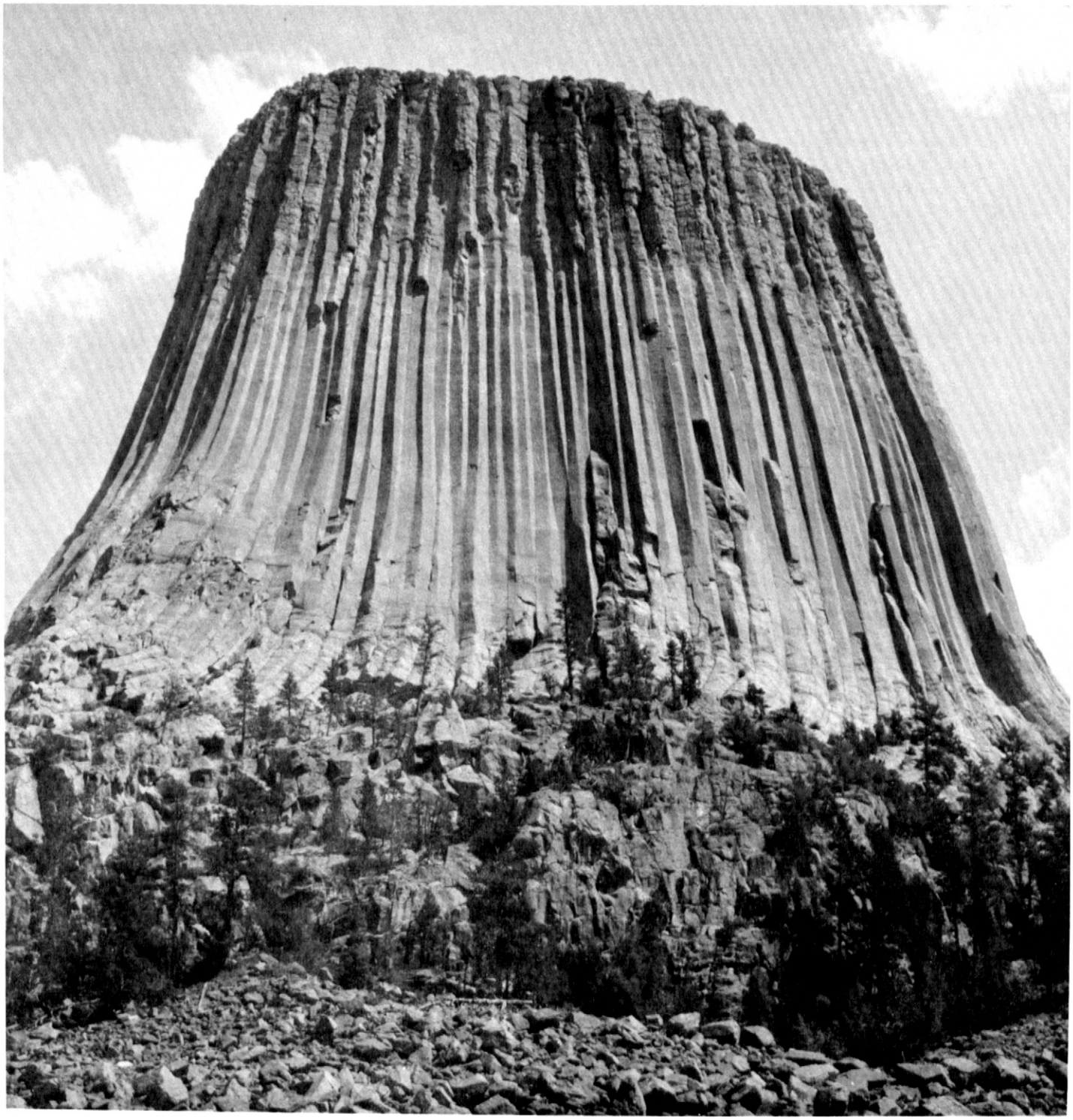
United States Department of Agriculture

Soil Conservation Service

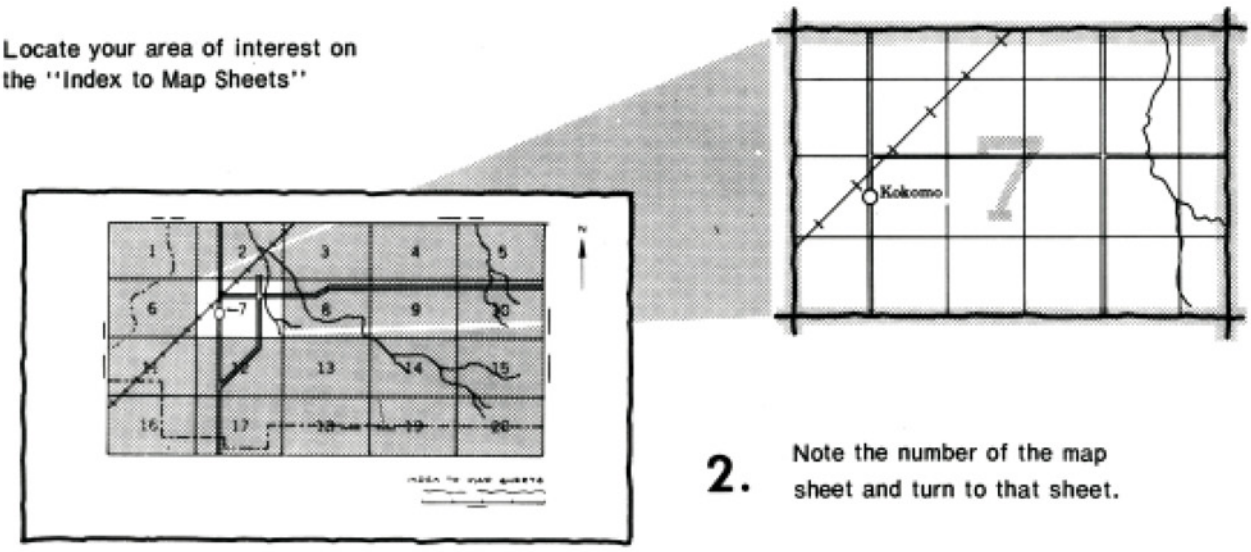
In Cooperation with United States Department of Agriculture, Forest Service, and Wyoming Agricultural Experiment Station

Soil Survey of Crook County Wyoming



HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"



