loam, 1 to 7 percent slopes, in foreground. Beyond this is Morrow silt loam, 7 to 12 percent slopes In the background is an area of Morrow silt loam, 12 to 20 percent slopes, dissected by diversion terraces for the control of water erosion.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass. For dryland hay and pasture, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, intermediate wheatgrass, beardless wheatgrass, tall wheatgrass, and hard fescue (*3*).

The native plant community is dominated by bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass and Idaho fescue decrease and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, cheatgrass, low value forbs, and shrubs predominate.

If the range is in poor condition, seedbed preparation and seeding are practical. Suitable for dryland seeding are big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa.

Mule deer use the plant community in spring and fall when plants are green and succulent. The plant community also provides food for small mammals and game birds.

The depth to bedrock and moderately slow permeability are limitations for community developments and sanitary facilities. The heavy texture of the subsoil can cause shrinking and swelling. Design modifications are needed for successful use of this soil. Permeability is a limitation for recreation facilities.

The capability subclass is IIIe dryland.

31C—Morrow silt loam, 7 to 12 percent slopes. This is a moderately deep, well drained soil on uplands at elevations of 2,200 to 3,500 feet. It formed in wind laid silt. The average slope is 9 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 46 to 50 degrees F. The frost free period is 110 to 140 days at 32 degrees and 150 to 190 days at 28 degrees.

In a representative profile the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is dark brown silty clay loam that grades to heavy silt loam. It is about 10 inches thick. The substratum is dark brown silt loam about 7 inches thick. Fractured basalt is at a depth of about 26 inches.

About 15 percent of this unit is included areas of Lickskillet and Bakeoven soils.

Permeability is moderately slow. Effective rooting depth is restricted by the underlying bedrock at a depth of 20 to 40 inches. Available water holding capacity is 4 to 8.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium, and the hazard of erosion is moderate.

Most of the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and

dryland hay and pasture are grown. Other areas are used for range and wildlife habitat.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Cross-slope tillage, contour tillage, and diversions are generally needed to prevent severe erosion caused by rapid runoff during high intensity rainfall or snowmelt.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass. For dryland hay and pasture, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, intermediate wheatgrass, beardless wheatgrass, tall wheatgrass, and hard fescue (*3*).

The native plant community is dominated by bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass and Idaho fescue decrease and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, cheatgrass, low value forbs, and shrubs predominate.

If the range is in poor condition, seedbed preparation and seeding are practical considerations. Suitable for dryland seeding are big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa.

Mule deer use this plant community in spring and again in fall when plants are green and succulent. The plant community also provides food for small mammals and game birds.

The depth to rock, slope, and moderately slow permeability are limitations for community developments and sanitary facilities. The heavy texture of the subsoil can also cause shrinking and swelling. Design modifications are needed for dwellings, small buildings, and sanitary facilities. The permeability and slope are limitations for recreation facilities.

The capability subclass is IIIe dryland.

32D—Morrow silt loam, 12 to 20 percent north slopes. This is a moderately deep, well drained soil on north-facing slopes on uplands at elevations of 2,200 to 3,500 feet. It formed in wind laid silt. The average slope is 15 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 46 to 50 degrees F. The frost free period is 110 to 140 days at 32 degrees and 150 to 190 days at 28 degrees.

In a representative profile the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is dark brown silty clay loam that grades to heavy silt loam. It is about 10 inches thick. The substratum is dark brown silt loam about 7 inches thick. Fractured basalt is at a depth of about 26 inches.

About 15 percent of this unit is included areas of soils similar to Morrow soils but more than 40 inches thick and 15 percent is Lickskillet and Bakeoven soils.

Permeability is moderately slow. Effective rooting depth is restricted by the underlying bedrock at a depth from 20 to 40 inches. Available water holding capacity is 4 to 8.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium, and the hazard of erosion is moderate.

About half the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland hay and pasture are grown. Other areas are used for range and wildlife habitat.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch and minimum tillage along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Contour tillage and diversions help to prevent severe erosion caused by rapid runoff during high intensity rainfall and snowmelt.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

For dryland hay and pasture, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, intermediate wheatgrass, beardless wheatgrass, tall wheatgrass, and hard fescue (*3*).

The native plant community is dominated by Idaho fescue. Bluebunch wheatgrass and Cusick bluegrass are prominent. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, the proportion of bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, annual grasses and low value forbs, such as common teasel and bullthistle, predominate.

If the range is in poor condition, seedbed preparation and seeding the more gently sloping areas to grass are practical. Suitable for dryland seeding are intermediate wheatgrass, hard fescue, pubescent wheatgrass, and alfalfa.

Mule deer use this plant community in summer and late in fall because of the cooler temperature and proximity to cover. The plant community also provides food for small mammals and game birds.

The slope, depth to bedrock, and moderately slow permeability are limitations for community uses. Extensive design modifications are needed for dwellings, small buildings, sanitary facilities, and recreation facilities.

The capability sublass is IVe dryland.

32E—Morrow silt loam, 20 to 35 percent north slopes. This is a moderately deep, well drained soil on north-facing slopes on uplands at elevations of 2,200 to 3,500 feet. It formed in wind laid silt. The average slope is 30 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 46 to 50 degrees F. The frost-free period is 110 to 140 days at 32 degrees and 150 to 190 days at 28 degrees.

In a representative profile the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is dark brown silty clay loam that grades to heavy silt loam. It is about 10 inches thick. The substratum is dark brown silt loam about 7 inches thick. Fractured basalt is at a depth of about 26 inches.

About 20 percent of this unit is included areas of soils that are similar to Morrow soils but are more than 40 inches thick and 10 percent is Wrentham soils.

Permeability is moderately slow. Effective rooting depth is restricted by the underlying bedrock at a depth from 20 to 40 inches. Available water holding capacity is 4 to 8.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas are used for range and wildlife habitat. The rest is under a grain-fallow cropping system. Wheat and barley are grown.

The native plant community is dominated by Idaho fescue. Bluebunch wheatgrass and Cusick bluegrass are prominent. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, the proportion of Idaho fescue and Cusick bluegrass decreases and the proportion of bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, annual grasses and low value forbs, such as common teasel and bullthistle, predominate.

If the range is in poor condition, seedbed preparation and seeding the more gently sloping areas to grass are practical. Suitable for dryland seeding are intermediate wheatgrass, hard fescue, pubescent wheatgrass, and alfalfa.

Mule deer use this plant community in summer and late in fall because of the cooler temperatures and proximity to cover. Game birds and small mammals also use the plant community.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture for plant growth.

Where this soil is dryfarmed, stubble mulch and minimum tillage along with a crop-fallow system are needed to minimize erosion loss and help to maintain soil moisture. Contour tillage and diversions help to prevent severe erosion caused by rapid runoff during high intensity rainfall and snowmelt.

The slope, depth to rock, and moderately slow permeability are limitations for community uses. Extensive and expensive design modifications are needed for dwellings, small buildings, and sanitary facilities. The slope is a limitation for recreation facilities.

The capability subclass is IVe dryland.

33D—Morrow silt loam, 12 to 20 percent south slopes. This is a moderately deep, well drained soil on south-facing slopes on uplands at elevations of 2,200 to 3,500 feet. It formed in wind laid silt. The average slope is 15 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 46 to 50 degrees F. The frost free period is 110 to 140 days at 32 degrees and 150 to 190 days at 28 degrees.

In a representative profile the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is dark brown silty clay loam that grades to heavy silt loam. It is about 10 inches thick. The substratum is dark brown silt loam about 7 inches thick. Fractured basalt is at a depth of about 26 inches.

About 15 percent of this unit is included areas of soils that are similar to Morrow soils but are more than 40 inches thick and 15 percent is Lickskillet and Bakeoven soils.

Permeability is moderately slow. Effective rooting depth is restricted by the underlying bedrock at a depth of 20 to 40 inches. Available water holding capacity is 4 to 8.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium to rapid, and the hazard of erosion is moderate.

About half the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Barley is commonly grown and some dryland hay. Other areas are used for range, dryland pasture, and wildlife habitat.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch and minimum tillage along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Contour tillage and diversions help to prevent severe erosion caused by rapid runoff during high intensity rainfall and snowmelt.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

For dryland hay, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass (*3*).

The native vegetation is a plant community dominated by bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent. A variety of perennial forbs, such as arrowleaf balsamroot, milkvetch, and yarrow, occurs throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, plant vigor is greatly reduced and the proportion of bluebunch wheatgrass and other desirable grasses decreases. If deterioration is severe, cheatgrass and other low value plants predominate and the hazard of erosion is high.

Seedbed preparation and seeding of the more gently sloping areas are practical if the range is in poor condition. Suitable for dryland seeding are beardless wheatgrass, big bluegrass, crested wheatgrass, and alfalfa.

This plant community is used by mule deer in winter and early in spring when other areas are snow covered. In most areas it also provides food for a variety of small mammals and game birds. Wildlife should be considered in management planning.

The slope, depth to rock, and moderately slow permeability are limitations for community uses. Extensive design modifications are needed for dwellings, small buildings, sanitary facilities, and recreation facilities.

The capability subclass is VIe dryland.

33E—Morrow silt loam, 20 to 30 percent south slopes. This is a moderately deep, well drained soil on south-facing slopes on uplands at elevations of 2,200 to 3,500 feet. It formed in wind laid silt. The average slope is 25 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 46 to 50 degrees F The frost free period is 110 to 140 days at 32 degrees and 150 to 190 days at 28 degrees.

In a representative profile the surface layer is very dark brown silt loam about 9 inches thick. The subsoil is dark brown silty clay loam that grades to heavy silt loam. It is about 10 inches thick. The substratum is dark brown silt loam about 7 inches thick. Fractured basalt is at a depth of about 26 inches.

About 15 percent of this unit is included areas of soils that are similar to Morrow soils but are more than 40 inches thick and 15 percent is Lickskillet and Bakeoven soils.

Permeability is moderately slow. Effective rooting depth is restricted by the underlying bedrock at a depth of 20 to 40 inches. Available water holding capacity is 4 to 8.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas are used for range and wildlife habitat. The rest is under a grain-fallow cropping system. Wheat and barley are grown.

The native vegetation is a plant community dominated by bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent. A variety of perennial forbs, such as arrowleaf balsamroot, milkvetch, and yarrow, occurs throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, plant vigor is greatly reduced and the proportion of bluebunch wheatgrass and other desirable grasses decreases. If deterioration is severe, cheatgrass and other low value plants predominate and the potential for erosion is high.

Seedbed preparation and seeding of the more gently sloping areas are practical if the range is in poor condition. Suitable for dryland seeding are beardless wheatgrass, big bluegrass, crested wheatgrass, and alfalfa.

This plant community is used by mule deer in winter and early in spring when other areas are snow covered. Wildlife values should be considered in management planning.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Where this soil is dryfarmed, stubble mulch and minimum tillage along with a crop-fallow system are needed to minimize erosion loss and help to maintain soil moisture. Contour tillage and diversions help to prevent severe erosion caused by rapid runoff during high intensity rainfall and snowmelt.

The slope, depth to rock, and moderately slow permeability are limitations for community uses. Extensive and expensive design modifications are needed for dwellings, small buildings, and sanitary facilities. The slope is a limitation for recreation facilities.

The capability subclass is VIe dryland.

34F—Nansene silt loam, 35 to 70 percent slopes. This is a deep, well drained soil formed in loess. It is on north-facing slopes at elevations of 800 to 1,900 feet. The average slope is 50 percent. The average annual precipitation is 12 to 13 inches, and the average annual air temperature is 48 to 52 degrees F. The frost free period is 140 to 170 days at 32 degrees and 170 to 200 days at 28 degrees.

In a representative profile the surface layer is very dark brown silt loam about 25 inches thick. The subsoil is dark brown silt loam about 13 inches thick. The substratum is dark brown silt loam about 7 inches thick. Fractured basalt is at a depth of about 45 inches.

About 20 percent of this unit is included areas of Ritzville, Rhea, and Wrentham soils and 5 percent is Lickskillet soils.

Permeability is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 6.5 to 11.5 inches. Water supplying capacity is 8 to 12 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for livestock grazing and wildlife habitat.

The native plant community on this soil is dominated by Idaho fescue. Bluebunch wheatgrass and Cusick

bluegrass are prominent. Sandberg bluegrass and a wide variety of perennial forbs occur throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, the proportion of Idaho fescue and Cusick bluegrass decreases and the proportion of bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, annual grasses and low value forbs are prominent.

Because slopes are steep, seedbed preparation and range seeding are not practical.

Mule deer use the plant community in summer and late in fall because of the cooler temperatures and proxmity to cover. The steep slopes are limitations for community and recreation uses. Extensive design modifications are needed for dwellings, small buildings, and sanitary and recreation facilities.

The capability subclass is VIIe.

35—Onyx silt loam. This is a very deep, well drained soil formed in alluvium from loess and volcanic ash. It is on alluvial bottom lands at elevations of 1,000 to 2,500 feet. The average slope is 1 percent. The average annual precipitation is 12 to 14 inches, and the average annual air temperature is 49 to 51 degrees F. The frost free period is 130 to 170 days at 32 degrees and 170 to 200 days at 28 degrees.

In a representative profile the surface layer is very dark brown silt loam about 26 inches thick. The next layer is very dark brown very fine sandy loam about 6 inches thick. The upper 7 inches of the substratum is very dark grayish brown very fine sandy loam. The lower part is very dark grayish brown gravelly very fine sandy loam that extends to a depth of 60 inches or more.

About 20 percent of this unit is included areas of Pedigo, Endersby, and Snow soils.

Permeability is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 7.5 to 12.5 inches. Water supplying capacity is 8 to 13 inches. Runoff is slow, and the hazard of erosion is slight. The soil is subject to rare flooding.

Nearly all the acreage is used for dryfarmed and irrigated crops. Hay and pasture are the main crops grown. Some winter wheat is also grown. Some irregularly shaped areas are used for range.

The major needs in crop management are conserving soil moisture and stabilizing streambanks against cutting by water. The proper timing and rate of applying irrigation water are needed. Where water is available, irrigation is by sprinklers, most commonly wheelline or handline systems.

A suitable cropping system under irrigation is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Light, frequent applications of irrigation water are needed. Split applications of fertilizer are desirable because plant nutrients are leached out of the rooting zone by the irrigation water.

In dryfarmed areas where wheat is grown, stubble mulch and minimum tillage along with a crop-fallow system help to minimize erosion and conserve soil moisture.

Streambanks can be stabilized by maintaining streamside vegetation, especially giant wildrye and such riparian shrubs as lilac or willow. Such vegetation also is important wildlife cover.

For dryland pasture and hay, suitable grasses and legumes grown alone or in various combinations are alfalfa, Siberian wheatgrass, crested wheatgrass, beardless wheatgrass, big bluegrass, intermediate wheatgrass, pubescent wheatgrass, and hard fescue (*3*).

Areas of this soil support populations of upland game birds, such as the ring-necked pheasant and valley quail. Mule deer and smaller mammals use this soil for food and cover.

This soil occurs on stream flood plains. It is subject to rare flooding, which results in limitations for many community developments. It has no serious limitations for most recreation facilities. Camp areas are severely limited as a result of the flood hazard.

The capability subclass is IIc dryland and class I irrigated.

36—Pedigo silt loam. This is a very deep, somewhat poorly drained soil formed in alluvium derived from loess and volcanic ash. It is on alluvial bottom lands at elevations of 1,000 to 2,500 feet. The average slope is 1 percent. The average annual precipitation is 11 to 14 inches, and the average annual air temperature is 49 to 51 degrees F. The frost free period is 130 to 150 days at 32 degrees and 180 to 200 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown silt loam about 10 inches thick. The subsoil is dark brown silt loam about 21 inches thick. The substratum is dark grayish brown, dark brown, and brown silt loam that extends to a depth of 66 inches or more.

About 15 percent of this unit is included areas of Onyx and Endersby soils.

Permeability is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 10 to 11 inches. Water supplying capacity is 9 to 13 inches. Runoff is slow, and the hazard of erosion is slight. The soil is subject to rare flooding. A water table is at a depth of 2.5 to 5 feet in winter and spring.

Nearly all the acreage is used for dryfarmed and irrigated crops. Hay and pasture are the main crops. Some winter wheat is also grown. Some irregularly shaped areas are used for range.

The major needs in crop management are conserving soil moisture and stabilizing streambanks against cutting by water. The proper timing and rate of applying irrigation water are needed. Where water is available,

irrigation is by sprinklers, most commonly wheelline or handline systems.

In irrigated areas a suitable cropping system is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Because this soil is somewhat poorly drained, light, frequent applications of irrigation water are needed. The rate of these applications should not cause ponding of water on the surface. In some areas subsurface drains are needed. Split applications of fertilizer are desirable because plant nutrients are leached out of the rooting zone by the irrigation water.

In dryfarmed areas where wheat is grown, stubble mulch and minimum tillage along with a crop-fallow system help to minimize erosion and conserve soil moisture.

Streambanks can be stabilized by maintaining streamside vegetation, especially giant wildrye and such riparian shrubs as lilac and willow. Such vegetation also is important wildlife cover.

For dryland pasture and hay, suitable grasses and legumes grown alone or in various combinations are alfalfa, Siberian wheatgrass, crested wheatgrass, beardless wheatgrass, big bluegrass, intermediate wheatgrass, pubescent wheatgrass, and hard fescue (*3*)

Areas of this soil support populations of upland game birds, such as ring-necked pheasant and valley quail. Mule deer use areas of this soil and the adjacent south-facing slopes in winter. The soil also provides food and cover for an assortment of smaller mammals.

This soil occurs on stream flood plains and is subject to rare flooding. Because the soil is somewhat poorly drained, it is subject to periods of wetness. These conditions are limitations for community and recreation developments.

The capability subclass is IIw dryland and irrigated.

37A—Prosser silt loam, 0 to 2 percent slopes. This is a moderately deep, well drained soil on terraces at elevations of 300 to 600 feet. It formed in wind laid silt. The average slope is 1 percent. The average annual precipitation is 7 to 9 inches, and the average annual air temperature is 50 to 54 degrees F. The frost free period is 160 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsoil is dark brown silt loam about 25 inches thick. Fractured bedrock is at a depth of about 29 inches.

About 20 percent of this unit is included areas of Quinton, Taunton, and Koehler soils and 15 percent is Quincy soils, shallow soils, and Rock outcrop.

Permeability is moderate. Effective rooting depth is restricted by the underlying bedrock at a depth of 20 to 40 inches. Available water holding capacity is 4 to 8.5 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is slow, and the hazard of erosion is slight. The hazard of soil blowing is moderate.

Most areas of this soil are used for range and wildlife habitat. Some of the acreage is used for irrigated alfalfa hay and pasture.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally is dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses are practical. Because the hazard of soil blowing is severe, seeding to grass presents special management problems. Direct drill seeding after a fire is advisable to restore production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant.

Livestock grazing should be limited mainly to winter.

The major concern in the management of this soil is the proper application of irrigation water. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

For hay and pasture, suitable grasses to be grown with alfalfa include orchardgrass, smooth bromegrass, tall fescue, and meadow foxtail (*3*).

Because of the moderately low infiltration rate and moderate depth to bedrock, application rates of water should be carefully determined to avoid overirrigation.

Only irrigated hay and pasture are grown on this soil. As agriculture in the northern part of the survey area continues to grow, many other irrigated crops, such as wheat, corn, and potatoes, will be grown on this soil.

This soil supports small populations of mule deer. Birds and small mammals are common.

The depth of bedrock is a limitation for community uses. Design modifications are needed for dwellings, small buildings, and sanitary facilities. This soil has no serious limitations for most recreation facilities, but the depth to rock may be a limitation for playgrounds.

The capability subclass is VIc dryland, IIs irrigated.

37B—Prosser silt loam, 2 to 7 percent slopes. This is a moderately deep, well drained soil on uplands at elevations of 300 to 600 feet. It formed in wind laid silt. The average slope is 5 percent. The average annual precipitation is 7 to 9 inches, and the average annual air temperature is 51 to 54 degrees F. The frost free period is 160 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsoil is dark brown silt loam about 25 inches thick. Fractured bedrock is at a depth of about 29 inches.

About 20 percent of this unit is included areas of Quinton, Taunton, and Koehler soils and 15 percent is Quincy soils, shallow soils, and Rock outcrop.

Permeability is moderate. Effective rooting depth is restricted by the underlying bedrock at a depth of 20 to 40 inches. Available water holding capacity is 4 to 8.5 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Most areas are used for range and wildlife habitat. Some are used for irrigated alfalfa hay and pasture.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally is dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses are practical considerations. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems. Direct drill seeding after a fire is a good method of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant.

Livestock grazing should be limited mainly to winter.

The major concern in management is the proper application of irrigation water. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

For hay and pasture, suitable grasses to be grown with alfalfa include orchardgrass, smooth bromegrass, tall fescue, and meadow foxtail (*3*).

Because of the moderate permeability and moderate depth to bedrock, application rates of irrigation water should be carefully determined in order to avoid overirrigation. Some erosion caused by runoff of excess irrigation water is probable if the soil is overirrigated.

Only irrigated hay and pasture are grown on this soil. Most likely many other irrigated crops, such as wheat, corn, and potatoes, will be grown.

This soil supports small populations of mule deer. Birds and small mammals are common.

The depth to bedrock is a limitation for community uses. Design modifications are needed for dwellings, small buildings, and sanitary facilities. This soil has no serious limitations for recreation facilities, but playgrounds may require cutting and filling.

The capability subclass is VIc dryland, IIe irrigated.

38D—Prosser-Rock outcrop complex, 1 to 20 percent slopes. This map unit is adjacent to the Columbia River at elevations of 300 to 600 feet. It is about 60 percent Prosser soil, 20 percent Rock outcrop, 20 percent Quinton, Taunton, Koehler, and Quincy soils.

The average slope is about 5 percent. The average annual precipitation is 7 to 9 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 160 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile of Prosser soil, the surface layer is very dark grayish brown silt loam about 4 inches thick. The subsoil is dark brown silt loam about 25 inches thick. Fractured basalt bedrock is at a depth of about 29 inches.

Rock outcrop is basalt bedrock.

The Prosser soil has moderate permeability. Effective rooting depth is 20 to 40 inches. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6.5 to 8 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

This unit is used mainly as rangeland and wildlife habitat. Small areas are used for irrigated permanent pasture. In most areas, the pattern of the Rock outcrop precludes irrigation.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally is dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses are practical. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems. Direct drill seeding after a fire is advisable to restore production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant.

Livestock grazing should be limited mainly to winter.

This unit supports small populations of mule deer. Birds and small mammals are common.

The depth to rock limits construction of septic tanks and sewage lagoons. Dwellings, commercial buildings, and streets and roads may require some modification because of the depth to rock. Slope is a limitation for most recreation facilities.

The capability subclass is VIs dryland.

39C—Quincy fine sand, 2 to 12 percent slopes. This is a very deep, excessively drained soil formed in mixed sand. It is on terraces at elevations of 250 to 700 feet. The average slope is 6 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 degrees to 54 degrees F. The frost free period is 160 to 200 days at 32 degrees.

In a representative profile the upper 30 inches is dark brown fine sand. Below this is dark brown and brown sand that extends to a depth of 60 inches or more.

About 15 percent of this unit is included areas of Burbank, Quinton, Royal, and Winchester soils and Dune land.

Permeability is rapid. Effective rooting depth is more than 60 inches. Available water capacity is 3 to 4 inches. Water supplying capacity is 2 to 3 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Extensive areas of this soil are used for irrigated crops, and many more areas are being converted to irrigated cropland. A large percentage of the acreage is used for range and wildlife habitat, particularly where the soil is within the Boardman Naval Reservation. Major irrigated crops include potatoes, wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the low available water capacity and the hazard of soil blowing. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed control and disease problems are common.

Because of the coarse texture, low water supplying capacity, and high water consumption, light, frequent applications of fertilizer are desirable.

The hazard of soil blowing is one of the highest in the area because of the predominance of fine sand in the surface layer and frequent, high winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts, hummocks, and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures needed to control soil blowing include winter cover crops; timely irrigations, cultivations, and planting; minimum tillage; crosswind tillage; and planting of row crops perpendicular to the wind. Blowout areas require special treatments, such as disked-in straw mulching and seeding to suitable grasses. Windbreaks, doublecropping, and stripcropping are needed in places. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation system before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is dominated by needleandthread and Indian ricegrass. Antelope bitterbrush is common and is prominent in places. Perennial forbs, such as Columbia milkvetch and Carey balsamroot, are common. Other shrubs, such as big sagebrush and rabbitbrush, occur sporadically.

If range condition deteriorates, the proportion of Indian ricegrass decreases and the proportion of needleandthread and low value forbs increases. If deterioration is severe, cheatgrass invades and strongly dominates the stand. As a result, the hazard of soil blowing during the growing season is severe, and sand movement may be difficult to control.

If the range is in poor condition, total protection of the existing plant cover is practical. Seedbed preparation and seeding present special problems because of the hazard of soil blowing. Direct drill seeding to crested or Siberian wheatgrass is advisable after a fire.

Livestock grazing should be limited mainly to winter.

This soil supports small populations of mule deer. Birds and small mammals are common.

This soil generally is well suited to community uses. Because of seepage, some design modifications of sewage lagoons and sanitary landfills are required in places. Construction of dwellings, commercial buildings, and roads and streets is somewhat limited in the steeper areas. Recreation facilities are limited by the fine sand.

The capability subclass is VIIe dryland, IVs irrigated.

40C—Quincy loamy fine sand, 2 to 12 percent slopes. This is a deep, excessively drained soil formed in mixed sand. It is on terraces near the Columbia River at elevations of 250 to 700 feet. The average slope is 4 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 160 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark brown loamy fine sand about 6 inches thick. Below this is dark brown and brown loamy fine sand that extends to a depth of 60 inches or more.

About 15 percent of this unit is included areas of Burbank, Quinton, Ellum, Royal, Sagehill, and Winchester soils and Dune land.

Permeability is rapid. Effective rooting depth is more than 60 inches. Available water capacity is 4 to 5.5 inches. Water supplying capacity is 2 to 3 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Extensive areas are used for irrigated crops, and many more are being converted to irrigated cropland. Much of the acreage is used for range and wildlife habitat. Major irrigated crops include potatoes, annual wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the low available water capacity and the hazard of soil blowing. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa. If wheat or potatoes are grown in consecutive years, serious disease control problems are common.

Because of the coarse texture, low water supplying capacity, and high water consumption, light, frequent applications of irrigation water are needed. Plant nutrients are readily leached from the rooting zone because of the rapid permeability. Split applications of fertilizer are desirable.

The hazard of soil blowing is high because of the loamy fine sand and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts, hummocks, and dunes in the fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures needed to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Blowout areas need special treatment, such as disked-in straw mulching and seeding to suitable grasses. Windbreaks, doublecropping and stripcropping are needed in places. Protection from soil blowing is critical when new rangeland is converted to irrigated cropland. Completely developing the irrigation system before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is dominated by needleandthread and Indian ricegrass. Antelope bitterbrush is common and is prominent in places. Perennial forbs, such as Columbia milkvetch and Carey balsamroot, are common. Other shrubs, such as big sagebrush and rabbitbrush, occur sporadically.

If range condition deteriorates, the proportion of Indian ricegrass decreases and the proportion of needleandthread and low value forbs increases. If deterioration is severe, cheatgrass invades and strongly dominates the stand. As a result, the hazard of soil blowing during the growing season is high, and sand movement may be difficult to control.

If the range is in poor condition, total protection of the existing plant cover is practical. Seedbed preparation and seeding present a special problem because of the hazard of soil blowing. Direct drill seeding to crested or Siberian wheatgrass is feasible after a fire.

Livestock grazing should be limited primarily to winter.

This soil supports small populations of mule deer. Birds and small mammals are common.

This soil generally is well suited to community and recreation uses. Because of seepage, some design modifications of sewage lagoons and sanitary landfills are required in places. Construction of dwellings, buildings, and roads and streets is somewhat limited in the steeper areas.

The capability subclass is IVs irrigated, VIIe dryland.

41B—Quinton loamy fine sand, 2 to 5 percent slopes. This is a moderately deep, excessively drained soil formed in mixed sand. It is on terraces at elevations of 250 to 700 feet. The average slope is 3 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark brown loamy fine sand about 7 inches thick. The substratum is 23 inches of dark brown loamy fine sand over 7 inches of dark brown gravelly loamy fine sand. Fractured basalt is at a depth of about 37 inches.

About 15 percent of this unit is included areas of Koehler, Quincy, and Royal soils and Dune land.

Permeability is rapid. Effective rooting depth is restricted by the underlying bedrock at a depth from 20 to 40 inches. Available water capacity is 2 to 4 inches. Water supplying capacity is 2 to 3 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

About 80 percent of the acreage is used for irrigated alfalfa hay and pasture. The soil also is suited to such crops as potatoes, corn, and wheat. The rest is used for range and wildlife habitat.

Major concerns in management are the proper application of irrigation water and the hazard of soil blowing. Irrigation methods include flooding, handlines, and wheellines. Care should be taken not to overirrigate. In several areas of this soil near Boardman Naval Reservation, overirrigation has resulted in a high water table.

The hazard of soil blowing is high because of the loamy fine sand surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and hummocks in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Practices needed to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; and minimum tillage. Blowout areas require special treatment, such as disked-in straw mulching and seeding to suitable grasses. Much of the acreage in rangeland may be converted to irrigated cropland. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation systems before any land is broken out, limiting new land

disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community on this soil is dominated by needleandthread and Indian ricegrass. Antelope bitterbrush is common and is prominent in places. Perennial forbs, such as Columbia milkvetch and Carey balsamroot, are common. Other shrubs, such as big sagebrush and rabbitbrush, occur sporadically.

If range condition deteriorates, the proportion of Indian ricegrass decreases and the proportion of needleandthread and low value forbs increases. If deterioration is severe, cheatgrass invades and strongly dominates the stand. As a result, the potential for soil blowing during the growing season is high, and sand movement may be difficult to control.

If the range is in poor condition, total protection of the existing plant cover is practical. Seedbed preparation and seeding present a special problem because of the hazard of soil blowing. Direct drill seeding of crested or Siberian wheatgrass is advisable after a fire.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The depth to rock and seepage are limitations for sanitary facilities. This soil is generally well suited to construction of dwellings, commercial buildings, and roads and streets. Dwellings with basements may require some variation in design because of the depth to rock. The soil has no serious limitation for recreation facilities. Playgrounds in steeper areas may require leveling.

The capability subclass is VIIe dryland, IVe irrigated.

42D—Quinton-Rock outcrop complex, 2 to 20 percent slopes. This map unit is adjacent to the Columbia River at elevations of 250 to 350 feet. It is about 60 percent Quinton soil, 20 percent Rock outcrop, and 20 percent Koehler and Quincy soils and Dune land.

The average slope is about 10 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile of Quinton soil, the surface layer is dark brown loamy fine sand about 7 inches thick. The substratum is 23 inches of dark brown loamy fine sand over 7 inches of dark brown gravelly loamy fine sand. Fractured basalt is at a depth of about 37 inches.

Rock outcrop is basalt bedrock.

The Quinton soil has rapid permeability. Effective rooting depth is 20 to 40 inches. Available water capacity is 2 to 4 inches. Water supplying capacity is 2 to 3 inches. Runoff is slow and the hazard of water erosion is slight. The hazard of soil blowing is high.

This unit is used mainly for rangeland and wildlife habitat. In most areas the pattern of the Rock outcrop precludes irrigation.

The native plant community is dominated by needleandthread and Indian ricegrass. Antelope bitterbrush is common and is prominent in places. Perennial forbs, such as Columbia milkvetch and Carey balsamroot, are common. Other shrubs, such as big sagebrush and rabbitbrush, occur in minor amounts.

If range condition deteriorates, the proportion of Indian ricegrass decreases and the proportion of needleandthread and low value forbs increases. If deterioration is severe, cheatgrass invades and strongly dominates the stand. As a result, the potential for soil blowing during the growing season is high and sand movement may be difficult to control.

If the range is in poor condition, total protection of the existing plant cover is a practical consideration. Seedbed preparation and seeding present a special problem because of the soil blowing hazard. Direct drill seeding of crested or Siberian wheatgrass is advisable after a fire.

Livestock grazing should be limited mainly to winter.

This unit supports small populations of mule deer. Waterfowl, other birds, and small mammals are common.

The depth to rock and seepage are limitations for sanitary facilities. Construction of dwellings, commercial buildings, roads and streets, and recreation facilities may require some variation in design because of the depth to rock and Rock outcrop.

The capability subclass is VIIe dryland.

43B—Rhea silt loam, 1 to 7 percent slopes. This is a very deep, well drained soil formed in material from wind laid silt mixed with small amounts of volcanic ash. It occurs at elevations of 1,600 to 3,200 feet. The average slope is 4 percent. The average annual precipitation is 11 to 14 inches, and the average annual air temperature is 47 to 51 degrees F. The frost free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the upper 7 inches of the surface layer is very dark brown silt loam, and the lower 7 inches is very dark grayish brown silt loam. The subsoil is dark brown and brown silt loam about 19 inches thick. The substratum is dark brown silt loam that extends to a depth of 60 inches or more (fig. 8).

About 20 percent of this unit is included areas of Valby soils and soils formed in volcanic ash and 5 percent is Bakeoven and Lickskillet soils.

Permeability is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 8 to 15 inches. Water supplying capacity is 6 to 10 inches. Runoff is slow, and the hazard of erosion is slight.

Nearly all the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland hay and pasture are grown. The rest of the acreage is used for range and wildlife habitat.

The major need in crop management is conserving soil moisture.

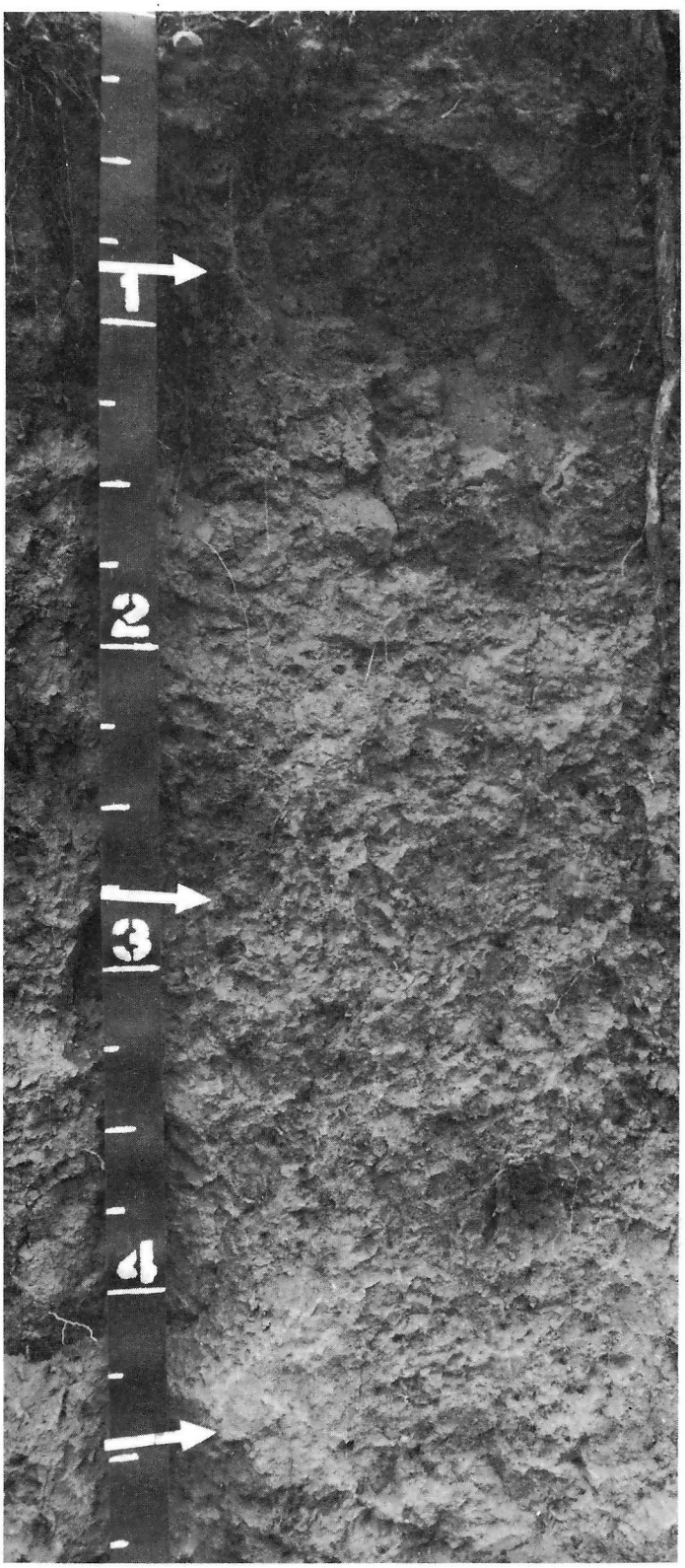


Figure 8.—Profile of Rhea silt loam Basalt is below 60 inches

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system help to maintain soil moisture. Cross-slope tillage in the more level areas and contour tillage and diversions in the steeper areas are desirable, especially where slopes are long.

Response of wheat and barley to nitrogen fertilizer is low as a result of low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass. For dryland hay, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass (*3*).

The native plant community is dominated by bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass and Idaho fescue decrease and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, cheatgrass, low value forbs, and shrubs predominate.

If the range is in poor condition, seedbed preparation and seeding are practical considerations. Suitable for dryland seeding are big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa.

Mule deer use this plant community in spring and fall when plants are green and succulent. The plant community also provides food for small mammals and game birds.

This soil has no serious limitations for community uses or recreation facilities. Playgrounds may require leveling in the steeper areas.

The capability subclass is IIe dryland.

43C—Rhea silt loam, 7 to 12 percent slopes. This is a very deep, well drained soil formed in material from wind laid silt mixed with small amounts of volcanic ash. It occurs on uplands at elevations of 1,600 to 3,200 feet. The average slope is 9 percent. The average annual precipitation is 11 to 14 inches, and the average annual air temperature is 47 to 51 degrees F. The frost free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the upper 7 inches of the surface layer is very dark brown silt loam, and the lower 7 inches is very dark grayish brown silt loam. The subsoil is dark brown and brown silt loam about 19 inches thick. The substratum is dark brown silt loam that extends to a depth of 60 inches or more.

About 20 percent of this unit is included areas of Valby soils and soils formed in volcanic ash and 5 percent is Bakeoven soils.

Permeability is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 8 to 15 inches. Water supplying capacity is 6 to 10 inches. Runoff is medium, and the hazard of erosion is moderate.

Most of the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland hay and pasture are grown. The rest of the acreage is used for range and wildlife habitat.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Cross-slope tillage, contour tillage, and diversions are generally needed to prevent severe erosion from rapid runoff during high intensity rainfall or snowmelt.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass. For dryland hay, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass (*3*).

The native plant community is dominated by bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass and Idaho fescue decrease and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, cheatgrass, low value forbs, and shrubs predominate.

If the range is in poor condition, seedbed preparation and seeding are practical considerations. Suitable for dryland seeding are big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa.

Mule deer use this plant community in spring and fall when plants are green and succulent. The plant community also provides food for small mammals and game birds.

The slope is a limitation for community and recreation uses. Design modifications are needed for dwellings, small buildings, and sanitary facilities to overcome slope. Playgrounds require major cutting and filling

The capability subclass is IIIe dryland.

43D—Rhea silt loam, 12 to 20 percent slopes. This is a very deep, well drained soil formed in material from wind laid silt mixed with small amounts of volcanic ash. It occurs at elevations of 1,600 to 3,200 feet. The average slope is 15 percent. The average annual precipitation is 11 to 14 inches, and the average annual air temperature is 47 to 51 degrees F. The frost free period is 100 to 150 days at 32 degrees F. and 150 to 200 days at 28 degrees.

In a representative profile the upper 7 inches of the surface layer is very dark brown silt loam, and the lower 7 inches is very dark grayish brown silt loam. The subsoil is dark brown and brown silt loam about 19 inches thick. The substratum is dark brown silt loam that extends to a depth of 60 inches or more.

About 20 percent of this map unit is included areas of Valby soils and soils formed in volcanic ash and 5 percent is Bakeoven soils.

Permeability is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 8 to 15 inches. Water supplying capacity is 6 to 10 inches. Runoff is medium, and the hazard of erosion is moderate.

About half the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland hay and pasture are grown. The rest of the acreage is used for range and wildlife habitat.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch and minimum tillage along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Contour tillage and diversions help to prevent severe erosion from rapid runoff during high intensity rainfall and snowmelt.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

For dryland hay, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass (*3*).

The native plant community is dominated by bluebunch wheatgrass and Idaho fescue. On slopes facing strongly to the north, Idaho fescue may be dominant. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand. Shrubs are minor

If range condition deteriorates, bluebunch wheatgrass and Idaho fescue decrease and the proportion of Sandberg bluegrass and perennial forbs increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated. As a result, annual weeds, lupine, and low value shrubs predominate.

If the range is in poor condition, seedbed preparation and seeding of the more gently sloping areas to grass are practical. Suitable for dryland seeding are big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa.

The plant community provides food for mule deer, small mammals and game birds.

The slope is a limitation for community and recreation uses. Extensive design modifications are needed for dwellings, small buildings, sanitary facilities, and most recreation facilities.

The capability subclass is IIIe dryland.

43E—Rhea silt loam, 20 to 35 percent slopes. This is a very deep, well drained soil formed in material from wind laid silt mixed with small amounts of volcanic ash. It occurs at elevations of 1,600 to 3,200 feet. The average slope is 28 percent. The average annual precipitation is 11 to 14 inches, and the average annual air temperature is 47 to 51 degrees F. The frost free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the upper 7 inches of the surface layer is very dark brown silt loam, and the lower 7 inches is very dark grayish brown silt loam. The subsoil is dark brown and brown silt loam about 19 inches thick. The substratum is dark brown silt loam that extends to a depth of 60 inches or more.

About 20 percent of this map unit is included areas of Valby soils and soils formed in volcanic ash and 5 percent is Lickskillet soils.

Permeability is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 8 to 15 inches. Water supplying capacity is 6 to 10 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for range and wildlife habitat. The rest is under a grain-fallow cropping system. Wheat and barley are grown.

The native plant community is dominated by bluebunch wheatgrass and Idaho fescue. On slopes facing strongly to the north, Idaho fescue may be dominant. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass and Idaho fescue decrease and the proportion of Sandberg bluegrass and perennial forbs increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated. As a result, annual weeds, lupine, and low value shrubs predominate.

If the range is in poor condition, seedbed preparation and seeding of the more gently sloping areas to grass are practical considerations. Suitable for dryland seeding are big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa.

The plant community provides food and cover for mule deer, small mammals, and game birds.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

In areas where this soil is dryfarmed, stubble mulch and minimum tillage along with a crop-fallow system are necessary to minimize erosion loss and help to maintain soil moisture. Contour tillage and diversions help to prevent severe erosion from rapid runoff during high intensity rainfall and snowmelt.

The slope is a severe limitation for community and recreation uses. Extensive design modifications are needed for dwellings, small buildings, sanitary facilities, and most recreation facilities.

The capability subclass is IVe dryland.

43F—Rhea silt loam, 35 to 50 percent slopes. This is a very deep, well drained soil formed in material from wind laid silt mixed with small amounts of volcanic ash. It occurs at elevations of 1,600 to 3,200 feet. The average slope is 40 percent. The average annual precipitation is 11 to 14 inches, and the average annual air temperature is 47 to 51 degrees F. The frost free period is 100 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the upper 7 inches of the surface layer is very dark brown silt loam, and the lower 7 inches is very dark grayish brown silt loam. The subsoil is dark brown and brown silt loam about 19 inches thick. The substratum is dark brown silt loam that extends to a depth of 60 inches or more.

About 20 percent of this map unit is included areas of Valby soils and 5 percent is Lickskillet soils.

Permeability is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 8 to 15 inches. Water supplying capacity is 6 to 10 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for range and wildlife habitat.