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

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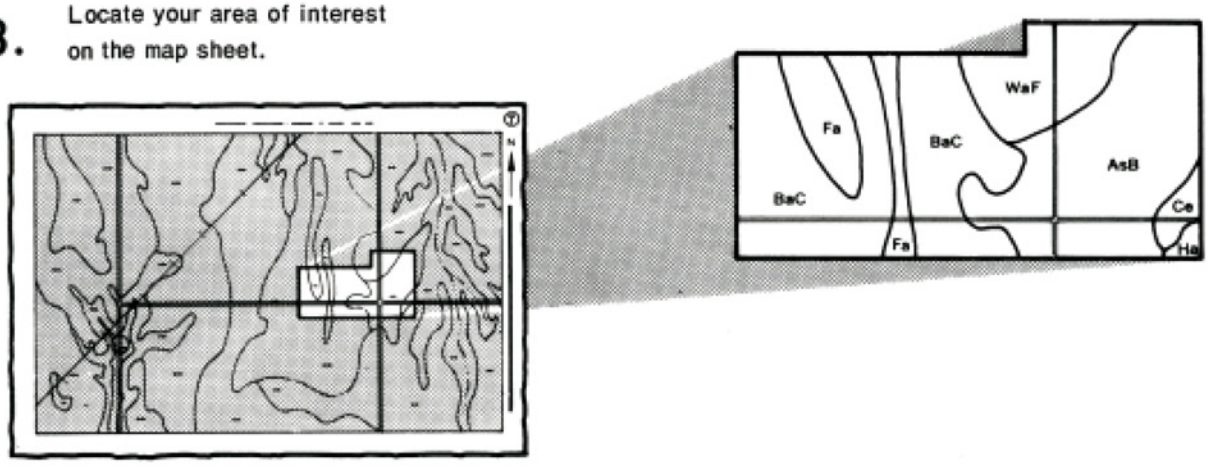
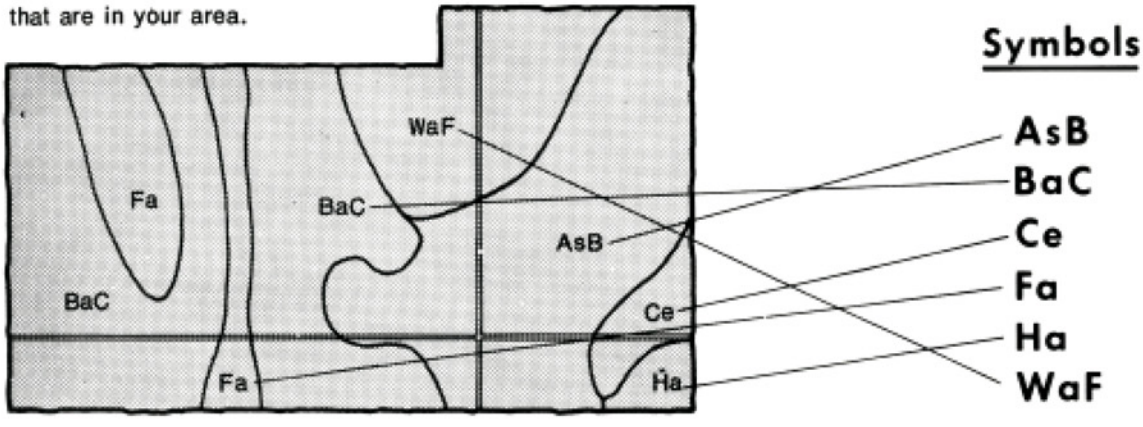
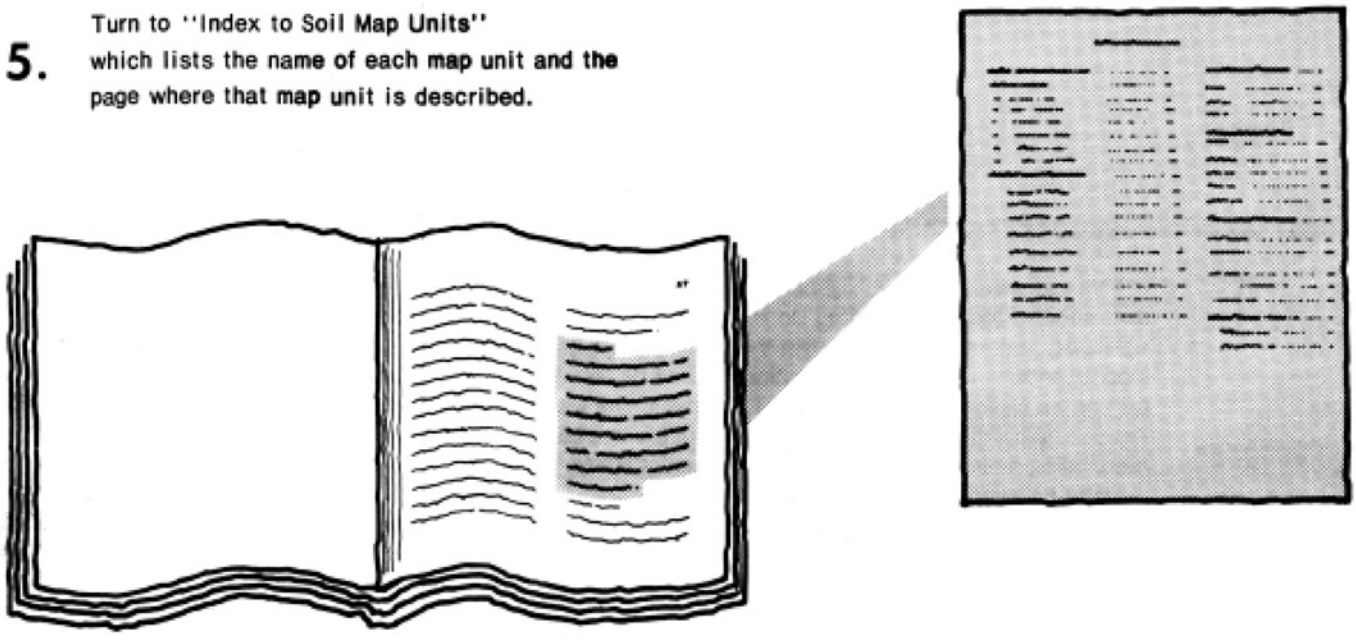