The native plant community is dominated by bluebunch wheatgrass and Idaho fescue. On slopes facing strongly to the north, Idaho fescue may be dominant. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass and Idaho fescue decrease and the proportion of Sandberg bluegrass and perennial forbs increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated. As a result, annual weeds, lupine, and low value shrubs predominate.

Because of the steep slopes, range seeding is not practical.

Most areas provide food and cover for mule deer, small mammals, and game birds.

The slope is a limitation for community and recreation uses. Extensive design modifications are needed but in most places are not practical for dwellings, small buildings, and sanitary facilities and most recreation facilities.

The capability subclass is VIe dryland.

44B—Ritzville very fine sandy loam, 2 to 7 percent slopes. This is a deep, well drained soil formed in wind laid silt and volcanic ash. It occurs at elevations of 1,000 to 2,500 feet. The average slope is 4 percent. The average annual precipitation is 9 to 12 inches, and the

average annual air temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown very fine sandy loam about 13 inches thick. The subsoil is dark brown and brown silt loam about 20 inches thick. The substratum is brown silt loam that extends to a depth of 60 inches or more.

About 15 percent of this unit is included areas of Warden and Willis soils, 10 percent is Sagehill soils, and 5 percent is Gravden soils.

Permeability is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 7 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is slow, and the erosion hazard is slight. The hazard of soil blowing is moderate.

Nearly all the acreage is used for crops under a grain-fallow system. Some areas are irrigated. Winter wheat is the main crop. Some hay is also grown. A few areas are used for range and wildlife habitat.

The major needs in crop management are protecting the soil from soil blowing and conserving soil moisture. The proper timing and rate of applying irrigation water are needed. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system under irrigation is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Because of the high water consumption, light, frequent applications of irrigation water are needed. Split applications of fertilizer are desirable because plant nutrients are leached out of the rooting zone by the irrigation water. Irrigation rates need to be monitored. If they exceed the infiltration rate of the soil, runoff and erosion losses result.

The soil blowing hazard can be a limitation because of the very fine sandy loam texture and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts, hummocks, and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. In irrigated areas practices that may be needed to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; and minimum tillage. Blowout areas require special treatment such as disked-in straw mulching and seeding to suitable grasses. Doublecropping and stripcropping are needed in places. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation system before any land is broken out and leaving vegetation intact on odd areas are the practices and precautions needed.

Stubble mulch, minimum tillage, and grassed waterways along with a grain-fallow system reduce water erosion and help to maintain soil moisture in dryfarmed cropland. Cross-slope tillage in the more level areas and diversions in the steeper areas are desirable, particularly where slopes are long.

Response of wheat and barley to nitrogen fertilizer is low because of the low annual rainfall. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass.

The native plant community is dominated by bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is left bare.

If the range is in poor condition, seedbed preparation and seeding are practical considerations. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

This soil has no serious limitations for community developments. It has no serious limitations for recreation facilities, but playgrounds require leveling because of the slopes.

The capability subclass is IIIe dryland, IIe irrigated.

44C—Ritzville very fine sandy loam, 7 to 12 percent slopes. This is a deep, well drained soil formed in wind laid silt and volcanic ash. It occurs at elevations of 1,000 to 2,500 feet. The average slope is 9 percent. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown very fine sandy loam about 13 inches thick. The subsoil is dark brown and brown silt loam about 20 inches thick. The substratum is brown silt loam that extends to a depth of 60 inches or more.

About 15 percent of this unit is included areas of Warden and Willis soils, 10 percent is Sagehill soils, and 5 percent is Gravden soils.

Permeability is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 7 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium, and the hazard of erosion is moderate. The hazard of soil blowing is moderate.

Nearly all the acreage is used for crops under a grain-fallow system. Some areas are irrigated. Winter wheat is

the main crop. Some hay is also grown. The rest of the acreage is used for range and wildlife habitat.

The major needs in crop management are protecting the soil from blowing and water erosion and conserving soil moisture. The proper timing and rate of applying irrigation water are needed. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system under irrigation is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Because of the high water consumption, light, frequent applications of irrigation water are needed. Split applications of fertilizer are desirable because plant nutrients are leached out of the root zone by the irrigation water. The rate at which irrigation water is applied is important. If it exceeds the infiltration rate of the soil, runoff and erosion losses result.

The soil blowing hazard can be a limitation because of very fine sandy loam texture and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts, hummocks, and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures needed in irrigated areas to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; and minimum tillage. Blowout areas require special treatment, such as disked-in straw mulching and seeding to suitable grasses. Doublecropping and stripcropping are needed in places. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation system before any land is broken out and leaving vegetation intact on odd areas are the practices and precautions needed.

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system minimize erosion loss and help to maintain soil moisture in dryfarmed cropland. Cross-slope tillage, contour tillage, and diversions generally are needed to prevent erosion during high intensity rainfall and snowmelt.

Response of wheat and barley to nitrogen fertilizer is low because of the low annual rainfall. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass.

The native plant community is dominated by bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is left bare.

If the range is in poor condition, seedbed preparation and seeding are practical considerations. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

The slope is a limitation for community and recreation uses. Modifications in design are needed for dwellings, sanitary facilities, and most recreation facilities.

The capability subclass is IIIe dryland, IIIe irrigated.

44D—Ritzville very fine sandy loam, 12 to 25 percent slopes. This is a deep, well drained soil formed in wind laid silt and volcanic ash. It occurs at elevations of 1,000 to 2,500 feet. The average slope is 17 percent. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown very fine sandy loam about 13 inches thick. The subsoil is dark brown and brown silt loam about 20 inches thick. The substratum is brown silt loam that extends to a depth of 60 inches or more.

About 15 percent of this unit is included areas of Warden and Willis soils, 10 percent is Sagehill soils, and 5 percent is Gravden gravelly loam.

Permeability is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 7 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium to rapid, and the hazard of erosion is moderate. The hazard of soil blowing is medium.

About half the acreage is used for crops under a grain-fallow system. Some areas, mainly small areas of this soil in areas of gently sloping Ritzville soils, are irrigated. Winter wheat is the main crop. Some hay is grown. The rest of the acreage is used for range and wildlife habitat.

The major needs in crop management are protecting the soil from soil blowing and water erosion and conserving soil moisture. The proper timing and rate of applying irrigation water are needed. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system under irrigation is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Because of the high water consumption and the slope, light, frequent applications of irrigation water are needed. Split applications of fertilizer are desirable because plant nutrients are leached out of the root zone by the

irrigation water. In sloping areas the rate at which irrigation water is applied is important. If it exceeds the infiltration rate of the soil, runoff and possible serious erosion losses result.

The soil blowing hazard can be a limitation because of the very fine sandy loam texture and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts, hummocks, and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. In irrigated areas measures that may be needed to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; and minimum tillage. Blowout areas require special treatments, such as disked-in straw mulching and seeding to suitable grasses. Doublecropping and stripcropping are needed in places. Protection from soil blowing is critical when new rangeland is converted to irrigated cropland. Completely developing the irrigation system before any land is broken out and leaving vegetation intact on odd areas are the practices and precautions needed.

Stubble mulch and minimum tillage along with a crop-fallow system both minimize erosion loss and help to maintain soil moisture in dryfarmed cropland. Contour tillage and diversions help to prevent severe erosion during high intensity rainfall and snowmelt.

Response of wheat and barley to nitrogen fertilizer is low because of the low annual rainfall. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall.

The native plant community is dominated by bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is left bare.

If the range is in poor condition, seedbed preparation and seeding are practical considerations. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

The slope is a limitation for community and recreation uses. Extensive modifications in design are needed for dwellings, sanitary facilities, and most recreation facilities.

The capability subclass is IVe dryland, IIIe irrigated.

45A—Ritzville silt loam, 0 to 2 percent slopes. This is a deep, well drained soil formed in wind laid silt and volcanic ash. It occurs at elevations of 1,000 to 2,500 feet. The average slope is 1 percent. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 13 inches thick. The subsoil is dark brown and brown silt loam about 20 inches thick. The substratum is brown silt loam that extends to a depth of 60 inches or more.

About 25 percent of this unit is included areas of Mikkalo silt loam and Warden and Willis soils and 5 percent is Gravden and Bakeoven soils.

Permeability is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 7 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is slow, and the hazard of erosion is slight.

Nearly all the acreage is used for crops under a grain-fallow system. Some areas are irrigated. Winter wheat is the main crop. Some hay is also grown. The rest of the acreage is used for range and wildlife habitat.

The major needs in crop management are protecting the soil from water erosion and conserving soil moisture. The proper timing and rate of applying irrigation water are needed. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system under irrigation is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Because of the high water consumption, light, frequent applications of irrigation water are needed. Split applications of fertilizer are desirable because plant nutrients are leached out of the root zone by the irrigation water. The rate at which irrigation water is applied is important. If it exceeds the infiltration rate of the soil, runoff and erosion losses result.

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system minimize erosion loss and help to maintain soil moisture in dryfarmed cropland.

Response of wheat and barley to nitrogen fertilizer is low because of the low annual rainfall. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass.

The native plant community is dominated by bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is left bare.

If the range is in poor condition, seedbed preparation and seeding are practical considerations. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

This soil has no serious limitations for community developments.

The capability subclass is IIIc dryland and class I irrigated.

45B—Ritzville silt loam, 2 to 7 percent slopes. This is a deep, well drained soil formed in wind laid silt and volcanic ash. It occurs at elevations of 1,000 to 2,500 feet. The average slope is 4 percent. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 13 inches thick. The subsoil is dark brown and brown silt loam about 20 inches thick. The substratum is brown silt loam that extends to a depth of 60 inches or more.

About 20 percent of this unit is included areas of Mikkalo silt loam, Warden silt loam, and Willis silt loam; 2 percent is Gravden gravelly loam; and 1 percent is volcanic ash deposits.

Permeability is moderate. Effective rooting depth is more than 60 inches. Available water capacity is 7 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is slow, and the hazard of erosion is slight.

Nearly all the acreage is used for crops under a grain-fallow system. Some areas are irrigated. Winter wheat is the main crop. Some hay is also grown. The rest of the acreage is used for range and wildlife habitat.

The major need in crop management is conserving soil moisture. The proper timing and rate of applying irrigation water are needed. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system under irrigation is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Because of the high water consumption, light, frequent applications of irrigation water are needed. Split applications of fertilizer are desirable because plant nutrients are leached out of the root zone by the irrigation water. The rate at which irrigation water is applied is important. If it exceeds the infiltration rate of the soil, runoff and erosion losses result.

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system help to maintain soil moisture in dryfarmed cropland. Cross-slope tillage in the more level areas and diversions in the steeper areas are desirable, especially where slopes are long.

Response of wheat and barley to nitrogen fertilizer is low because of the low annual rainfall. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass.

The native plant community is dominated by bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is left bare.

If the range is in poor condition, seedbed preparation and seeding are practical considerations. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

This soil has no serious limitations for community developments. It has no serious limitations for recreation facilities, but playgrounds require leveling because of the slope.

The capability subclass is IIIe dryland, IIe irrigated.

45C—Ritzville silt loam, 7 to 12 percent slopes. This is a deep, well drained soil formed in wind laid silt and volcanic ash. It occurs at elevations of 1,000 to 2,500 feet. The average slope is 9 percent. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 13 inches thick. The subsoil is dark brown and brown silt loam about 20 inches thick. The substratum is brown silt loam that extends to a depth of 60 inches or more.

About 25 percent of this unit is included areas of Mikkalo, Warden, and Willis soils and 5 percent is Gravden, Bakeoven, and Lickskillet soils.

Permeability is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 7 to 12.5

inches. Water supplying capacity is 5 to 9 inches. Runoff is medium, and the hazard of erosion is moderate.

Most of the acreage is used for crops under a grain-fallow system. Some areas are irrigated. Winter wheat is the main crop. Some hay is also grown. The rest of the acreage is used for range and wildlife habitat.

The major needs in crop management are protecting the soil from water erosion and conserving soil moisture. The proper timing and rates of applying irrigation water are needed. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system under irrigation is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Because of the high water consumption, light, frequent applications of irrigation water are needed. Split applications of fertilizer are desirable because plant nutrients are leached out of the rooting zone by the irrigation water. Irrigation rates must be monitored on slopes. If they exceed the infiltration rate of the soil, runoff and possibly serious erosion losses result.

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system minimize erosion loss and help to maintain soil moisture in dryfarmed cropland. Cross-slope tillage, contour tillage, and diversions generally are needed to prevent erosion during high intensity rainfall and snowmelt.

Response of wheat and barley to nitrogen fertilizer is low because of the low annual rainfall. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass.

The native plant community is dominated by bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is left bare.

If the range is in poor condition, seedbed preparation and seeding are practical considerations. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

The slope is a limitation for community uses. Modifications in design are needed for dwellings and sanitary facilities. The slope is also a limitation for most recreation facilities.

The capability subclass is IIIe dryland and irrigated.

45D—Ritzville silt loam, 12 to 20 percent slopes. This is a deep, well drained soil formed in wind laid silt and volcanic ash. It occurs at elevations of 1,000 to 2,500 feet. The average slope is 15 percent. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 13 inches thick. The subsoil is dark brown and brown silt loam about 20 inches thick. The substratum is brown silt loam that extends to a depth of 60 inches or more.

About 25 percent of this unit is included areas of Mikkalo, Warden, and Willis soils and 5 percent is Gravden, Bakeoven, and Lickskillet soils.

Permeability is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 7 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is medium, and the hazard of erosion is moderate.

About half the acreage is used to raise crops under a grain-fallow system. Some areas, mainly small areas of gently sloping Ritzville soils, are irrigated. Winter wheat is the main crop. Some hay is grown. The rest of the acreage is used for range and wildlife habitat.

The major needs in crop management are protecting the soil from water erosion and conserving soil moisture. The proper timing and rate of applying irrigation water are needed. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system under irrigation is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Because of the high water consumption and the slope, light, frequent applications of irrigation water are needed. Split applications of fertilizer are desirable because plant nutrients are leached out of the rooting zone by the irrigation water. Irrigation rates must be monitored on slopes. If they exceed the infiltration rate of the soil, runoff and possible serious erosion losses result.

Stubble mulch and minimum tillage along with a crop-fallow system minimize erosion loss and help to maintain soil moisture in dryfarmed cropland. Contour tillage and diversions help to prevent severe erosion during high intensity rainfall and snowmelt.

Response of wheat and barley to nitrogen fertilizer is low because of the low annual rainfall. Generally, 25 pounds per acre of nitrogen fertilizer is applied to summer fallow in spring or fall.

The native plant community is dominated by bluebunch wheatgrass and Sandberg wheatgrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and

forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is left bare.

If the range is in poor condition, seedbed preparation and seeding are practical considerations. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

The slope is a limitation for community and recreation uses. Extensive modifications in design are needed for dwellings, sanitary facilities, and most recreation facilities.

The capability subclass is IIIe dryland, IIIe irrigated.

46E—Ritzville silt loam, 20 to 40 percent north slopes. This is a deep, well drained soil formed in wind laid silt and volcanic ash. It is on north-facing slopes at elevations of 1,000 to 2,500 feet. The average slope is 30 percent. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 13 inches thick. The subsoil is dark brown and brown silt loam about 20 inches thick. The substratum is brown silt loam that extends to a depth of 60 inches or more.

About 20 percent of this unit is included areas of Mikkalo, Warden, and Willis soils and 5 percent is Nansene soils.

Permeability is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 7 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas are used for range and wildlife habitat. The others are under a grain-fallow system. Wheat and barley are grown.

The native plant community is dominated by bluebunch wheatgrass and Idaho fescue. On slopes facing strongly to the north, Idaho fescue may be dominant. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass and Idaho fescue decrease and the proportion of Sandberg bluegrass and perennial forbs increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated. As a result, annual weeds, lupine, and low value shrubs predominate.

If the range is in poor condition, seedbed preparation and seeding of the more gently sloping areas to grass are practical considerations. Suitable for dryland seeding are big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa.

The plant community and most areas of this soil provide food and cover for mule deer, small mammals, and game birds.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch and minimum tillage along with a crop-fallow system are necessary to minimize erosion loss and help to maintain soil moisture in dryfarmed cropland. Contour tillage and diversions help to prevent severe erosion from rapid runoff during high intensity rainfall and snowmelt.

The slope is a limitation for community and recreation uses. Extensive and expensive design modifications are needed for dwellings, small buildings, sanitary facilities, and recreation facilities.

The capability subclass is IVe dryland.

47E—Ritzville silt loam, 20 to 40 percent south slopes. This is a deep, well drained soil formed in wind laid silt and volcanic ash. It is on south-facing slopes at elevations of 1,000 to 2,500 feet. The average slope is 30 percent. The average annual precipitation is 9 to 12 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 130 to 180 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 13 inches thick. The subsoil is dark brown and brown silt loam about 20 inches thick. The substratum is brown silt loam that extends to a depth of 60 inches or more.

About 25 percent of this unit is included areas of Mikkalo and Warden soils and 15 percent is Gravden and Lickskillet soils.

Permeability is moderate. Effective rooting depth is 40 to 60 inches. Available water capacity is 7 to 12.5 inches. Water supplying capacity is 5 to 9 inches. Runoff is rapid, and the hazard of erosion is high.

Most areas are used for range and wildlife habitat. The others are under a grain-fallow cropping system. Wheat and barley are grown.

The native plant community is dominated by bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs occurs throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and Thurber needlegrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated. As a result, much of the surface is left bare and the hazard of soil erosion is high.

If the range is in poor condition, seedbed preparation and seeding of the more gently sloping areas to grass are practical considerations. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch and minimum tillage along with a crop-fallow system are needed to minimize erosion loss and help to maintain soil moisture in dryfarmed cropland. Contour tillage and diversions help to prevent severe erosion from rapid runoff during high intensity rainfall and snowmelt.

The slope is a limitation for community and recreation uses. Extensive and expensive design modifications are needed for dwellings, small buildings, sanitary facilities, and recreation facilities.

The capability subclass is IVe dryland.

48—Riverwash. This map unit consists of irregularly shaped strips of well rounded sand, gravel, stones, and boulders, generally of basalt. The strips are 40 to 200 yards wide. They are about 2 to 10 feet above the normal waterline in bends of stream channels and along drainageways. The slope is 0 to 5 percent. Depth to bedrock is 20 to more than 60 inches. The elevation ranges from about 850 to 3,100 feet. The average annual precipitation is 9 to 20 inches, and the average annual air temperature is 43 to 52 degrees F. The average frost free period is variable.

About 5 percent of this unit is Snow soils and Xeric Torriorthents.

Permeability is rapid to very rapid. Available water capacity and water supplying capacity vary. Effective rooting depth is 20 to 60 inches. The hazard of water erosion is high.

Riverwash is subject to overflow when the water is high, and it is extremely droughty when the water is low. During each overflow, material is deposited or removed. Small stones are a limitation. For these reasons, this unit has severe limitations for community and recreation developments. Some forage is produced, but generally this land has little value as range. Riverwash is used as wildlife habitat and as a possible source of gravel.

The capability subclass is VIIIs.

49F—Rock outcrop-Rubble land complex, very steep. This map unit is 65 to 75 percent Rock outcrop; 20 to 30 percent Rubble land; 10 percent Lickskillet, Bakeoven, Waterbury, and Rockly soils; and 5 percent Prosser, Quinton, Wrentham, and Klicker soils. It formed on uplands in basalt outcrop and rubble. It is bare basalt outcrop or cobbly and stony rubble that varies in thickness. The slope ranges from 5 percent to more than 100 percent. Elevations are 300 to 5,000 feet. The average annual precipitation is 7 to 25 inches, and the average annual air temperature is 45 to 54 degrees F. The frost free period is 50 to 180 days at 32 degrees and 100 to 215 days at 28 degrees.

Permeability is very slow in Rock outcrop and very rapid in Rubble land. Runoff is very rapid on Rock outcrop and very slow on Rubble land. Available water capacity and water supplying capacity are less than 0.5 inches. The hazard of erosion is slight.

The slope, depth to rock, and large stones are severe limitations for all community and recreation facilities. Except for small areas of included soils, this map unit has no value as range. In many places it forms a natural barrier to livestock. It is used mainly as wildlife habitat.

The capability subclass is VIIIs.

50D—Rockly very gravelly loam, 2 to 20 percent slopes. This is a very shallow, well drained soil formed in wind laid silt, volcanic ash, and basalt colluvium. It occurs at elevations of 3,000 to 4,300 feet. The average slope is 5 percent. The average annual precipitation is 14 to 22 inches, and the average annual air temperature is 47 to 49 degrees F. The frost free period is 60 to 120 days at 32 degrees and 120 to 170 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown very gravelly loam about 2 inches thick. It is 50 percent rock fragments. The subsoil is very dark grayish brown and dark brown very gravelly loam about 7 inches thick. It is 55 percent rock fragments up to 3 inches in size and about 5 percent fragments 3 inches or larger. Fractured basalt is at a depth of about 9 inches.

About 15 percent of this unit is included areas of Waha and Hankins soils.

Permeability is moderately slow. Effective rooting depth is restricted by the underlying bedrock at a depth of 5 to 12 inches. Available water capacity is 0.5 to 1.5 inches. Water supplying capacity is 1 to 4 inches. Runoff is slow to medium, and the hazard of erosion is moderate.

Nearly all areas of this soil are used for livestock grazing.

The major concern is maintaining an adequate plant cover for control of water erosion.

The native plant community is dominated by very shallow rooted plants, such as Sandberg bluegrass and Oregon bluegrass. Idaho fescue and bluebunch wheatgrass may also occur in small amounts. Low growing perennial forbs, such as pussytoes and phlox, are common.

If range condition deteriorates, small bluegrasses decrease and the proportion of low value forbs increases. If deterioration is severe, most plants are nearly eliminated and a barren rock pavement forms.

Because the soil is very shallow and stony, seedbed preparation and seeding are not practical.

This plant community is used by mule deer in winter and early in spring as a source of green succulent feed when other areas are snow covered. Areas of this soil provide limited food and cover for small mammals and game birds and song birds.

The depth to bedrock and stoniness are severe limitations for community and recreation uses. Extensive design modifications are needed but in most places are not practical for dwellings, small buildings, and sanitary and recreation facilities

The capability subclass is VIIs.

51B—Royal loamy fine sand, 2 to 5 percent slopes. This is a very deep, well drained soil formed in wind laid material. The elevation is 300 to 800 feet. The average slope is 3 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 150 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown loamy fine sand about 6 inches thick. The subsoil is dark brown fine sandy loam about 8 inches thick. The substratum is dark brown, dark grayish brown, and very dark gray stratified fine sandy loam, loamy fine sand, and fine sand that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Quincy and Burbank soils and 5 percent is Ellum, Sagehill, and Irrigon soils.

Permeability is moderately rapid. Effective rooting depth is 40 to 60 inches. Available water capacity is 5 to 9 inches. Water supplying capacity is 2 to 3 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. A large part of the acreage is used for range and wildlife habitat. Major irrigated crops include potatoes, wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the moderately low water capacity and the hazard of soil blowing. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the moderately low water capacity and high water consumption, light, frequent applications of irrigation water are needed. Plant nutrients are readily leached from the rooting zone because of the moderately rapid permeability. Split applications of fertilizer are desirable.

The hazard of soil blowing is high because of the loamy fine sand texture of the surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and hummocks in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures needed to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Blowout areas require special treatment, such as disked-in straw mulching and seeding to suitable grasses. Doublecropping and stripcropping are needed in places. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation systems before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally dominates. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses are practical considerations. Because the hazard of soil blowing is high, seeding to grass presents special management problems. Direct drill seeding after a fire is a good method of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

This soil generally is well suited to community uses. Sanitary facilities, such as sewage lagoons and sanitary landfills, may require some modifications because of seepage. Some variation in design is needed for roads, dwellings, and commercial buildings because of the low strength. The loamy fine sand texture is a limitation for all types of recreation facilities unless the design is modified.

The capability subclass is VIe dryland, IIIe irrigated.

51C—Royal loamy fine sand, 5 to 12 percent slopes. This is a very deep, well drained soil formed in wind laid material. It occurs at elevations of 300 to 800 feet. The average slope is 8 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 150 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown loamy fine sand about 6 inches thick. The subsoil is dark brown fine sandy loam about 8 inches thick. The substratum is dark brown, dark grayish

brown, and very dark gray stratified fine sandy loam, loamy fine sand, and fine sand that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Quincy and Burbank soils and 5 percent is Ellum, Sagehill, and Irrigon soils.

Permeability is moderately rapid. Effective rooting depth is 40 to 60 inches. Available water capacity is 5 to 9 inches. Water supplying capacity is 2 to 3 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. A large part of the acreage is used for range and wildlife habitat. Major irrigated crops include potatoes, wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the moderately low water capacity and the hazard of soil blowing. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the moderately low water capacity and high water consumption, light, frequent applications of irrigation water are needed. Plant nutrients are readily leached from the rooting zone because of the moderately rapid permeability. Split applications of fertilizer are desirable.

The hazard of soil blowing is high because of the loamy fine sand texture of the surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and hummocks in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures needed to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Blowout areas require special treatments, such as disked-in straw mulching and seeding to suitable grasses. Doublecropping and stripcropping are needed in places. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation systems before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally dominates. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses are practical. Because the hazard of soil blowing is high, seeding to grass presents special management problems. Direct drill seeding after a fire is a good method of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

This soil generally is well suited to community uses. Sanitary facilities, such as sewage lagoons and sanitary landfills, may require some modifications because of seepage. Some variation in design is needed for roads, dwellings, and commercial buildings because of the low strength. The loamy fine sand texture and slope are limitations for all recreation facilities unless the design is modified.

The capability subclass is VIe dryland, IIIe irrigated.

52B—Royal fine sandy loam, 2 to 5 percent slopes. This is a very deep, well drained soil formed in wind laid material. It occurs at elevations of 300 to 800 feet. The average slope is 3 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 150 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark brown fine sandy loam about 6 inches thick. The subsoil is dark brown very fine sandy loam about 11 inches thick. The substratum is dark brown, dark grayish brown, and very dark gray stratified fine sandy loam, loamy fine sand, and fine sand that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Quincy and Burbank soils and 5 percent is Ellum, Sagehill, and Irrigon soils.

Permeability is moderately rapid. Effective rooting depth is 40 to 60 inches. Available water capacity is 5 to 9 inches. Water supplying capacity is 2 to 3 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. A large percentage of the acreage is used as range and wildlife habitat. Major irrigated crops include potatoes, wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the moderately low water capacity and the hazard of soil blowing. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the moderately low water capacity and high water consumption, light, frequent applications of irrigation water are needed. Plant nutrients are readily leached from the root zone because of the moderately rapid permeability. Split applications of fertilizer are desirable.

The hazard of soil blowing is high because of the fine sandy loam surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts, hummocks, and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures that help in controlling soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation systems before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is a good stand of needleandthread. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses are practical. Because the hazard of soil blowing is high, seeding to grass presents special management problems. Direct drill seeding after a fire is a good method of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

This soil generally is well suited to community uses. Sanitary facilities, such as sewage lagoons and sanitary landfills, may require some modifications because of seepage. The fine sandy loam texture is a limitation for all recreation facilities unless the design is modified.

The capability subclass is VIe dryland and IIe irrigated.

52C—Royal fine sandy loam, 5 to 12 percent slopes. This is a very deep, well drained soil formed in wind laid material. It occurs at elevations of 300 to 800 feet. The average slope is 8 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 150 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark brown fine sandy loam about 6 inches thick. The subsoil is dark brown very fine sandy loam about 11 inches thick. The substratum is dark brown, dark grayish brown and very dark gray stratified fine sandy loam, loamy fine sand, and fine sand that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Quincy and Burbank soils and 5 percent is Ellum, Sagehill, Irrigon, and Warden soils.

Permeability is moderately rapid. Effective rooting depth is 40 to 60 inches. Available water capacity is 5 to 9 inches. Water supplying capacity is 2 to 3 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. Much of the acreage is used for range and wildlife habitat. Major irrigated crops include potatoes, wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the moderately low water capacity and the hazard of soil blowing. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the moderately low water capacity and high water consumption, light, frequent applications of irrigation water are needed. Because of the slope, irrigation water runoff may be a problem if application rates are too high. Plant nutrients are readily leached out of the root zone because of the moderately rapid permeability. Split applications of fertilizer are desirable.

The hazard of soil blowing is high because of the fine sandy loam surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts, hummocks, and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures that help in controlling soil blowing include

winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation systems before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally is dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses are practical. Because the hazard of soil blowing is high, seeding to grass presents special management problems. Direct drill seeding after a fire is a good method of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seeding vigor and be drought resistant. Suitable for seeding is crested or Siberian wheatgrass.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The slope is a limitation for many uses in community development. Variation in design may be needed. The fine sandy loam texture and the slope are limitations for all recreation facilities unless the design is modified.

The capability subclass is VIe dryland, IIIe irrigated.

52D—Royal fine sandy loam, 12 to 20 percent slopes. This is a very deep, well drained soil formed in wind laid material. It occurs at elevations of 300 to 800 feet. The average slope is 15 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 150 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark brown fine sandy loam about 6 inches thick. The subsoil is dark brown very fine sandy loam about 11 inches thick. The substratum is dark brown, dark grayish brown, and very dark gray stratified fine sandy loam, loamy fine sand, and fine sand. It extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Quincy and Burbank soils; 5 percent is Ellum, Sagehill, Irrigon, and Warden soils; and 10 percent is Royal soils that have slopes of 20 to 30 percent.

Permeability is moderately rapid. Effective rooting depth is 40 to 60 inches. Available water capacity is 5 to 9 inches. Water supplying capacity is 2 to 3 inches. Runoff is slow, and the hazard of water erosion is slight to moderate. The hazard of soil blowing is high.

Some of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. Most of the acreage, however, is used for range and wildlife habitat. Major irrigated crops include potatoes, wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the moderately low water capacity, the hazard of soil blowing, and the proper application of irrigation water to prevent water erosion. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the slope, proper application rates of irrigation water are important in order to reduce the hazard of water erosion. Plant nutrients are readily leached out of the root zone because of the moderately rapid permeability. Split applications of fertilizer are desirable.

The hazard of soil blowing is high because of the fine sandy loam texture of the surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts, hummocks, and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures that help in controlling soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation system before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally is dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses are practical. Because

the hazard of soil blowing is high, seeding to grass presents special management problems. Direct drill seeding after a fire is a good method of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested or Siberian wheatgrass.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The slope is a limitation for many community and recreation uses.

The capability subclass is VIe dryland, IVe irrigated.

53A—Royal silt loam, 0 to 3 percent slopes. This is a very deep, well drained soil formed in wind laid material. It occupies long, narrow areas of alluvial bottom lands adjacent to streams. The elevation is 300 to 800 feet. The average slope is 1 percent. The average annual precipitation is 7 to 9 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 150 to 200 days at 32 degrees F. and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown silt loam about 6 inches thick. The subsoil is dark brown and dark grayish brown fine sandy loam about 27 inches thick. The substratum is dark grayish brown stratified fine sandy loam and fine sand that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Burbank, Quincy, and Royal soils and 5 percent is Xeric Torriorthents.

Permeability is moderately rapid. Effective rooting depth is 40 to 60 inches. Available water capacity is 5 to 9 inches. Water supplying capacity is 2 to 3 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Although much of the acreage is used for irrigated crops, a considerable acreage is used for range and wildlife habitat. More of the acreage is converted to irrigated cropland every year. Major irrigated crops include potatoes, wheat, corn, alfalfa hay, and pasture.

The major concern in management is the low infiltration rate. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the low infiltration rate, the proper application of irrigation water is especially important where these soils occur in the same field with soils that have a higher infiltration rate. In such instances, one soil can be overirrigated and an adjacent soil underirrigated.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally is dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses are practical. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems. Direct drill seeding after a fire is a good method of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have a strong seedling vigor and be drought resistant.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

This soil is generally well suited to community and recreation uses. Sanitary facilities, such as sewage lagoons and sanitary landfills, may require some modification because of seepage.

The capability subclass is VIe dryland, IIs irrigated.

54B—Sagehill fine sandy loam, 2 to 5 percent slopes. This is a very deep, well drained soil formed in wind laid material and calcareous lacustrine sediment. It is on terraces at elevations of 500 to 1,200 feet. The average slope is 3 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 150 to 200 days at 32 degrees F. and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark grayish brown fine sandy loam about 5 inches thick. The subsoil is dark brown fine sandy loam about 16 inches thick. The upper 7 inches of the substratum is dark brown fine sandy loam. Below this is brown and dark grayish brown silt loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Warden soils and 5 percent is Taunton, Royal, and Gravden soils.

Permeability is moderately rapid as far down as the substratum and moderate in the substratum. The effective rooting depth is restricted by semiconsolidated, water laid silt at a depth of 20 to 40 inches. The available water capacity is 9 to 10.5 inches. The water supplying capacity is 5 to 7 inches. Runoff is slow, and the erosion hazard is slight. The hazard of soil blowing is moderate.

Extensive areas are used for irrigated crops, and many more are converted to irrigated cropland every year. Much of the acreage is used for range and wildlife

habitat. Major irrigated crops include potatoes, annual wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the hazard of soil blowing and the proper application of irrigation water. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because the fine sandy loam textured solum overlies a compact, lacustrine silt substratum, ponding results in some areas if too much irrigation water is applied. Proper irrigation rates should be carefully determined in such areas.

The hazard of soil blowing is moderate because of the fine sandy loam texture and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts, hummocks, and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures that help in controlling soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation system before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is dominated by bluebunch wheatgrass. Sandberg bluegrass and needleandthread are prominent. Perennial forbs, such as Carey balsamroot, wooly indianwheat, and western yarrow, occur in small amounts. Big sagebrush and rubber rabbitbrush are common.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass, low value forbs, and big sagebrush increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand.

If the range is in poor condition, seedbed preparation and seeding are practical. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems Direct drill seeding after a fire is a good way of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested or Siberian wheatgrass.

Livestock grazing should be limited mainly to winter. Areas of this soil support small populations of mule deer. Birds and small mammals are common.

This soil is generally well suited to community and most recreation uses. Playgrounds in the more sloping areas require leveling.

The capability subclass is VIe dryland, IIe irrigated.

54C—Sagehill fine sandy loam, 5 to 12 percent slopes. This is a very deep, well drained soil formed in wind laid material and calcareous lacustrine sediment. It is on terraces at elevations of 500 to 1,200 feet. The average slope is 8 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 150 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark grayish brown fine sandy loam about 5 inches thick. The subsoil is dark brown fine sandy loam about 16 inches thick. The upper 7 inches of the substratum is dark brown fine sandy loam. Below this is brown and dark grayish brown silt loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Warden soils and 5 percent is Royal, Taunton, and Gravden soils.

Permeability is moderately rapid as far down as the substratum and moderate in the substratum. Effective rooting depth is restricted by semiconsolidated, water laid silt at a depth of 20 to 40 inches. Available water capacity is 9 to 10.5 inches. Water supplying capacity is 5 to 7 inches. Runoff is slow, and the erosion hazard is slight. The hazard of soil blowing is moderate.

Extensive areas are used for irrigated crops, and many more are being converted to irrigated cropland. Much of the acreage is used as range and wildlife habitat. Major irrigated crops include potatoes, annual wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the hazard of soil blowing and the proper application of irrigation water. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because the fine sandy loam textured solum overlies a compact, lacustrine silt substratum, ponding results in some areas if too much irrigation water is applied. Proper irrigation rates should be carefully determined in such areas.

The hazard of soil blowing is moderate because of the fine sandy loam texture and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts, hummocks, and dunes in fields. It also causes crop damage by

sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures that help in controlling soil blowing include winter cover crops, timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation system before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is dominated by bluebunch wheatgrass. Sandberg bluegrass and needleandthread are prominent. Perennial forbs, such as Carey balsamroot, wooly indianwheat, and western yarrow, occur in small amounts. Big sagebrush and rubber rabbitbrush are common.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass, low value forbs, and big sagebrush increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand.

If the range is in poor condition, seedbed preparation and seeding are practical. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems. Direct drill seeding after a fire is a good way of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested or Siberian wheatgrass.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The slope is a limitation for most community and recreation development. Variation in design may be required to overcome these limitations.

The capability subclass is VIe dryland, IIIe irrigated.

54D—Sagehill fine sandy loam, 12 to 20 percent slopes. This is a very deep, well drained soil formed in wind laid material and calcareous lacustrine sediment. It is on terraces at elevations of 500 to 1,200 feet. The average slope is 15 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 150 to 200 days at 32 degrees and 180 to 215 days at 28 degrees

In a representative profile the surface layer is dark grayish brown fine sandy loam about 5 inches thick. The subsoil is dark brown fine sandy loam about 16 inches thick. The upper 7 inches of the substratum is dark brown fine sandy loam. Below this is brown and dark grayish brown silt loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Warden soils and 5 percent is Royal and Gravden soils.

Permeability is moderately rapid as far down as the substratum and moderate in the substratum. Effective rooting depth is restricted by semiconsolidated, water laid silt at a depth of 20 to 40 inches. Available water capacity is 9 to 10.5 inches. Water supplying capacity is 5 to 7 inches. Runoff is medium, and the erosion hazard is moderate. The hazard of soil blowing is moderate.

Areas of this soil are used for irrigated crops, and more areas are converted to irrigated cropland every year. Much of the acreage is used for range and wildlife habitat. Major irrigated crops include potatoes, annual wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the hazard of soil blowing and the proper application of irrigation water to prevent water erosion. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems can arise.

Because the fine sandy loam textured solum overlies a compact, lacustrine silt substratum, infiltration may be impeded, causing runoff. Proper irrigation rates should be carefully determined. If runoff is too great, it results in soil loss through water erosion.

The hazard of soil blowing is moderate because of the fine sandy loam texture and the frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts, hummocks, and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures that help in controlling soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation system before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is dominated by bluebunch wheatgrass. Sandberg bluegrass and needleandthread are prominent. Perennial forbs, such as Carey balsamroot, wooly indianwheat, and western yarrow, occur in small amounts. Big sagebrush and rubber rabbitbrush are common.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of

Sandberg bluegrass, low value forbs, and big sagebrush increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand.

If the range is in poor condition, seedbed preparation and seeding are practical. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems. Direct drill seeding after a fire is a good way of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested or Siberian wheatgrass.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The slope is a limitation for most community and recreational development.

The capability subclass is VIe dryland, IVe irrigated.

55B—Sagehill fine sandy loam, hummocky, 2 to 5 percent slopes. This is a very deep, well drained soil formed in wind laid materials and calcareous lacustrine sediment. It is on terraces at elevations of 500 to 1,200 feet. The average slope is 3 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 150 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark grayish brown fine sandy loam about 5 inches thick. The subsoil is dark brown fine sandy loam about 16 inches thick. The upper 7 inches of the substratum is dark brown fine sandy loam. Below this is brown and dark grayish brown silt loam that extends to a depth of 60 inches or more. The surface layer has been eroded in some areas and the material redeposited as small mounds or hummocks.

About 5 percent of this unit is included areas of Warden soils and 10 percent is Royal, Taunton, and Gravden soils.

Permeability is moderately rapid as far down as the substratum and moderate below the substratum. Effective rooting depth is restricted by semiconsolidated, water laid silt at a depth of 20 to 40 inches. Available water capacity is 9 to 10.5 inches. Water supplying capacity is 5 to 7 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

This soil is used entirely as range and wildlife habitat. If leveled, many areas could be converted to irrigated cropland. Management would be the same as for Sagehill fine sandy loam, 2 to 5 percent slopes

The native plant community is dominated by bluebunch wheatgrass. Sandberg bluegrass and needleandthread are prominent. Perennial forbs, such as Carey balsamroot, wooly indianwheat, and western yarrow, occur in small amounts. Big sagebrush and rubber rabbitbrush are common.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass, low value forbs, and big sagebrush increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand.

If the range is in poor condition, seedbed preparation and seeding are practical. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems. Direct drill seeding after a fire is a good way of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested or Siberian wheatgrass.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The slope and rapid percolation are limitations for community developments. Modifications in design are needed for small buildings, dwellings, and sanitary facilities. This soil has no serious limitations for recreation uses, but playgrounds may require leveling.

The capability subclass is VIe dryland, IIIe irrigated.

55C—Sagehill fine sandy loam, hummocky, 5 to 12 percent slopes. This is a very deep, well drained soil formed in wind laid material and calcareous lacustrine sediment. It is on terraces at elevations of 500 to 1,200 feet. The average slope is 8 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 150 to 200 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark grayish brown fine sandy loam about 5 inches thick. The subsoil is dark brown fine sandy loam about I6 inches thick. The upper 7 inches of the substratum is dark brown fine sandy loam. Below this is brown and dark grayish brown silt loam that extends to a depth of 60 inches or more. The surface layer, eroded from some areas, has been redeposited as small mounds or hummocks.

About 10 percent of this unit is included areas of Warden, Royal, Taunton, and Gravden soils.

Permeability is moderately rapid as far down as the substratum and moderately slow in the substratum. Effective rooting depth is restricted by semiconsolidated, water laid silt at a depth of 20 to 40 inches. Available water capacity is 9 to 10.5 inches. Water supplying capacity is 5 to 7 inches. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate.

This soil is used entirely for range and wildlife habitat. If leveled, it would be suitable for irrigated crops, and

management would be the same as for Sagehill fine sandy loam, 5 to 12 percent slopes.

The native plant community is dominated by bluebunch wheatgrass. Sandberg bluegrass and needleandthread are prominent. Perennial forbs, such as Carey balsamroot, wooly indianwheat, and western yarrow, occur in small amounts. Big sagebrush and rubber rabbitbrush are common.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass, low value forbs, and big sagebrush increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass and rabbitbrush commonly dominate the stand.

If the range is in poor condition, seedbed preparation and seeding are practical. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems. Direct drill seeding after a fire is a good way of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested or Siberian wheatgrass.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The slope and rapid percolation are limitations for community and most recreation uses. Modifications in design are needed for small buildings, dwellings, sanitary facilities, and recreation facilities.

The capability subclass is VIe dryland, IIIe irrigated.

56F—Snell very stony loam, 35 to 70 percent north slopes. This is a moderately deep, well drained soil formed in loess mixed with basalt colluvium. It is on north-facing slopes on uplands at elevations of 2,500 to 4,000 feet. The average slope is 50 percent. The average annual precipitation is 15 to 20 inches, and the average annual air temperature is 43 to 45 degrees F. The frost free period is 60 to 95 days at 32 degrees and 90 to 110 days at 28 degrees.

In a representative profile the surface layer is black and very dark brown very stony loam and silty clay loam about 14 inches thick. The subsoil is very dark brown and dark yellowish brown very cobbly silty clay loam and extremely cobbly silty clay loam about 16 inches thick. Fractured basalt is at a depth of about 30 inches.

About 2 percent of this unit is included areas of Rock outcrop and 10 percent is Waha soils.

Permeability is moderately slow. Available water capacity is 1.5 to 4 inches. Water supplying capacity is 7 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for livestock grazing and wildlife habitat.

The native plant community is dominated by Idaho fescue. Bluebunch wheatgrass and Cusick bluegrass are prominent. Sandberg bluegrass and a wide variety of perennial forbs occur throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, the proportion of Idaho fescue and Cusick bluegrass decreases and the proportion of bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, annual grasses and low value forbs are prominent.

Because of the steep slopes and the surface stones, seedbed preparation and range seeding are not practical.

Mule deer use this plant community in the summer and fall because of the cooler temperatures and proximity to cover.

The depth to rock, stoniness, and very steep slopes are severe limitations for community and recreation uses. Extensive design modifications are needed but are rarely practical for dwellings, small buildings, sanitary facilities, and recreation facilities.

The capability subclass is VIIs.

57—Snow silt loam. This is a very deep, well drained soil that formed in alluvium derived from loess and volcanic ash. It is on alluvial bottom land at elevations of 2,200 to 3,200 feet. The average slope is 1 percent. The average annual precipitation is about 14 to 20 inches, and the average annual air temperature is about 46 to 48 degrees F. The frost free period is 115 to 125 days at 32 degrees and 125 to 160 days at 28 degrees.

In a representative profile the surface layer is black and very dark brown silt loam about 33 inches thick. The subsoil is very dark grayish brown silt loam about 13 inches thick. The substratum is very dark grayish brown loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Onyx, Pedigo, and Endersby soils.

Permeability is moderate. Available water capacity is 11 to 12 inches. Water supplying capacity is 9 to 15 inches. Effective rooting depth is more than 60 inches. Runoff is slow, and the hazard of erosion is slight. This soil is subject to rare flooding.

Nearly all the acreage is used for dryland or irrigated crops. Hay and pasture are the main crops. Some winter wheat is also grown. Some irregularly shaped areas are used as range.

The major needs in crop management are conserving soil moisture for plant growth and stabilizing streambanks against cutting by water. The proper timing and rates of applying irrigation water are important. Where water is available, irrigation is by sprinklers, most commonly wheelline or handline systems.

A suitable cropping system under irrigation is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Split applications of fertilizer are desirable because plant nutrients are leached out of the root zone by the irrigation water.

In dryfarmed areas where wheat is grown, stubble mulch and minimum tillage along with a crop-fallow system help to minimize erosion and conserve soil moisture.

Streambanks can be stabilized by maintaining streamside vegetation, especially giant wildrye, and riparian shrubs, such as lilac or willow. Such vegetation also serves as important wildlife cover.

For dryland pasture and hay, suitable grasses and legumes grown alone or in various combinations are alfalfa, dwarf yellow sweetclover, Siberian wheatgrass, beardless wheatgrass, crested wheatgrass, intermediate wheatgrass, pubescent wheatgrass, tall wheatgrass, big bluegrass, hard fescue, and smooth bromegrass (*3*).

Areas of this soil support populations of upland game birds, such as ring-necked pheasant and valley quail. Mule deer use areas of this soil and the adjacent south-facing slopes in winter. The soil also provides food and cover for smaller mammals.

Because this soil occurs on stream flood plains, it is subject to rare flooding, which results in limitations for many community developments. The soil has no serious limitations for recreation facilities. Campgrounds, however, are limited by the flooding.

The capability subclass is IIc dryland and class I irrigated.

58A—Taunton fine sandy loam, 0 to 2 percent slopes. This is a moderately deep, well drained soil formed in old alluvium reworked by wind. It is on terraces at elevations of 700 to 1,000 feet. The average slope is 1 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 150 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark grayish brown fine sandy loam about 5 inches thick. The subsoil is dark brown fine sandy loam about 10 inches thick. The substratum is dark brown, calcareous very fine sandy loam about 17 inches thick. A cemented, calcareous hardpan is at a depth of about 32 inches.

About 10 percent of this unit is included areas of Sagehill and Warden soils and 5 percent is Gravden soils

Permeability is moderately rapid. Available water capacity is 2.5 to 6 inches. Water supplying capacity is 4 to 7 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Much of the acreage is used for irrigated crops and more is converted to irrigated cropland every year. A large part of the acreage is used for range and wildlife habitat. Major irrigated crops include potatoes, corn, wheat, alfalfa hay, and pasture.

Major concerns in management are the hazard of soil blowing and the proper application of irrigation water. Where water is available, irrigation is by sprinklers, commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa hay If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the moderately low water capacity and high water consumption, light, frequent applications of irrigation water are needed. Because of the impervious cemented hardpan at a depth of 20 to 40 inches, overirrigation will result in ponding

The hazard of soil blowing is moderate because of the fine sandy loam texture of the surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures that help in controlling soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation systems before the land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally is dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbances, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses are practical. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems. Direct drill seeding after a fire is a good method of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The cemented hardpan is a limitation for sanitary facilities and other community development, such as dwellings and commercial buildings. The soil is suitable

for the construction of roads and streets. Recreation facilities have few limitations.

The capability subclass is IIIe irrigated, VIe dryland.

58B—Taunton fine sandy loam, 2 to 5 percent slopes. This is a moderately deep, well drained soil formed in old alluvium that has been reworked by wind. It is on terraces at elevations of 700 to 1,000 feet. The average slope is 3 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 150 to 180 days at 32 degrees and 180 to 215 days at 28 degrees F.

In a representative profile the surface layer is dark grayish brown fine sandy loam about 5 inches thick. The subsoil is dark brown fine sandy loam about 10 inches thick. The substratum is dark brown, calcareous very fine sandy loam about 17 inches thick. A cemented, calcareous hardpan is at a depth of about 32 inches.

About 10 percent of this unit is included areas of Sagehill and Warden soils and 5 percent is Gravden soils.

Permeability is moderately rapid. Available water capacity is 2.5 to 6 inches. Water supplying capacity is 4 to 7 inches. 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 moderate.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. A large acreage is used for range and wildlife habitat. Major irrigated crops are potatoes, annual wheat, alfalfa hay, and pasture.

Major concerns in management are the hazard of soil blowing and the proper application of irrigation water. Where water is available, irrigation is by sprinklers, commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the moderately low water capacity and high water consumption, light, frequent applications of irrigation water are needed. Because of the impervious cemented hardpan at a depth of 20 to 40 inches, overirrigation should be avoided. It can cause ponding, and in the steeper areas runoff may occur, resulting in erosion.

The hazard of soil blowing is moderate because of the fine sandy loam texture of the surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures that help in controlling soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation system before land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally is dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses are practical. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems. Direct drill seeding after a fire is a good method of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant.

Livestock grazing shoud be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The cemented hardpan is a limitation for sanitary facilities. Other uses for community development, such as dwellings and commercial buildings, are limited because of the pan and the low strength of the soil. This soil is suitable for the construction of roads and streets. There are few limitations for most recreation facilities.

The capability subclass is IIIe irrigated, VIe dryland.

58C—Taunton fine sandy loam, 5 to 12 percent slopes. This is a moderately deep, well drained soil formed in old alluvium reworked by wind. It is on terraces at elevations of 700 to 1,000 feet. The average slope is 8 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 150 to 180 days at 32 degrees F. and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark grayish brown fine sandy loam about 5 inches thick. The subsoil is dark brown fine sandy loam about 10 inches thick. The substratum is dark brown, calcareous very fine sandy loam about 17 inches thick. A cemented calcareous hardpan is at a depth of about 32 inches.

About 10 percent of this unit is included areas of Sagehill and Warden soils and 5 percent is Gravden soils.

Permeability is moderately rapid. Available water capacity is 2.5 to 6 inches. The water supplying capacity is 4 to 7 inches. 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 moderate.

Much of the acreage is used for irrigated crops, and more is converted to irrigated cropland every year. A large part of this soil is used as range and wildlife habitat. Major irrigated crops include potatoes, annual wheat, alfalfa hay, and pasture.

Major concerns in management are the hazard of soil blowing and the proper application of irrigation water. Where water is available, irrigation is by sprinklers, commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa hay If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

Because of the moderately low water capacity and high water consumption, light, frequent applications of irrigation water are needed. Because of the impervious cemented hardpan at a depth of 20 to 40 inches, overirrigation can cause excess water to run off and result in erosion.

The hazard of soil blowing is moderate because of the fine sandy loam texture of the surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures that help in controlling soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; and planting of row crops perpendicular to the wind direction. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation system before the land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally is dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbances, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses are practical. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems. Direct drill seeding after a fire is a good method of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The cemented hardpan is a limitation for sanitary facilities. Commercial buildings may need variations in design because of the slope. Construction of dwellings is limited because of the slope and low strength of the soil. Dwellings with basements may require design modification because of the cemented hardpan. The slope is a limitation for roads, streets, and recreation facilities.

The capability subclass is VIe dryland, IIIe irrigated.

59B—Taunton fine sandy loam, hummocky, 0 to 5 percent slopes. This is a moderately deep, well drained soil formed in old alluvium reworked by wind. It is on terraces at elevations of 700 to 1,000 feet. The average slope is 2 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 150 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is dark grayish brown fine sandy loam about 5 inches thick. The subsoil is dark brown fine sandy loam about 10 inches thick. The substratum is dark brown, calcareous very fine sandy loam about 17 inches thick. A cemented, calcareous hardpan is at a depth of about 32 inches. The surface layer has been eroded from some areas and the material redeposited as small mounds or hummocks.

About 10 percent of this unit is included areas of Sagehill and Warden soils and 5 percent Gravden soils.

Permeability is moderately rapid. Available water capacity is 2.5 to 6 inches. Water supplying capacity is 4 to 7 inches Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

This soil is used as range and wildlife habitat. Many areas are suitable for leveling and conversion to irrigated cropland. Because a cemented hardpan is at a depth of 20 to 40 inches, however, care is needed in leveling not to expose this pan. If leveled, the soil is suitable for irrigated crops. Management is the same as for Taunton fine sandy loam, 0 to 2 percent slopes.

The native plant community is a good stand of needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally is dominant. Sandberg bluegrass is prominent Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg

bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbances, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding to dryland grasses are practical. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems. Direct drill seeding after a fire is a good method of restoring production in a reasonable length of time. Grasses selected for dryland seeding should have strong seedling vigor and be drought resistant.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The cemented hardpan and seepage are limitations for the development of sanitary facilities. Other uses for community development, such as dwellings and commercial buildings, are limited by the pan and the low strength of the soil. This soil is suitable for the construction of roads and streets. It has no serious limitations for paths or trails. Playgrounds may require leveling.

The capability subclass is VIe dryland, IIIe irrigated.

60C—Tolo silt loam, 3 to 15 percent slopes. This is a very deep, well drained soil formed in volcanic ash and wind laid silt mixed with granite and basalt colluvium. It is on uplands of the Blue Mountains at elevations of 3,500 to 4,600 feet. The average slope is about 6 percent. The average annual precipitation is 18 to 25 inches, and the average annual air temperature is 42 to 45 degrees F. The frost free period is 50 to 80 days at 32 degrees and 80 to 110 days at 28 degrees.

In a representative profile the surface layer is very dark brown silt loam about 3 inches thick. The subsoil is yellowish brown and very pale brown silt loam about 22 inches thick. The buried substratum is dark brown loam and cobbly silty clay loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Boardtree soils and 10 percent is Klicker, Hankins, and Hall Ranch soils.

Permeability is moderately slow. Available water capacity is 11 to 18 inches. Water supplying capacity is 15 to 20 inches. Effective rooting depth is more than 60 inches. Runoff is slow, and the hazard of water erosion is slight.

This soil is used for timber, range, recreation, and wildlife habitat.

This soil is suited to the production of ponderosa pine. At a site index of 100 (*8*), it is capable of producing about 4,080 cubic feet of timber from a fully stocked stand at 40 years or 44,600 board feet (Scribner) of merchantable timber from a fully stocked stand at 120 years.

This soil is suited to tractor logging. Excessive soil disturbance should be avoided because removing the overlying ash layer and exposing the less fertile buried horizon adversely affect natural regeneration. If enough of this ash layer is removed, the productivity of the area affected will be lowered permanently. Excessive soil disturbance may also result in severe erosion and deterioration of water quality. The 20- to 40-inch ash layer makes the construction and maintenance of roads difficult. This material makes poor subgrade for roads. It does not compact easily, and it has high potential frost action and a high water holding capacity. The amount of ballast depends on the number and type of vehicles on the road and the months of the year that the road is used. Use early in spring should be limited.

The native vegetation is a mixed fir forest. The canopy cover is 40 to 70 percent. Western larch is subordinate in the stand. Under this canopy cover, the foliar understory does not provide significant forage for domestic livestock. It is about 15 percent common snowberry, 5 percent each bearberry and pachistima, 10 percent elk sedge, and about 5 percent peavine, a prominent forb. The understory of shade tolerant shrubs, forbs, and grasses decreases as the tree cover increases, but it provides considerable forage as long as the canopy remains open.

Following fire or logging, broadcast seeding is advisable before fall rains. A major objective of seeding is to stabilize disturbed soil areas. Suitable for seeding are orchardgrass, timothy, hard fescue, and white clover.

Mule deer use this plant community in summer and autumn for food and cover. At lower elevations, the plant community is in the winter range of Rocky Mountain elk, and it is used for cover during daytime and winter storms. A variety of small mammals and birds, including game birds such as blue and ruffed grouse, also use this community.

Because of the remote location and severe climate, most community developments are likely to be for recreation. Some variation in design may be required for dwellings and small buildings because of the low strength of the soil material. The moderately slow permeability and slope are limitations for septic tank absorption systems.

The capability subclass is VIe.

60E—Tolo silt loam, 15 to 35 percent slopes. This is a very deep, well drained soil formed in volcanic ash, wind laid silt, and granite and basalt colluvium. It is on uplands of the Blue Mountains at elevations of 3,500 to 4,600 feet. The average slope is about 6 percent. The average annual precipitation is 18 to 25 inches, and the average annual air temperature is 42 to 45 degrees F. The frost free period is 30 to 60 days at 32 degrees and 80 to 110 days at 28 degrees.

In a representative profile the surface layer is very dark brown silt loam about 3 inches thick. The subsoil is yellowish brown and very pale brown silt loam about 22 inches thick. The buried substratum is dark brown loam

and cobbly silty clay loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Boardtree soils; 10 percent is Klicker, Hankins, and Hall Ranch soils; and 5 percent is ashy skeletal soils.

Permeability is moderately slow. Available water capacity is 11 to 18 inches. Water supplying capacity is 15 to 20 inches. Effective rooting depth is more than 60 inches. Runoff is medium to rapid, and the hazard of water erosion is moderate to high.

The soil is used for timber, range, recreation, and wildlife habitat.

This soil is suited to the production of ponderosa pine. At a site index of 100 (*8*), it is capable of producing about 4,080 cubic feet of timber from a fully stocked stand at 40 years or 44,600 board feet (Scribner) of merchantable timber from a fully stocked stand at 120 years.

Tractor logging is practical in most areas. In steeper areas, cable logging may be desirable. Excessive soil disturbance should be avoided because removing the overlying ash layer and exposing the less fertile buried horizon adversely affect natural regeneration. If enough of this ash layer is removed, the productivity of the area affected may be lowered permanently. Excessive soil disturbance may also result in severe erosion and deterioration of water quality. The steep slopes and the 20- to 40-inch ash layer make the construction and maintenance of roads difficult. The ash layer provides poor subgrade for roads. It does not compact easily, and it has high potential frost action and a high water holding capacity. The amount of ballast depends on the number and type of vehicles using the road and the months of the year that the road is used. Use early in spring should be limited.

The native vegetation is a mixed fir forest. The tree canopy cover is 40 to 70 percent. Western larch is subordinate in the stand. Under this canopy cover, the foliar understory does not provide significant forage for domestic livestock. It is about 15 percent common snowberry, 5 percent each bearberry and pachistima, 10 percent elk sedge, and about 5 percent peavine, a prominent forb. The understory of shade tolerant shrubs, forbs, and grasses decreases as the tree cover increases, but it provides considerable forage as long as the canopy remains open.

Following fire or logging, broadcast seeding is advisable before fall rains. A major objective of seeding is to stabilize disturbed soil areas. Suitable for seeding are orchardgrass, timothy, hard fescue, and white clover.

Mule deer use this plant community in summer and autumn for food and cover. At lower elevations, the plant community is in the winter range of Rocky Mountain elk, and it is used for cover during daytime and winter storms. A variety of small mammals and birds, including game birds such as blue and ruffed grouse, also use this community.

Because of the remote location of this soil and the severe climate, most anticipated community developments are likely to be for recreation Some variation in design may be required for dwellings and small buildings because of the low strength of the soil material and slope. The slope generally is a limitation for septic tank absorption systems.

The capability subclass is VIe.

60F—Tolo silt loam, 35 to 60 percent slopes. This is a very deep, well drained soil formed in volcanic ash, wind laid silt, and granite and basalt colluvium. It is on uplands of the Blue Mountains at elevations of 3,500 to 4,600 feet. The average slope is about 6 percent. The average annual precipitation is 18 to 25 inches, and the average annual air temperature is 42 to 45 degrees F. The frost free period is 30 to 60 days at 32 degrees and 80 to 110 days at 28 degrees.

In a representative profile the surface layer is very dark brown silt loam about 3 inches thick. The subsoil is yellowish brown and very pale brown silt loam about 22 inches thick. The buried substratum is dark brown loam and cobbly silty clay loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Boardtree soils; 10 percent is Klicker, Hankins, and Hall Ranch soils; and 10 percent is ashy skeletal soils.

Permeability is moderately slow. Available water capacity is 11 to 18 inches. Water supplying capacity is 15 to 20 inches. Effective rooting depth is more than 60 inches. Runoff is rapid, and the hazard of water erosion is high.

The soil is used for timber, range, recreation, and wildlife habitat.

This soil is suited to the production of ponderosa pine. At a site index of 100 (*8*), it is capable of producing about 4,080 cubic feet of timber from a fully stocked stand at 40 years or 44,600 board feet (Scribner) of merchantable timber from a fully stocked stand at 120 years.

Because of the slope, the only practical method of logging is by cable. Excessive soil disturbance should be avoided because removing the overlying ash layer and exposing the less fertile buried horizons adversely affect natural regeneration. If enough of this ashy layer is removed, the productivity of the area affected may be lowered permanently. Excessive soil disturbance may also result in severe erosion and deterioration of water quality. The steep slopes and the 20- to 40-inch ash layer make construction and maintenance of roads difficult. The ash layer provides poor subgrade for roads. It does not compact easily, and it has high potential frost action and a high water holding capacity. The amount of ballast depends on the number and type of vehicles on the road and the months of the year that the road is used. Use early in spring should be limited.

The native vegetation is a mixed fir forest. The canopy cover is 40 to 70 percent. Western larch is subordinate in the stand. Under this canopy cover, the foliar understory does not provide significant forage for domestic livestock. It is about 15 percent common snowberry, 5 percent each bearberry and pachistima, 10 percent elk sedge, and about 5 percent peavine, a prominent forb. The understory of shade tolerant shrubs, forbs, and grasses decreases as the tree cover increases, but it provides considerable forage as long as the canopy is open.

Following fire or logging, broadcast seeding is advisable before fall rains. A major objective of seeding is to stabilize disturbed soil areas. Suitable for seeding are orchardgrass, timothy, hard fescue, and white clover.

Mule deer use this plant community in summer and autumn for food and cover. At lower elevations, the plant community is in the winter range for Rocky Mountain elk, and it is used for cover in daytime and winter storms. A variety of small mammals and birds, including game birds such as blue and ruffed grouse, also use this community.

In most places, community and recreation uses are not practical because of the steep slope.

The capability subclass is VIIe.

61E—Ukiah stony silty clay loam, 5 to 30 percent slopes. This is a moderately deep, well drained soil formed in colluvium from volcanic tuff. It is on south-facing slopes on uplands at elevations of 3,500 to 4,500 feet. The average slope is 20 percent. The average annual precipitation is 17 to 20 inches, and the average annual air temperature is 47 to 49 degrees. The frost free period is 80 to 110 days at 32 degrees F.

In a representative profile the surface layer is black and very dark brown stony silty clay loam about 7 inches thick. The subsoil is dark brown and brown cobbly clay about 19 inches thick. Soft, partly weathered volcanic tuff is at a depth of about 26 inches.

About 5 percent of this unit is included areas of Waterbury and Hankins soils.

Permeability is very slow. Available water capacity is 2 to 6 inches. Water supplying capacity is 6 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for livestock grazing and wildlife habitat.

The potential native vegetation is a plant community dominated by bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent. A variety of perennial forbs, such as arrowleaf balsamroot, milkvetch, and yarrow, occurs throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, plant vigor is greatly reduced and the proportion of bluebunch wheatgrass and other desirable grasses decreases. If deterioration is severe, cheatgrass and other low value plants predominate and the hazard of erosion is high.

If the range is in poor condition, seedbed preparation and seeding of the more gently sloping areas are practical. Suitable for dryland seeding are beardless wheatgrass, big bluegrass, crested wheatgrass, and alfalfa.

The plant community provides food for Rocky Mountain elk and mule deer in winter and early in spring when other areas are snow covered.

The depth to rock, slope, high clay content, and high shrink-swell potential are limitations for community developments. Extensive design modifications are needed but are rarely practical for dwellings, small buildings, and sanitary facilities. The stones and slope are limitations for recreation facilities.

The capability subclass is VIIs.

62D—Utley loam, 8 to 20 percent slopes. This is a very deep, well drained soil formed in material derived from basalt and soft volcanic rock. It is on foot slopes at elevations of 3,500 to 4,200 feet. The average slope is about 12 percent. The average annual precipitation is 20 to 23 inches, and the mean annual air temperature is 42 to 45 degrees F. The frost free period is 40 to 70 days at 32 degrees.

In a representative profile the upper 6 inches of the surface layer is very dark brown loam, and the lower 10 inches is very dark grayish brown loam. The subsoil is dark grayish brown shaly loam about 22 inches thick. The substratum is dark grayish brown very shaly loam that extends to a depth of 60 inches or more.

About 15 percent of this unit is included areas of Waha soils and 5 percent is Waterbury soils.

Permeability is moderate. Available water capacity is 6 to 10 inches. Water supplying capacity is 11 to 14 inches. Effective rooting depth is more than 40 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for livestock grazing and wildlife habitat.

The native plant community is Idaho fescue, Sandberg bluegrass, and bluebunch wheatgrass. A variety of perennial forbs occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, the proportion of Idaho fescue decreases and the proportion of bluebunch wheatgrass and Sandberg bluegrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, annuals and other less desirable grasses and forbs are prominent.

If the range is in poor condition, seedbed preparation and seeding are practical. Suitable for dryland seeding are intermediate wheatgrass, beardless wheatgrass, hard fescue, and alfalfa.

Areas of this soil provide good habitat for mule deer, small mammals, and game birds.

The slope is a limitation for community and recreation uses. Modifications in design are needed.

The capability subclass is VIe.

63B—Valby silt loam, 1 to 7 percent slopes. This is a moderately deep soil formed in loess mixed with some ash over basalt. It is on uplands of the Columbia Plateau at elevations of 1,600 to 3,600 feet. The average annual precipitation is 11 to 14 inches, and the average annual air temperature is 47 to 51 degrees F. The frost free season is 110 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is very dark grayish brown and dark brown heavy silt loam about 17 inches thick. The substratum is dark brown, calcareous silt loam about 5 inches thick. Fractured basalt is at a depth of about 30 inches.

About 10 percent of this unit is included areas of Rhea soils and 5 percent is Bakeoven and Lickskillet soils.

Permeability is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of erosion is slight.

Nearly all the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland hay and pasture are grown. The rest of the acreage is used for range and wildlife habitat.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system help to maintain soil moisture. Cross-slope tillage in the more level areas and contour tillage and diversions in the steeper areas are desirable, especially where slopes are long.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass. For dryland hay and pasture, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass (*3*).

The native plant community is dominated by bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass and Idaho fescue decrease and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, cheatgrass, low value forbs, and shrubs predominate.

If range is in poor condition, seedbed preparation and seeding are practical. Suitable for dryland seeding are big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa.

Mule deer use this plant community in spring and again in fall when plants are green and succulent. The plant community also provides food for small mammals and game birds.

The depth to bedrock is a limitation for community uses. Design modifications are needed for dwellings, small buildings, and sanitary facilities. This soil has no serious limitations for recreation facilities. Playgrounds in the most sloping areas may need to be leveled.

The capability subclass is IIIs dryland.

63C—Valby silt loam, 7 to 12 percent slopes. This is a moderately deep soil formed in loess mixed with some ash over basalt bedrock. It is on uplands of the Columbia Plateau at elevations of 1,600 to 3,600 feet. The average annual precipitation is 11 to 14 inches, and the average annual air temperature is 47 to 51 degrees F. The frost free season is 110 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is very dark grayish brown and dark brown heavy silt loam about 17 inches thick. The substratum is dark brown, calcareous silt loam about 5 inches thick. Fractured basalt is at a depth of about 30 inches.

About 10 percent of this unit is included areas of Rhea soils and 5 percent is Bakeoven and Lickskillet soils.

Permeability is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

Most of the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland hay and pasture are grown. The rest of the acreage is used for range and wildlife habitat.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Cross-slope tillage, contour tillage, and diversions are generally needed to prevent severe erosion from rapid runoff during high intensity rainfall or snowmelt.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass. For dryland hay and pasture, suitable grasses and legumes grown alone or in combination are

alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass (*3*).

The native plant community is dominated by bluebunch wheatgrass and Idaho fescue. Sandberg bluegrass is prominent. A variety of perennial forbs occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass and Idaho fescue decrease and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, cheatgrass, low value forbs, and shrubs predominate.

If the range is in poor condition, seedbed preparation and seeding are practical. Suitable for dryland seeding are big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa.

Mule deer use this plant community in spring and again in fall when plants are green and succulent. The plant community also provides food for small mammals and game birds.

The slope and depth to bedrock are limitations for community and most recreation uses. Design modifications are needed for dwellings, small buildings, sanitary facilities, and recreation facilities.

The capability subclass is IIIe dryland.

64D—Valby silt loam, 12 to 20 percent north slopes. This is a moderately deep soil formed in loess mixed with some ash over basalt bedrock. It is on uplands of the Columbia Plateau at elevations of 1,600 to 3,600 feet. The average annual precipitation is 11 to 14 inches, and the average annual air temperature is 47 to 51 degrees F. The frost free season is 110 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is very dark grayish brown and dark brown heavy silt loam about 17 inches thick. The substratum is dark brown, calcareous silt loam about 5 inches thick. Fractured basalt is at a depth of about 30 inches.

About 15 percent of this unit is included areas of Rhea soils and 2 percent is Bakeoven and Lickskillet soils.

Permeability is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

About half the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland hay and pasture are grown. The rest of the acreage is used for range and wildlife habitat.

The major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch and minimum tillage along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Contour tillage and diversions help to prevent erosion from rapid runoff during high intensity rainfall and snowmelt.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

For dryland hay, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass (*3*).

The native plant community is dominated by bluebunch wheatgrass and Idaho fescue. On north-facing slopes, Idaho fescue may be dominant. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass and Idaho fescue decrease and the proportion of Sandberg bluegrass and perennial forbs increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated. As a result, annual weeds, lupine, and low value shrubs predominate.

If the range is in poor condition, seedbed preparation and seeding of the more gently sloping areas to grass are practical. Suitable for dryland seeding are big bluegrass, crested wheatgrass, beardless wheatgrass, and alfalfa.

The plant community provides food for mule deer, small mammals, and game birds.

The slope and depth to bedrock are severe limitations for community and recreation uses. Extensive design modifications are needed for dwellings, small buildings, sanitary facilities, and recreation facilities.

The capability subclass is IIIe.

65D—Valby soil loam, 12 to 20 percent south slopes. This is a moderately deep soil formed in loess mixed with some ash over basalt bedrock. It is on uplands of the Columbia Plateau at elevations of 1,600 to 3,600 feet. The average annual precipitation is 11 to 14 inches, and the average annual air temperature is 47 to 51 degrees F. The frost free season is 110 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is very dark grayish brown and dark brown heavy silt loam about 17 inches thick. The substratum is dark brown, calcareous silt loam about 5 inches thick. Fractured basalt is at a depth of about 30 inches.

About 15 percent of this unit is included areas of Bakeoven and Lickskillet soils.

Permeability is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

About half the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Barley is commonly grown. Some dryland hay is also grown. The rest of the acreage is used for range, dryland pasture, and wildlife habitat.

The major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch and minimum tillage along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Contour tillage and diversions help to prevent severe erosion from rapid runoff during high intensity rainfall and snowmelt.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen is applied in spring or fall.

For dryland hay, suitable grasses and legumes grown alone or in combination are alfalfa, big bluegrass, crested wheatgrass, Siberian wheatgrass, and intermediate wheatgrass (*3*).

The native plant community is dominated by bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs occurs throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and Thurber needlegrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated. As a result, much of the surface is left bare and the hazard of erosion is high.

If the range is in poor condition, seedbed preparation and seeding of the more gently sloping areas to grass are practical. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

The slope and depth to bedrock are limitations for community and recreation uses. Extensive design modifications are needed for dwellings, small buildings, sanitary facilities, and recreation facilities.

The capability subclass is IVe dryland.

65E—Valby silt loam, 20 to 30 percent south slopes. This is a moderately deep soil formed in loess mixed with some ash over basalt bedrock. It is on uplands of the Columbia Plateau at elevations of 1,600 to 3,600 feet. The average annual precipitation is 11 to 14 inches, and the average annual air temperature is 47 to 51 degrees F. The frost free period is 110 to 150 days at 32 degrees and 150 to 200 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is very dark grayish brown and dark brown heavy silt loam about 17 inches thick. The substratum is dark brown, calcareous silt loam about 5 inches thick. Fractured basalt is at a depth of about 30 inches.

About 10 percent of this unit is included areas of Bakeoven and Lickskillet soils and 5 percent is Wrentham and Rhea soils.

Permeability is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of erosion is high.

Most of the acreage is used for range and wildlife habitat. The rest is under a grain-fallow cropping system. Wheat and barley are grown.

The native plant community is dominantly bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs occurs throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and Thurber needlegrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated. As a result, much of the surface is left bare and the hazard of erosion is high.

If the range is in poor condition, seedbed preparation and seeding of the more gently sloping areas to grass are practical. Suitable for dryland seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

If this soil is dryfarmed, stubble mulch and minimum tillage along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Contour tillage and diversions help to prevent erosion from rapid runoff during high intensity rainfall and snowmelt.

The slope and depth to bedrock are limitations for community and recreation uses. Extensive and expensive design modifications are needed for dwellings, small buildings, sanitary facilities, and recreation facilities.

The capability subclass is IVe dryland.

66B—Waha silt loam, 1 to 7 percent slopes. This is a moderately deep, well drained soil formed in loess. It is at elevations of 2,800 to 4,300 feet. The average slope is 5 percent. The average annual precipitation is 16 to 20 inches, and the average annual air temperature is 45 to 49 degrees F. The frost free period is 100 to 120 days at 32 degrees and 110 to 150 days at 28 degrees.

In a representative profile the surface layer is black and very dark grayish brown silt loam about 12 inches thick. The subsoil is very dark grayish brown and dark brown silty clay loam about 17 inches thick. It is very gravelly in the lower part. Fractured basalt is at a depth of about 29 inches.

About 5 percent of this unit is included areas of Waterbury and Rockly soils.

Permeability is moderately slow. Available water capacity is 3.5 to 8 inches. Water supplying capacity is

7.5 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is slow, and the hazard of erosion is slight.

Nearly all the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Barley is commonly grown. Some dryland hay is also grown. The rest of the acreage is used for range, dryland pasture, and wildlife habitat.

The major need in crop management is conserving soil moisture.

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system help to maintain soil moisture. Cross-slope tillage in the more level areas and contour tillage and diversions are desirable, particularly where slopes are long.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, about 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, intermediate wheatgrass, and hard fescue. For dryland hay, suitable grasses grown alone or in combination are alfalfa, intermediate wheatgrass, beardless wheatgrass, hard fescue, tall wheatgrass, and smooth bromegrass (*3*).

The native plant community is dominated by Idaho fescue, Sandberg bluegrass, and bluebunch wheatgrass. A variety of perennial forbs occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, the proportion of Idaho fescue decreases and the proportion of bluebunch wheatgrass and Sandberg bluegrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, annuals and other less desirable grasses and forbs are prominent.

If the range is in poor condition, seedbed preparation and seeding are practical. Suitable for dryland seeding are intermediate wheatgrass, beardless wheatgrass, hard fescue, and alfalfa.

Areas of this soil provide good habitat for mule deer, small mammals, and game birds.

Use for community development is limited. Depth to bedrock is a limitation for sanitary facilities and dwellings with basements.

The depth to bedrock and slope are limitations for development of roads, streets, and dwellings without basements. This soil has no serious limitations for recreation use, but playgrounds should be leveled in the more sloping areas.

The capability subclass is IIIe.

67D—Waha silt loam, 7 to 25 percent north slopes. This is a moderately deep, well drained soil formed in loess. It is at elevations of 2,800 to 4,300 feet. The average slope is 15 percent. The average annual precipitation is 16 to 20 inches, and the average annual air temperature is 45 to 49 degrees F. The frost free period is 100 to 120 days at 32 degrees and 110 to 150 days at 28 degrees.

In a representative profile the surface layer is black and very dark grayish brown silt loam about 12 inches thick. The subsoil is very dark grayish brown and dark brown silty clay loam about 17 inches thick. It is very gravelly in the lower part. Fractured basalt is at a depth of about 29 inches.

About 5 percent of this unit is included areas of Waterbury and Rockly soils and 2 percent is Rock outcrop and ash pockets.

Permeability is moderately slow. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 7.5 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

About 60 percent of the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Barley is commonly grown. Some dryland hay and pasture are also grown. The rest of the acreage is used for range and wildlife habitat.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch and minimum tillage along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Contour tillage and diversions in the less sloping areas are needed to prevent severe erosion from rapid runoff during high intensity rainfall and snowmelt.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, as much as 20 pounds per acre is applied in spring, summer, or fall.

For dryland hay, suitable grasses grown alone or in combination are alfalfa, intermediate wheatgrass, beardless wheatgrass, hard fescue, tall wheatgrass, and smooth bromegrass (*3*).

The native plant community is dominated by Idaho fescue, bluebunch wheatgrass, and Cusick bluegrass. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, the proportion of Idaho fescue and Cusick bluegrass decreases and the proportion of bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, annual grasses and low value forbs, such as common teasel and bullthistle, predominate.

If the range is in poor condition, seedbed preparation and seeding of the more gently sloping areas to grass are practical. Suitable for dryland seeding are intermediate wheatgrass, hard fescue, pubescent wheatgrass, and alfalfa.

Mule deer use the plant community in summer and late in fall because of the cooler temperatures and

proximity to cover. Areas of this soil provide good habitat for small mammals and game birds.

The slope and depth to bedrock are severe limitations for all community and recreation uses, including sanitary facilities and roads. Design modifications are needed.

The capability subclass is IVe.

67E—Waha silt loam, 25 to 40 percent north slopes. This is a moderately deep, well drained soil formed in loess. It is at elevations of 2,800 to 4,300 feet. The average slope is 30 percent. The average annual precipitation is 16 to 20 inches, and the average annual air temperature is 45 to 59 degrees F. The frost free period is 100 to 120 days at 32 degrees and 110 to 150 days at 28 degrees.

In a representative profile the surface layer is black and very dark grayish brown silt loam about 12 inches thick. The subsoil is very dark grayish brown and dark brown silty clay loam about 17 inches thick It is very gravelly in the lower part. Fractured basalt is at a depth of about 29 inches.

About 10 percent of this unit is included areas of Wrentham soils, Rock outcrop, and ash pockets.

Permeability is moderately slow. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 7.5 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of erosion is high.

This soil is used for range and wildlife habitat.

The native plant community is dominated by Idaho fescue. Bluebunch wheatgrass and Cusick bluegrass are prominent. Sandberg bluegrass and a variety of perennial forbs occur throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, the proportion of Idaho fescue and Cusick bluegrass decreases and the proportion of bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, annual grasses and low value forbs, such as common teasel and bullthistle, predominate.

If the range is in poor condition, seedbed preparation and seeding of the more gently sloping areas to grass are practical. Suitable for dryland seeding are intermediate wheatgrass, hard fescue, pubescent wheatgrass, and alfalfa.

Mule deer use the plant community in summer and late in fall because of the cooler temperatures and proximity to cover. Areas of this soil provide good habitat for small mammals and game birds.

The slope and depth to bedrock are severe limitations for all community and recreation uses including sanitary facilities and roads. Design modifications are needed.

The capability subclass is VIe.

68D—Waha silt loam, 7 to 25 percent south slopes. This is a moderately deep, well drained soil formed in loess. It is at elevations of 2,800 to 4,300 feet. The average slope is 15 percent. The average annual precipitation is 16 to 20 inches, and the average annual air temperature is 45 to 49 degrees F. The frost free period is 100 to 120 days at 32 degrees and 110 to 150 days at 28 degrees.

In a representative profile the surface layer is black and very dark grayish brown silt loam about 12 inches thick. The subsoil is very dark grayish brown and dark brown silty clay loam about 17 inches thick. It is very gravelly in the lower part. Fractured basalt is at a depth of about 29 inches.

About 5 percent of this unit is included areas of Waterbury and Rockly soils.

Permeability is moderately slow. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 7.5 to 12 inches. Effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of erosion is moderate.

Most of the acreage is used for range and wildlife habitat. Some areas are dryfarmed under a grain-fallow system. The major crop is winter wheat. Barley is commonly grown. The rest of the acreage is used for dryland hay and pasture.

The native vegetation is a plant community dominated by bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent. A variety of perennial forbs, such as an arrowleaf balsamroot, milkvetch, and yarrow, occurs throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, plant vigor is greatly reduced and the proportion of bluebunch wheatgrass and other desirable grasses decreases. If deterioration is severe, cheatgrass and other low value plants predominate and the hazard of erosion is high.

Seedbed preparation and seeding of the more gently sloping areas are practical if the range is in poor condition. Suitable for dryland seeding are beardless wheatgrass, big bluegrass, crested wheatgrass, and alfalfa.

The plant community is used by Rocky Mountain elk and mule deer in winter and early in spring when other areas are snow covered.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch and minimum tillage along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Contour tillage is needed to prevent severe erosion from rapid runoff during high intensity rainfall and snowmelt.

In most areas this soil is only 20 inches deep. For this reason, yields are lower than on the other Waha soils.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation and shallow depth. Generally, as much as 20 pounds per acre is applied in spring or fall.

For dryland hay, suitable grasses grown alone or in combination are alfalfa, intermediate wheatgrass, beardless wheatgrass, hard fescue, tall fescue, and smooth bromegrass (*3*).

Areas of this soil provide good habitat for mule deer, small mammals, and game birds.

The slope and depth to bedrock are limitations for all community and recreation uses, including sanitary facilities and roads. Design modifications are needed.

The capability subclass is IVe.

69D—Waha-Rockly complex, 2 to 20 percent slopes. This map unit is on ridgetops at elevations of 3,000 to 4,300 feet. It is 35 percent the shallow Rockly soil formed in wind laid silt, volcanic ash, and basalt colluvium; 50 percent the moderately deep Waha soil formed in loess; 10 percent Waterbury soils; and 5 percent Hankins soils. The Waha and Rockly soils are well drained. Both formed over fractured basalt. This unit occurs as patterned land, locally known as biscuit scabland. The Rockly soil occurs as scabland between and around areas of the Waha soil. If the slope is less than 10 percent, the Waha soil occurs as circular mounds, or biscuits, that have a convex surface and are deepest at the center. If the slope is more than 10 percent, the Waha soil occurs as long mounds, the long axis parallel with the slope. The circular mounds are 20 to 50 feet wide and 20 to 40 feet apart. The long mounds are 100 to 300 feet long and 30 to 60 feet wide.

The average slope is 10 percent. The average annual precipitation is 16 to 20 inches, and the average annual air temperature is 45 to 49 degrees F. The average frost free period is 100 to 120 days at 32 degrees and 110 to 150 at 28 degrees.

In a representative profile of Waha silt loam the surface layer is black and very dark grayish brown and is about 12 inches thick. The subsoil is very dark grayish brown and dark brown silty clay loam about 17 inches thick. It is very gravelly in the lower part. Fractured basalt is at a depth of about 29 inches.

In a representative profile of Rockly very gravelly loam the surface layer is very dark grayish brown and is about 2 inches thick. It is 50 percent rock fragments. The subsoil is very dark grayish brown and dark brown very gravelly loam about 7 inches thick. It is 55 percent rock fragments up to 3 inches in size and about 5 percent fragments 3 inches or larger. Fractured basalt is at a depth of about 9 inches.

The Waha soil has moderately slow permeability. Effective rooting depth is 20 to 40 inches. Available water capacity is 3.5 to 8 inches. Water supplying capacity is 7.5 to 12 inches. Runoff is slow, and the hazard of erosion is slight.

The Rockly soil has moderately slow permeability. Effective rooting depth is restricted by the underlying bedrock at a depth of 5 to 12 inches. Available water capacity is 0.5 to 1.5 inches. Water supplying capacity is 1 to 4 inches. Runoff is slow to medium, and the hazard of erosion is moderate.

Nearly all of the acreage is used for livestock grazing and wildlife habitat.

The major concern in management is maintaining an adequate plant cover for control of water erosion.

On the Waha soil, the native plant community is dominated by Idaho fescue, Sandberg bluegrass, and bluebunch wheatgrass. A variety of perennial forbs occurs throughout the stand. Shrubs are minor. On the Rockly soil, the plant community is dominated by very shallow rooted plants, such as Sandberg bluegrass. Small amounts of Idaho fescue and bluebunch wheatgrass also occur in places. Low growing perennial forbs, such as pussytoes and phlox, are common.

If range condition deteriorates, the proportion of Idaho fescue decreases on the Waha soil and the proportion of bluebunch wheatgrass and Sandberg bluegrass increases. The stand of small bluegrasses decreases and the proportion of low value forbs increases on the Rockly soil. If deterioration is severe, the forage bunchgrasses on the Waha soil and the entire plant community on the Rockly soil are nearly eliminated. As a result, annuals and other less desirable grasses and forbs are prominent on the deeper Waha soil and a barren rock pavement forms on the interspersed Rockly soil.

Because of interspersed areas of the very shallow and stony Rockly soil, range seeding generally is not practical.

Most of the acreage provides food and limited cover for mule deer, small mammals, game birds, and song birds.

The depth to bedrock, the cobbles, and the stones are severe limitations for community and recreation uses on the Rockly soil. Extensive design modifications are needed but in most places are not practical for dwellings, small buildings, and sanitary facilities.

The depth to bedrock and the slope are limitations for community and recreation uses on the Waha soil. Design modifications are needed for dwellings, small buildings, sanitary facilities, and recreation.

The capability subclass is VIIs.

70B—Warden very fine sandy loam, 2 to 5 percent slopes. This is a very deep, well drained soil formed in loess over calcareous lacustrine silt. It is at elevations of 500 to 1,200 feet. The average slope is 4 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 210 days at 28 degrees.

In a representative profile the surface layer is dark brown very fine sandy loam about 5 inches thick. The subsoil is dark brown very fine sandy loam about 15 inches thick. The substratum is calcareous, dark grayish

brown silt loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Ritzville and Sagehill soils and 5 percent is Royal and Taunton soils.

Permeability is moderate. Available water capacity is 11 to 12 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is more than 60 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

Most of the acreage is used for dryfarmed small grain. Where water is available, irrigated crops are grown. Major irrigated crops include potatoes, annual wheat, and alfalfa hay. The rest of the acreage is used for range and wildlife habitat, particularly where the soil occurs within the Boardman Naval Reservation.

Major concerns in management are the hazard of soil blowing, the proper application of irrigation water, and in dryfarmed cropland the conservation of soil moisture. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system under irrigation is a rotation consisting of wheat, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

In many areas, compact, slowly permeable lacustrine silt is at a moderate depth. In overirrigated areas erosion may result from the runoff of excess irrigation water. Proper irrigation rates should be carefully determined in such areas.

The hazard of soil blowing is moderate because of the very fine sandy loam surface layer and the frequent strong winds. Uncontrolled soil blowing causes soil loss. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures needed in controlling soil blowing include winter cover crops, timely irrigation, cultivation, and planting, stubble mulching; minimum tillage; and planting of row crops perpendicular to the wind direction.

In dryfarmed areas, stubble mulch and minimum tillage along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Contour tillage generally helps in preventing erosion from rapid runoff during high intensity rainfall.

The native plant community is dominated by bluebunch wheatgrass. Sandberg bluegrass is prominent. A few perennial forbs, such as spreading phlox, pussytoes, and western yarrow, are common. Big sagebrush occurs in the stand.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and big sagebrush increases. If deterioration is severe, big sagebrush dominates and much of the surface is left bare under the brush. If fire is the major disturbance, cheatgrass and rubber rabbitbrush dominate the plant community.

If the range is in poor condition, seedbed preparation and seeding are practical. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems. After a fire, direct drill seeding without seedbed preparation is a good way of restoring production in a reasonable length of time. Grasses selected for seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested wheatgrass or beardless wheatgrass.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

This soil generally is well suited to community and recreation uses. Playgrounds may require leveling.

The capability subclass is IVe dryland, IIe irrigated.

70C—Warden very fine sandy loam, 5 to 12 percent slopes. This is a very deep, well drained soil formed in wind laid very fine sand over calcareous lacustrine silt. It is on terraces at elevations of 500 to 1,200 feet. The average slope is 8 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 210 days at 28 degrees.

In a representative profile the surface layer is brown very fine sandy loam about 5 inches thick. The subsoil is brown silt loam about 15 inches thick. The substratum is calcareous brown silt loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Sagehill and Ritzville soils and 5 percent is Royal and Taunton soils.

Permeability is moderate. Available water capacity is 11.5 to 12 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is 40 to 60 inches. Runoff is medium. The hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most of the acreage is used for dryfarmed small grain. Where the water is available, irrigated crops are grown. Major irrigated crops include potatoes, annual wheat, and alfalfa hay. The rest of the acreage is used for range and wildlife habitat, particularly where the soil occurs within the Boardman Naval Reservation.

Major concerns in management are the proper application of irrigation water and the conservation of soil moisture in dryfarmed cropland. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

In irrigated areas, a suitable cropping system is a rotation consisting of wheat, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

In many areas, compact, slowly permeable lacustrine silt is at a moderate depth. If these areas are overirrigated, erosion may result from the runoff of excess irrigation water. In such areas proper irrigation rates should be carefully determined.

The hazard of soil blowing is moderate because of the very fine sandy loam surface layer and the frequent strong winds. Uncontrolled soil blowing causes soil loss. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures that help in controlling soil blowing include winter cover crops; timely irrigation, cultivation, and planting; stubble mulching; minimum tillage; and planting of row crops perpendicular to the wind direction.

In dryfarmed areas, stubble mulch and minimum tillage along with a crop-fallow system minimize erosion and help to maintain soil moisture. Contour tillage generally helps to control erosion from rapid runoff during high intensity rainfall.

The native plant community is dominated by bluebunch wheatgrass. Sandberg bluegrass is prominent. A few perennial forbs, such as spreading phlox, pussytoes, and western yarrow, are common. Big sagebrush occurs in the stand.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and big sagebrush increases. If deterioration is severe, big sagebrush dominates and much of the surface is left bare under the brush. If fire is the major disturbance, cheatgrass and rubber rabbitbrush dominate the plant community.

If the range is in poor condition, seedbed preparation and seeding are practical. Because soil blowing is moderate, seeding to grass presents special problems. After a fire, direct drill seeding without seedbed preparation is a good way of restoring production in a reasonable length of time. Grasses selected for seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested wheatgrass or beardless wheatgrass.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The slope and dust are limitations to community and recreation uses.

The capability subclass is IVe dryland, IIIe irrigated.

70D—Warden very fine sandy loam, 12 to 20 percent slopes. This is a very deep, well drained soil formed in wind laid very fine sand over calcareous lacustrine silt. It is on terraces at elevations of 500 or 1,200 feet. The average slope is 15 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost-free period is 140 to 180 days at 32 degrees and 180 to 210 days at 28 degrees.

In a representative profile the surface layer is brown very fine sandy loam about 5 inches thick. The subsoil is dark brown very fine sandy loam about 15 inches thick. The substratum is calcareous dark grayish brown silt loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Sagehill and Ritzville soils and 5 percent is Royal and Taunton soils.

Permeability is moderate. Available water capacity is 11.5 to 12 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is 40 to 60 inches. Runoff is medium. The hazard of water erosion is moderate. The hazard of soil blowing is moderate.

Most areas are used for range and wildlife habitat. The rest are used for irrigated crops and dryfarmed small grain.

The native plant community is dominantly bluebunch wheatgrass. Sandberg bluegrass is prominent. A few perennial forbs, such as spreading phlox, pussytoes, and western yarrow, are common. Big sagebrush occurs in the stand.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and big sagebrush increases. If deterioration is severe, big sagebrush dominates and much of the surface is left bare under the brush. If fire is the major disturbance, cheatgrass and rubber rabbitbrush dominate the plant community.

If the range is in poor condition, seedbed preparation and seeding are practical. Because the hazard of soil blowing is moderate, seeding to grass presents special management problems. After a fire, direct drill seeding without seedbed preparation is a good way of restoring production in a reasonable length of time. Grasses selected for seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested wheatgrass or beardless wheatgrass.

Livestock grazing should be limited mainly to winter.

Major concerns in management are the proper application of irrigation water, the hazard of soil blowing, and the conservation of soil moisture in dryfarmed cropland. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system under irrigation is a rotation consisting of wheat, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

In many areas, compact, slowly permeable lacustrine silt is at a moderate depth. If these areas are overirrigated, erosion may result from the runoff of excess irrigation water. Proper irrigation rates should be carefully determined.

Stubble mulch and minimum tillage along with a crop-fallow system minimize erosion loss and help to maintain

soil moisture. Contour tillage generally helps to prevent erosion from rapid runoff during high intensity rainfall.

The hazard of soil blowing is moderate because of the very fine sandy loam surface layer and frequent strong winds. Uncontrolled soil blowing causes soil loss. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures that help in controlling soil blowing include winter cover crops; timely irrigation, cultivation, and planting, stubble mulching; minimum tillage; and planting of row crops perpendicular to the wind direction.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The slope and dust are limitations for community and recreation uses.

The capability subclass is IVe dryland, IVe irrigated.

71A—Warden silt loam, 0 to 2 percent slopes. This is a very deep, well drained soil formed in loess over calcareous lacustrine silt. It is at elevations of 500 to 1,200 feet. The average slope is 1 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 210 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 5 inches thick. The subsoil is brown silt loam about 20 inches thick. The substratum is calcareous, brown silt loam that extends to a depth of 60 inches or more

About 10 percent of this unit is included areas of Ritzville and Sagehill soils and 5 percent is Royal and Taunton soils.

Permeability is moderate. Available water capacity is 11 to 12 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is more than 60 inches. Runoff is slow, and the hazard of water erosion is slight

Most of the acreage is used for dryfarmed small grain. Where water is available, irrigated crops are grown. Major irrigated crops include potatoes, annual wheat, and alfalfa hay. The rest of the acreage is used for range and wildlife habitat.

Major concerns in management are the proper application of irrigation water and the conservation of soil moisture. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

In irrigated areas, a suitable cropping system is a rotation consisting of wheat, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

In many areas, compact, slowly permeable lacustrine silt is at a moderate depth. If these areas are overirrigated, ponding results. Proper irrigation rates should be carefully determined in such areas.

In dryfarmed areas, stubble mulch and minimum tillage along with a crop-fallow system help to maintain soil moisture.

The native plant community is dominantly bluebunch wheatgrass. Sandberg bluegrass is prominent. A few perennial forbs, such as spreading phlox, pussytoes, and western yarrow, are common. Big sagebrush occurs in the stand.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and big sagebrush increases. If deterioration is severe, big sagebrush dominates and much of the surface is left bare under the brush. If fire is the major disturbance, cheatgrass and rubber rabbitbrush dominate the plant community.

If the range is in poor condition, seedbed preparation and seeding are practical. After a fire, direct drill seeding without seedbed preparation is a good way of restoring production in a reasonable period. Grasses selected for seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested wheatgrass or beardless wheatgrass.

Livestock grazing should be limited to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

This soil is generally well suited to community and recreation uses.

The capability subclass is IVc dryland and class I irrigated.

71B—Warden silt loam, 2 to 5 percent slopes. This is a very deep, well drained soil formed in loess over calcareous lacustrine silt It is on terraces at elevations of 500 to 1,200 feet. The average slope is 3 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 210 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 5 inches thick. The subsoil is brown silt loam about 20 inches thick. The substratum is calcareous, brown silt loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Ritzville and Sagehill soils and 5 percent is Royal and Taunton soils.

Permeability is moderate. Available water capacity is 11 to 12 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is 40 inches to more than 60 inches. Runoff is slow, and the hazard of water erosion is slight.

Most of the acreage is used for dryfarmed small grain. Where water is available, irrigated crops are grown. Major irrigated crops include potatoes, annual wheat, and alfalfa hay. The rest of the acreage is used for range and wildlife habitat.

Major concerns in management are the proper application of irrigation water and the conservation of soil moisture. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system under irrigation is a rotation consisting of wheat, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

In many areas, compact, slowly permeable lacustrine silt is at a moderate depth. In overirrigated areas soil erosion may result from the runoff of excess irrigation water. Proper irrigation rates should be carefully determined in such areas.

In dryfarmed areas, stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system help to maintain soil moisture. Contour tillage generally helps to prevent erosion from rapid runoff during high intensity rainfall.

Suitable grasses for seeding waterways include pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass.

The native plant community is dominantly bluebunch wheatgrass. Sandberg bluegrass is prominent. A few perennial forbs, such as spreading phlox, pussytoes, and western yarrow, are common. Big sagebrush occurs in the stand.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and big sagebrush increases. If deterioration is severe, big sagebrush dominates and much of the surface is left bare under the brush. If fire is the major disturbance, cheatgrass and rubber rabbitbrush dominate the plant community.

If the range is in poor condition, seedbed preparation and seeding are practical. After a fire, direct drill seeding without seedbed preparation is a good way of restoring production in a reasonable period. Grasses selected for seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested wheatgrass or beardless wheatgrass.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

This soil is generally well suited to community and recreation uses. Playgrounds may require leveling.

The capability subclass is IVe dryland, IIe irrigated.

71C—Warden silt loam, 5 to 12 percent slopes. This is a very deep, well drained soil formed in loess over calcareous lacustrine silt. It is on terraces at elevations of 500 to 1,200 feet. The average slope is 8 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 210 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 5 inches thick. The subsoil is brown silt loam about 20 inches thick. The substratum is calcareous, brown silt loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Ritzville and Sagehill soils and 5 percent is Royal and Taunton soils.

Permeability is moderate. Available water capacity is 11 to 12 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is 40 inches to more than 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

Most of the acreage is used for dryfarmed small grain. Where water is available, irrigated crops are grown. Major irrigated crops include potatoes, annual wheat, and alfalfa hay. The rest of the acreage is used for range and wildlife habitat.

Major concerns in management are the proper application of irrigation water, the hazard of water erosion, and the conservation of soil moisture. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

In irrigated areas, a suitable cropping system is a rotation consisting of wheat, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

In many areas, compact, slowly permeable lacustrine silt is at a moderate depth. In overirrigated areas soil erosion may result from the runoff of excess irrigation water. Proper irrigation rates should be carefully determined in such areas.

In dryfarmed areas, stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system minimize erosion and help to maintain soil moisture. Contour tillage and stripcropping generally help to control erosion from rapid runoff during high intensity rainfall.

Suitable grasses for waterways include pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass.

The native plant community is dominantly bluebunch wheatgrass. Sandberg bluegrass is prominent. A few perennial forbs, such as spreading phlox, pussytoes, and western yarrow, are common. Big sagebrush occurs in the stand.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and big sagebrush increases. If deterioration is severe, big sagebrush dominates and much of the surface is left bare under the brush. If fire is the major disturbance, cheatgrass and rubber rabbitbrush dominate the plant community.

If the range is in poor condition, seedbed preparation and seeding are practical. After a fire, direct drill seeding without seedbed preparation is a good way of restoring

production in a reasonable period. Grasses selected for seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested wheatgrass or beardless wheatgrass.

Livestock grazing should be limited mainly to winter.

Areas of this soil support small populations of mule deer. Birds and small mammals are common.

The slope is a limitation for community and recreation uses.

The capability subclass is IVe dryland, IIIe irrigated.

71D—Warden silt loam, 12 to 20 percent slopes. This is a very deep, well drained soil formed in loess over calcareous lacustrine silt It is on terraces at elevations of 500 to 1,200 feet. The average slope is 15 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 210 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 5 inches thick. The subsoil is brown silt loam about 20 inches thick. The substratum is calcareous, brown silt loam that extends to depth of 60 inches or more.

About 10 percent of this unit is included areas of Ritzville and Sagehill soils and 5 percent is Royal and Gravden soils.

Permeability is moderate. Available water capacity is 11 to 12 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is 40 inches to more than 60 inches Runoff is medium, and the hazard of water erosion is moderate.

Most of the acreage occurs within the Boardman Naval Reservation. It is used as range and wildlife habitat. Areas outside the reservation are used for irrigated crops and dryfarmed small grain.

The native plant community is dominantly bluebunch wheatgrass. Sandberg bluegrass is prominent. A few perennial forbs, such as spreading phlox, pussytoes, and western yarrow, are common. Big sagebrush occurs in the stand.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and big sagebrush increases. If deterioration is severe, big sagebrush dominates and much of the surface is left bare under the brush. If fire is the major disturbance, cheatgrass and rubber rabbitbrush dominate the plant community.

If the range is in poor condition, seedbed preparation and seeding are practical. After a fire, direct drill seeding without seedbed preparation is a good way of restoring production in a reasonable length of time. Grasses selected for seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested wheatgrass or beardless wheatgrass.

Livestock grazing should be limited mainly to winter.

Major concerns in management are the proper application of irrigation water, the hazard of water erosion, and the conservation of soil moisture Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

In irrigated areas, a suitable cropping system is a rotation consisting of wheat, potatoes, and alfalfa hay. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed and disease control problems are common.

In many areas, compact, slowly permeable lacustrine silt is at a moderate depth. In overirrigated areas soil erosion may result from the runoff of excess irrigation water. Proper irrigation rates should be carefully determined in such areas.

In dryfarmed areas, stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Contour tillage and stripcropping generally help to prevent erosion from rapid runoff during high intensity rainfall. Suitable grasses for waterways include pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass.

The slope is a limitation for community and recreational uses.

The capability subclass is IVe dryland, IVe irrigated.

71E—Warden silt loam, 20 to 40 percent slopes. This is a very deep, well drained soil formed in loess over calcareous lacustrine silt. It is on terraces at elevations of 500 to 1,200 feet. The average slope is 30 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 210 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 5 inches thick. The subsoil is brown silt loam about 20 inches thick. The substratum is calcarecus, brown silt loam that extends to a depth of 60 inches or more.

About 10 percent of this unit is included areas of Ritzville and Sagehill soils and 5 percent is Royal and Gravden soils.

Permeability is moderate. Available water capacity is 11 to 12 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is 40 inches to more than 60 inches. Runoff is rapid, and the hazard of water erosion is high.

This soil is used for range and wildlife habitat.

The native plant community is dominantly bluebunch wheatgrass. Sandberg bluegrass is prominent. A few perennial forbs, such as spreading phlox, pussytoes, and western yarrow, are common. Big sagebrush occurs in the stand.

If the range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and big sagebrush increases. If

deterioration is severe, big sagebrush dominates and much of the surface under the brush is left bare. If fire is the major disturbance, cheatgrass and rubber rabbitbrush dominate the plant community.

If the range is in poor condition, seedbed preparation and seeding are practical. After a fire, direct drill seeding without seedbed preparation is a good way of restoring production in a reasonable period. Grasses selected for seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested wheatgrass or beardless wheatgrass.

Livestock grazing should be limited mainly to winter.

This soil supports small populations of mule deer. Birds and mammals are common.

The slope is a limitation for recreation and community uses, including sanitary facilities, dwellings, and buildings.

The capability subclass is VIe dryland.

72C—Warden silt loam, 3 to 12 percent slopes, eroded. This is a very deep, well drained soil formed in loess over calcareous lacustrine silt. It is at elevations of 500 to 1,200 feet. The average slope is 8 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 210 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 1 inch thick. The subsoil is brown silt loam about 20 inches thick. The substratum is calcareous, brown silt loam to a depth of 60 inches or more. In most areas the surface layer and part of the subsoil are eroded and the soil is calcareous to the surface.

About 10 percent of this unit is included areas of Ritzville and Sagehill soils and 5 percent is Royal and Taunton soils.

Permeability is moderate. Available water capacity is 11 to 12 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is more than 60 inches. Runoff is medium, and the hazard of water erosion is moderate.

This soil occurs within the Boardman Naval Reservation. It is used as range and wildlife habitat.

The native plant community has been greatly altered by erosion. Forage production is much lower than in uneroded areas of Warden soils.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and big sagebrush increases. If deterioration is severe, big sagebrush dominates and much of the surface is left bare under the brush. If fire is the major disturbance, cheatgrass and rubber rabbitbrush dominate the plant community.

If the range is in poor condition, seedbed preparation and seeding are practical. After a fire, direct drill seeding without seedbed preparation is a good way of restoring production in a reasonable period. Grasses selected for seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested wheatgrass or beardless wheatgrass.

Livestock grazing should be limited mainly to winter.

This soil supports small populations of mule deer. Birds and small mammals are common.

The slope and dust are limitations for community and recreation uses.

The capability subclass is IVe dryland.

72D—Warden silt loam, 12 to 20 percent slopes, eroded. This is a very deep, well drained soil formed in loess over calcareous lacustrine silt. It is at elevations of 500 to 1,200 feet. The average slope is 15 percent. The average annual precipitation is 8 to 9 inches, and the average annual air temperature is 49 to 53 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 210 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 1 inch thick. The subsoil is brown silt loam about 20 inches thick. The substratum is calcareous, brown silt loam that extends to a depth of 60 inches or more. In most areas the surface layer and part of the subsoil are eroded and the soil is calcareous to the surface.

About 10 percent of this unit is included areas of Ritzville and Sagehill soils and 5 percent is Royal and Taunton soils.

Permeability is moderate. Available water capacity is 11 to 12 inches. Water supplying capacity is 6.5 to 9 inches. Effective rooting depth is more than 60 inches. Runoff is rapid, and the hazard of water erosion is high.

This soil occurs within the Boardman Naval Reservation. It is used for range and wildlife habitat.

The native plant community has been greatly altered by erosion. Forage production is much lower than in uneroded areas of Warden soils.

If range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and big sagebrush increases. If deterioration is severe, big sagebrush dominates and much of the surface is left bare under the brush. If fire is the major disturbance, cheatgrass and rubber rabbitbrush dominate the plant community.

If the range is in poor condition, seedbed preparation and seeding are practical considerations. After a fire, direct drill seeding without seedbed preparation is a good way of restoring production in a reasonable period. Grasses selected for seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested wheatgrass or beardless wheatgrass.

Livestock grazing should be limited mainly to winter.

This soil supports small populations of mule deer. Birds and small mammals are common.

The slope and dust are limitations for community and recreation uses.

The capability subclass is VIe dryland.

73E—Waterbury extremely stony silt loam, 7 to 40 percent slopes. This is a shallow, well drained soil formed in weathered basalt colluvium. It is on south- and west-facing slopes at elevations of 2,600 to 4,300 feet. The average slope is about 25 percent. The average annual precipitation is 14 to 20 inches, and the mean annual air temperature is 45 to 49 degrees F. The frost free period is 80 to 110 days at 32 degrees and 110 to 140 days at 28 degrees.

In a representative profile the upper 3 inches of the surface layer is black extremely stony silt loam, and the lower 6 inches is black very cobbly silt loam. The subsoil is black and dark brown very cobbly clay about 8 inches thick. Fractured basalt is at a depth of about 17 inches.

About 15 percent of this unit is included areas of Rockly and Waha soils.

Permeability is very slow. Available water capacity is 1 to 2.5 inches. Water supplying capacity is 6 to 9 inches. Effective rooting depth is 12 to 20 inches. Runoff is medium, and the hazard of erosion is moderate.

This soil is used for livestock grazing and wildlife habitat.

The native vegetation is a plant community dominated by bluebunch wheatgrass. Idaho fescue and Sandberg bluegrass are prominent. A variety of perennial forbs, such as arrowleaf balsamroot, milkvetch, and yarrow, occurs throughout the stand in small amounts. There are few or no shrubs.

If range condition deteriorates, plant vigor is greatly reduced and the proportion of bluebunch wheatgrass and other desirable grasses decreases. If deterioration is severe, cheatgrass and other low value plants predominate and the potential for erosion is high.

Because this soil is stony and shallow, range seeding is not practical.

This plant community is used by Rocky Mountain elk and mule deer in winter and early in spring when other areas are snow covered.

The depth to rock, stones, slope, high clay content, and shrinking and swelling are limitations for community uses. Extensive design modifications are needed but are rarely practical for dwellings, small buildings, and sanitary facilities. The stones, slope, and very slow permeability are limitations for recreation facilities.

The capability subclass is VIIs.

74F—Waterbury-Rock outcrop complex, 40 to 70 percent slopes. This map unit is on south-facing slopes on uplands at elevations of 2,600 to 4,300 feet. It is about 55 percent Waterbury soil, 20 percent Rock outcrop, and 25 percent Waha and Gwin soils and a soil that is similar to this Waterbury soil but is more than 20 inches deep over bedrock. The average slope is about 55 percent. The average annual precipitation is 14 to 20 inches, and the average annual air temperature is 45 to 49 degrees F. The frost free period is 80 to 110 days at 32 degrees and 110 to 140 days at 28 degrees.

In a representative profile of Waterbury soil, the upper 3 inches of the surface layer is black extremely stony silt loam and the lower 6 inches is black very cobbly silt loam. The subsoil is black and dark brown very cobbly clay loam and very cobbly clay about 8 inches thick. Fractured basalt is at a depth of about 17 inches.

Rock outcrop is basalt bedrock.

The Waterbury soil has very slow permeability. Available water capacity is 1 to 2.5 inches. Water supplying capacity is 6 to 9 inches. Effective rooting depth is 12 to 20 inches. Runoff is rapid, and the hazard of erosion is high.

This unit is used for livestock grazing and wildlife habitat.

The native vegetation is a plant community dominated by bluebunch wheatgrass. Sandberg bluegrass and Thurber needlegrass are prominent. A variety of perennial forbs and a few shrubs occur in small amounts.

If range condition deteriorates, plant vigor is greatly reduced and the proportion of bluebunch wheatgrass and other desirable grasses decreases. If deterioration is severe, the forage bunchgrasses are nearly eliminated. As a result, low value plants predominate, soils are subject to erosion, and much of the surface is left bare and rocky.

Because the unit is very stony and slopes are steep, range seeding is not practical. At the higher elevations, the plant community is used by Rocky Mountain elk and mule deer in winter and early in spring when other areas are snow covered.

The depth to rock, stones, slope, Rock outcrop, shrinking and swelling, and high clay content are limitations for community developments. Extensive design modifications are needed but are rarely practical for dwellings, small buildings, and sanitary facilities. The stones, slope, and very slow permeability are limitations for recreation facilities.

The capability subclass is VIIs.

75B—Willis silt loam, 2 to 5 percent slopes. This is a moderately deep, well drained soil formed in loess. It is on uplands at elevations of 1,000 to 2,000 feet. The average slope is 4 percent. The average annual precipitation is 9 to 11 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 12 inches thick. The subsoil is brown silt loam about 9 inches thick. The substratum is brown silt loam about 14 inches thick. A calcareous hardpan is at a depth of about 35 inches (fig. 9).

About 5 percent of this unit is included areas of Mikkalo soils and 5 percent is Ritzville soils.

Permeability is moderate. Available water capacity is 4

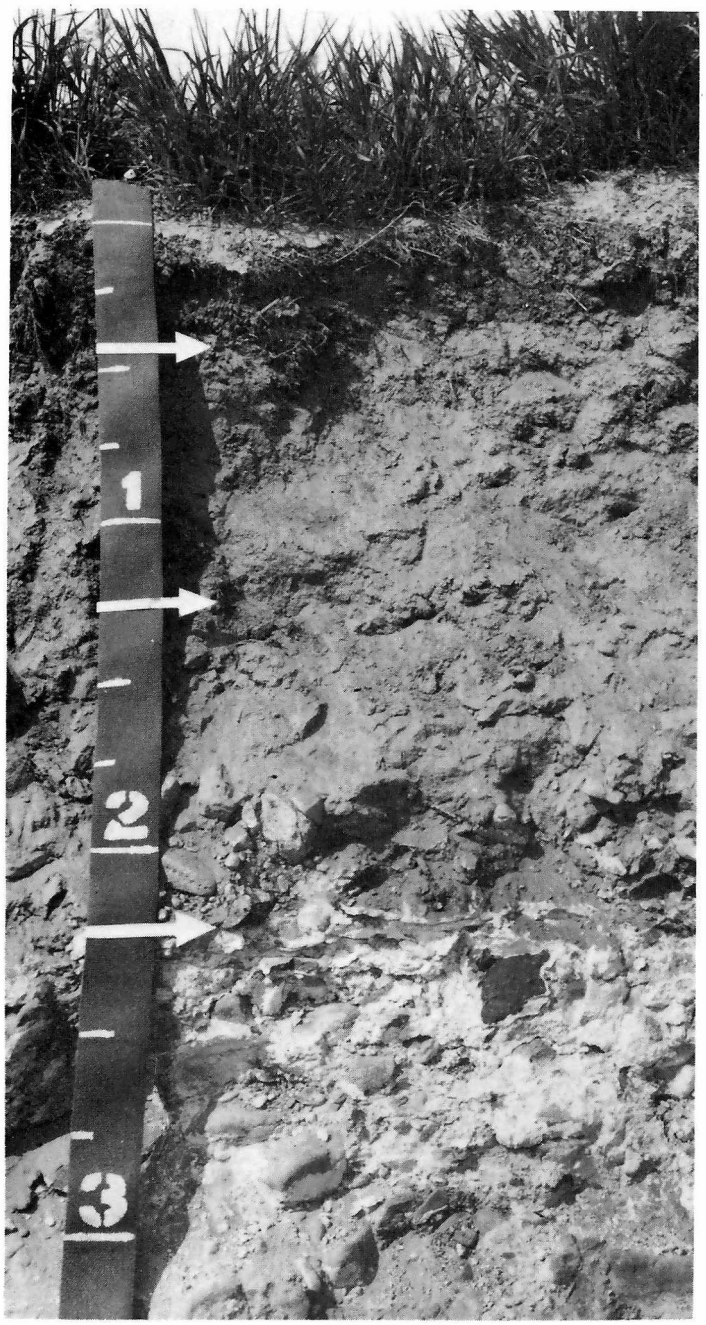


Figure 9.—Profile of Willis silt loam At a depth of 20 to 40 inches is a calcareous indurated hardpan.

to 8.5 inches. Water supplying capacity is 6 to 8 inches. Runoff is slow, and the hazard of erosion is slight. The effective rooting depth is 20 to 40 inches.

Nearly all the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland hay and pasture are grown. The rest of the acreage is used for range and wildlife habitat.

The major need in crop management is conserving soil moisture.

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Cross-slope tillage in the more level areas and diversions in the steeper areas are desirable, particularly where slopes are long.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass. For dryland hay and pasture, suitable grasses grown alone or in combination are alfalfa, crested wheatgrass, Siberian wheatgrass, beardless wheatgrass, and big bluegrass (*3*).

The native plant community is dominantly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is left bare.

If the range is in poor condition, seedbed preparation and seeding are practical. Suitable for range seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

The cemented pan is a limitation for community uses. Design modifications are needed for dwellings, small buildings, and sanitary facilities. The soil has no serious limitations for recreation facilities. Playgrounds, however, are limited by the cemented pan.

The capability subclass is IVe dryland.

75C—Willis silt loam, 5 to 12 percent slopes. This is a moderately deep, well drained soil formed in loess. It is on uplands at elevations of 1,000 to 2,000 feet. The average slope is 9 percent. The average annual precipitation is 9 to 11 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 12 inches thick. The subsoil is brown silt loam about 9 inches thick. The substratum is brown silt loam about 14 inches thick. A calcareous hardpan is at a depth of about 35 inches.

About 5 percent of this unit is included areas of Mikkalo soils and 5 percent is Ritzville soils.

Permeability is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Runoff is medium, and the hazard of erosion is moderate. Effective rooting depth is 20 to 40 inches.

Most of the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland hay and pasture are grown. The rest of the acreage is used for range and wildlife habitat.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch, minimum tillage, and grassed waterways along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Cross-slope tillage, contour tillage, and diversions generally are needed to prevent erosion losses during high intensity rainfall or snowmelt.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

Suitable plants for seeding waterways are pubescent wheatgrass, crested wheatgrass, and streambank wheatgrass. For dryland hay and pasture, suitable grasses grown alone or in combination are alfalfa, crested wheatgrass, Siberian wheatgrass, beardless wheatgrass, and big bluegrass (*3*).

The native plant community is dominated by bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is left bare.

If the range is in poor condition, seedbed preparation and seeding are practical. Suitable for range seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

The slope and the cemented pan are limitations for community uses. Modifications in design are needed for dwellings, small buildings, and sanitary facilities. The slope is a limitation for recreation facilities.

The capability subclass is IVe dryland.

75D—Willis silt loam, 12 to 20 percent slopes. This is a moderately deep, well drained soil formed in loess. It is on uplands at elevations of 1,000 to 2,000 feet. The average slope is 15 percent. The average annual precipitation is 9 to 11 inches, and the average annual air temperature is 48 to 51 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 200 days at 28 degrees.

In a representative profile the surface layer is dark brown silt loam about 12 inches thick. The subsoil is brown silt loam about 9 inches thick. The substratum is brown silt loam about 14 inches thick. A calcareous hardpan is at a depth of about 35 inches.

About 5 percent of this unit is included areas of Mikkalo soils and 5 percent is Ritzville soils.

Permeability is moderate. Available water capacity is 4 to 8.5 inches. Water supplying capacity is 6 to 8 inches. Runoff is medium, and the hazard of erosion is moderate. Effective rooting depth is 20 to 40 inches.

About half the acreage is dryfarmed under a grain-fallow system. Wheat is the major crop. Some barley and dryland hay and pasture are grown. The rest of the acreage is used for range and wildlife habitat.

The two major needs in crop management are protecting the soil from water erosion and conserving soil moisture.

Stubble mulch and minimum tillage along with a crop-fallow system minimize erosion loss and help to maintain soil moisture. Contour tillage and diversion help to prevent severe erosion during high intensity rainfall and snowmelt.

Response of wheat and barley to nitrogen fertilizer is low as a result of the low annual precipitation. Generally, 25 pounds per acre of nitrogen fertilizer is applied in spring or fall.

For dryland hay and pasture, suitable grasses grown alone or in combination are alfalfa, crested wheatgrass, Siberian wheatgrass, beardless wheatgrass, and big bluegrass (*3*).

The native plant community is dominantly bluebunch wheatgrass and Sandberg bluegrass. A variety of perennial forbs, such as clustered phlox and western yarrow, occurs throughout the stand. Shrubs are minor.

If range condition deteriorates, bluebunch wheatgrass decreases and the proportion of Sandberg bluegrass and forbs increases. If deterioration is severe, bluebunch wheatgrass is nearly eliminated. As a result, cheatgrass and other low value plants predominate and much of the surface is left bare.

If the range is in poor condition, seedbed preparation and seeding are practical. Suitable for range seeding are big bluegrass, crested wheatgrass, and beardless wheatgrass.

The plant community provides food for mule deer, small mammals, and game birds.

The slope and the cemented pan are limitations for community and most recreation uses. Extensive design modifications are needed for dwellings, small buildings, sanitary facilities, and recreation facilities.

The capability subclass is IVe dryland.

76C—Winchester sand, 0 to 12 percent slopes. This is a very deep, excessively drained soil that formed in mixed sands on terraces. The elevation is 300 to 700 feet. The average slope is 5 percent. The average annual precipitation is 7 to 8 inches, and the average annual air temperature is 52 to 54 degrees F. The frost free period is 160 to 200 days at 32 degrees F. and 180 to 215 days at 28 degrees.

In a representative profile the surface layer is very dark grayish brown sand about 18 inches thick. The substratum is very dark grayish brown and very dark gray coarse sand that extends to a depth of 60 inches or more.

About 15 percent of this unit is included areas of Quincy and Quinton soils and Dune land. Some soils that are similar to Winchester soils but have bedrock at a depth of 40 to 60 inches are included in a few areas.

Permeability is rapid. Available water capacity is 2.5 to 3.5 inches. Water supplying capacity is 2 to 4 inches. Effective rooting depth is 60 inches or more. Runoff is slow, and the water erosion hazard is slight. The hazard of soil blowing is high.

Extensive areas are used for irrigated crops, and many more are converted to irrigated cropland every year. A large part of the acreage is used for range and wildlife habitat, particularly where the soil occurs within the Boardman Naval Reservation. Major irrigated crops include potatoes, winter wheat, corn, alfalfa hay, and pasture.

Major concerns in management are the low water capacity and the hazard of soil blowing. Where water is available, irrigation is by sprinklers, most commonly center pivot systems.

A suitable cropping system is a rotation consisting of wheat or corn, potatoes, and alfalfa. If wheat is grown more than 2 consecutive years or if potatoes follow potatoes, serious weed control and disease problems are common.

Because of the coarse texture, low water capacity, and high water consumption, light, frequent applications of irrigation water are needed. Plant nutrients are readily leached from the root zone because of the rapid permeability. Split applications of fertilizer are desirable.

The hazard of soil blowing is one of the highest in the survey area because of the predominance of fine sand in the surface layer and frequent, high winds. Uncontrolled soil blowing causes soil loss and deposition of coarse particles that form drifts, hummocks, and dunes in fields. It also causes crop damage by sandblasting plants, uncovering roots, and uprooting the plants and burying them under the windblown material. Roads are covered, and applied chemicals are lost. Measures that help to control soil blowing include winter cover crops; timely irrigation, cultivation, and planting; minimum tillage; crosswind tillage; and planting of row crops perpendicular to the wind direction. Blowout areas require special treatments, such as disked-in straw mulching and seeding to suitable grasses. Windbreaks, doublecropping, and stripcropping are needed in places. Protection from soil blowing is critical when rangeland is converted to irrigated cropland. Completely developing the irrigation system before any land is broken out, limiting new land disturbance to the period March 15 to September 15, and leaving vegetation intact on odd areas are the practices and precautions needed.

The native plant community is dominantly Indian ricegrass and antelope bitterbrush. Yellow wildrye is prominent on stabilized sand dunes and in other areas of sand movement. Perennial forbs, such as buckwheat and lomatium, are common. Big sagebrush and small green rabbitbrush occur in the plant community.

If range condition deteriorates, the proportion of Indian ricegrass and yellow ryegrass decreases and the proportion of low value forbs and annuals, such as tumblemustard and Russian-thistle, increases. If deterioration is severe, soil blowing is accelerated and sand movement becomes destructive and difficult to control.

If the range is in poor condition, total protection of the existing plant cover is practical. Seedbed preparation and seeding to grass present a special problem because of the critical soil blowing. Suitable for sand dune stabilization is 1-year-old mammoth wildrye.

Livestock grazing should be limited mainly to winter.

This soil supports small populations of mule deer. Birds and small mammals are common.

This soil is generally well suited to community uses. Because of seepage, some design modifications may be needed for sewage lagoons and sanitary landfills. Construction of dwellings, commercial buildings, and roads and streets in the steeper areas is limited somewhat because of the slope. Recreation facilities are limited by the coarse sand texture, and design modifications are needed.

The capability subclass is VIIe dryland, IVs irrigated.

77F—Wrentham-Rock outcrop complex, 35 to 70 percent slopes. This map unit is on north-facing slopes on uplands (fig. 10). It is at elevations of 1,100 to 3,200 feet. It is about 55 percent Wrentham soil; 20 percent Rock outcrop; and 25 percent Nansene and Lickskillet soils, a soil similar to this Wrentham soil but more than 40 inches deep or less than 20 inches deep to bedrock, and a soil similar to the Wrentham soil but calcareous below a depth of 15 to 30 inches. The average slope is about 50 percent. The average annual precipitation is 10 to 16 inches, and the average annual air temperature is 45 to 52 degrees F. The frost free period is 60 to 100 days at 32 degrees and 100 to 150 days at 28 degrees.

In a representative profile of Wrentham soil, the surface layer is black silt loam about 4 inches thick. The subsurface layer is black and very dark brown gravelly silt loam and very cobbly silt loam about 16 inches thick. The subsoil is dark brown very cobbly silt loam about 12 inches thick. Basalt is at a depth of about 32 inches.

Rock outcrop is basalt bedrock.

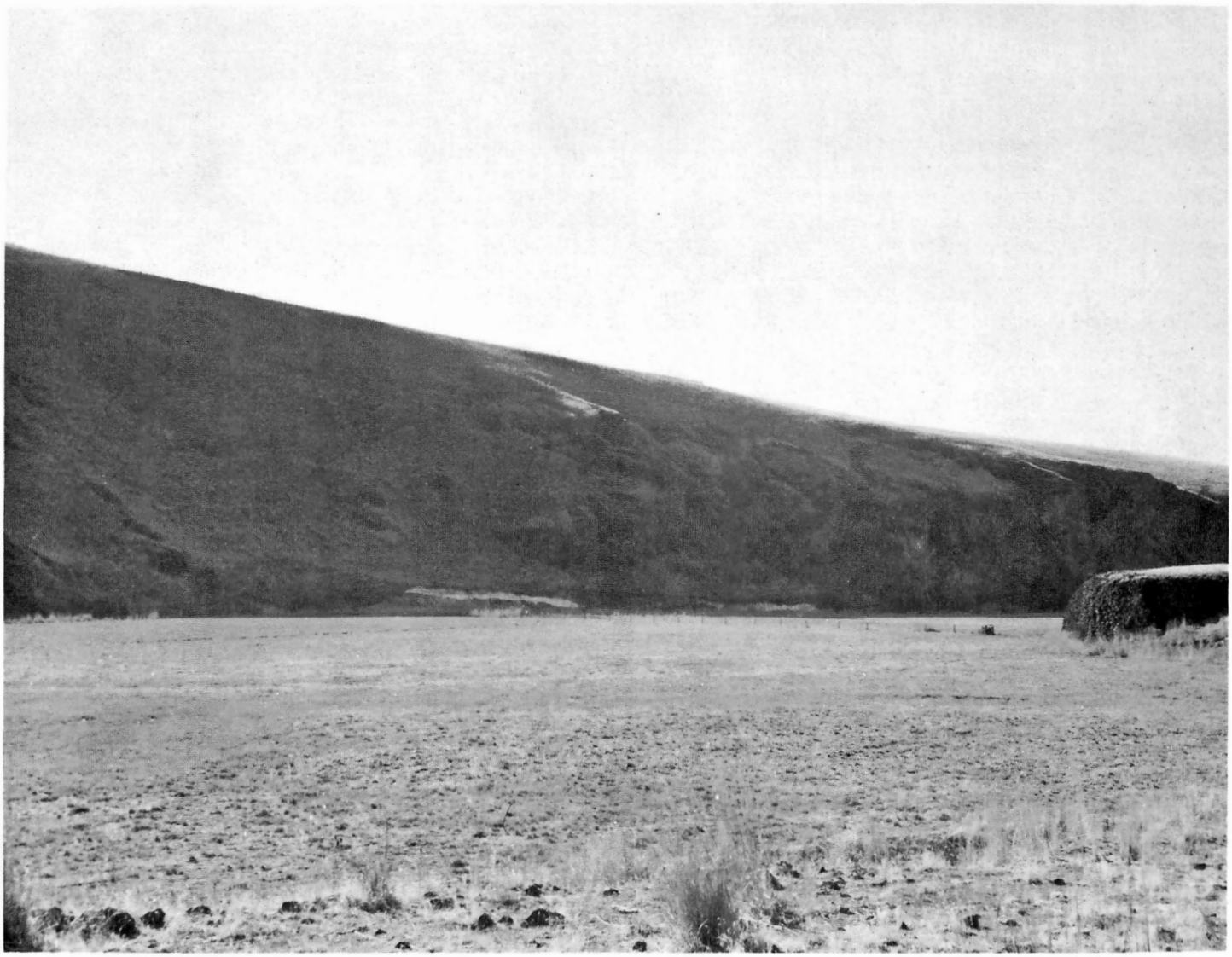


Figure 10—Wrentham-Rock outcrop complex, 35 to 70 percent slopes, in background In the foreground, on the bottom land along Rhea Creek, is an area of Onyx silt loam.

The Wrentham soil has moderately slow permeability. Available water capacity is 2.5 to 7 inches. Water supplying capacity is 6 to 8 inches. Effective rooting depth is 20 to 40 inches. Runoff is rapid, and the hazard of erosion is high.

This unit is used for livestock grazing and wildlife habitat.

The native plant community is dominantly Idaho fescue. Bluebunch wheatgrass and Cusick bluegrass are prominent. Sandberg bluegrass and a wide variety of perennial forbs occur throughout the stand in small amounts. Shrubs are minor.

If range condition deteriorates, the proportion of Idaho fescue and Cusick bluegrass decreases and the proportion of bluebunch wheatgrass increases. If deterioration is severe, the forage bunchgrasses are nearly eliminated or greatly reduced in vigor. As a result, annual grasses and low value forbs are prominent.

Because slopes are steep, range seeding is not practical. Mule deer use this unit in summer and in fall because of the cooler temperatures and proximity to cover.

The shallowness over bedrock, stoniness, Rock outcrop, and very steep slopes are severe limitations for

community and recreation uses. Extensive design modifications are needed but are rarely practical for dwellings, small buildings, and sanitary and recreation facilities.

The capability subclass is VIIs.

78—Xeric Torriorthents, nearly level. This map unit consists of very deep, somewhat excessively drained soils formed in water and wind laid materials. It is in canyon bottoms at elevations of 300 to 800 feet. The average slope is 1 percent. The average annual precipitation is about 8 to 9 inches, and the average annual air temperature is about 49 to 53 degrees F. The frost free period is 140 to 180 days at 32 degrees and 180 to 215 days at 28 degrees.

Xeric Torriorthents have a surface layer of dark brown sandy loam about 6 inches thick. The next layer is dark brown fine sandy loam about 9 inches thick. The substratum is 15 inches of dark grayish brown gravelly sandy loam over dark grayish brown very gravelly loamy sand that extends to a depth of 60 inches or more.

About 5 percent of this unit is included areas of Burbank, Koehler, and Ritzville soils; and 10 percent is Quincy, Royal, and Kimberly soils.

Permeability is rapid. Available water capacity and water supplying capacity are variable. The 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 to high.

Most areas of these soils are used for range and wildlife habitat. Some crops are grown. Hay is the main crop. Some winter wheat is also grown. Alfalfa hay is grown in dryfarmed and irrigated cropland.

The native plant community is needleandthread, bluebunch wheatgrass, and Indian ricegrass. Needleandthread generally is dominant. Sandberg bluegrass is prominent. Perennial forbs, such as Columbia milkvetch and western yarrow, are common. Big sagebrush commonly occurs in small amounts. The soil produces about 800 pounds of forage per acre in favorable years and about 600 pounds per acre in normal years.

If range condition deteriorates, the proportion of forage bunchgrasses decreases and the proportion of Sandberg bluegrass and low value forbs increases. If deterioration is severe as a result of fire or other disturbance, cheatgrass commonly dominates the stand.

If the range is in poor condition, seedbed preparation and seeding dryland grasses are practical. Because the hazard of soil blowing is high, seeding to grass presents special management problems. Grass selected for dryland seeding should have strong seedling vigor and be drought resistant. Suitable for seeding is crested or Siberian wheatgrass.

Livestock grazing should be limited mainly to winter.

These soils provide food and cover for upland game birds, such as ring-necked pheasant and valley quail. Mule deer and smaller mammals use this soil for food and cover.

The major needs in crop management are conserving soil moisture for plant growth and stabilizing streambanks against cutting by water The proper timing and rates of applying irrigation water are important in irrigated areas. Where water is available, irrigation is by sprinklers, most commonly wheelline or handline systems.

A suitable cropping system under irrigation is a rotation consisting of wheat and alfalfa. If wheat is grown more than 2 consecutive years, serious weed and disease control problems are common.

Because of the rapid permeability and high water consumption, light, frequent applications of irrigation water are needed. Split applications of fertilizer are desirable because plant nutrients are leached out of the rooting zone by the irrigation water.

In dryfarmed cropland, stubble mulch and minimum tillage along with a crop-fallow system where wheat is grown minimize erosion and help to conserve soil moisture.

Streambank erosion can be stabilized by maintaining streamside vegetation, especially giant wildrye and riparian shrubs. Such vegetation also serves as important cover.

These soils are on stream flood plains and are subject to flooding. The flooding is a limitation for community developments. The flooding and small stones are limitations for recreation facilities.

The capability subclass is VIe dryland and IIIe irrigated.