4. List the map unit symbols that are in your area.

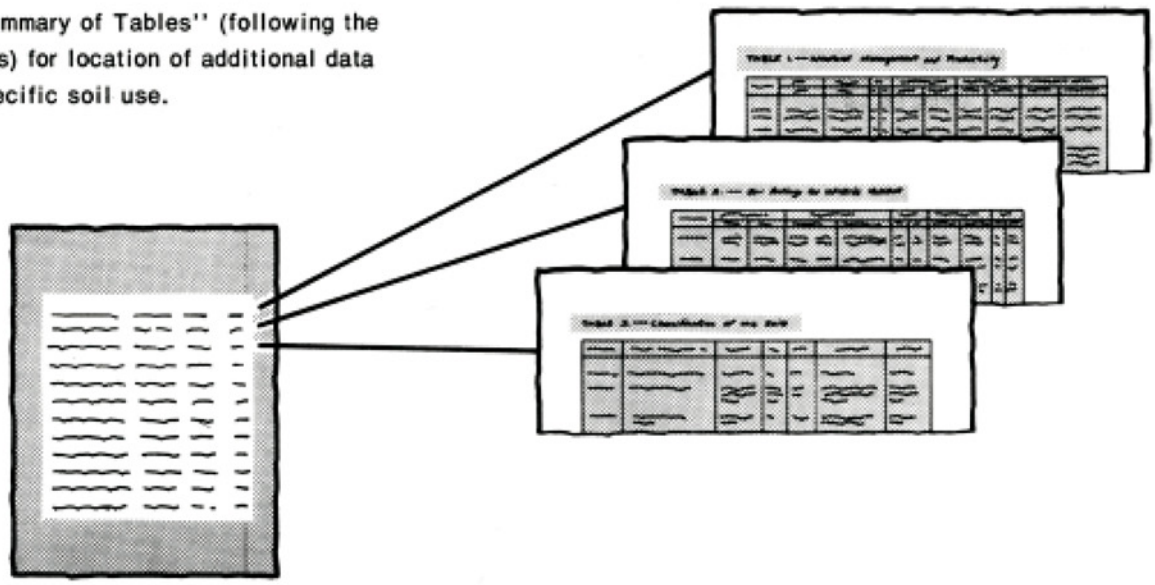


THIS SOIL SURVEY

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



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



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to 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 1960-77. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1977. This survey was made cooperatively by the Soil Conservation Service, the Forest Service, the Wyoming Agricultural Experiment Station, and the Wyoming Department of Revenue and Taxation. It is part of the technical assistance furnished to the Devils Tower 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: Devils Tower, the most prominent landmark in Crook County, became the first national monument in 1906.

contents

soil series

Issued May 1983

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summary of tables

foreword

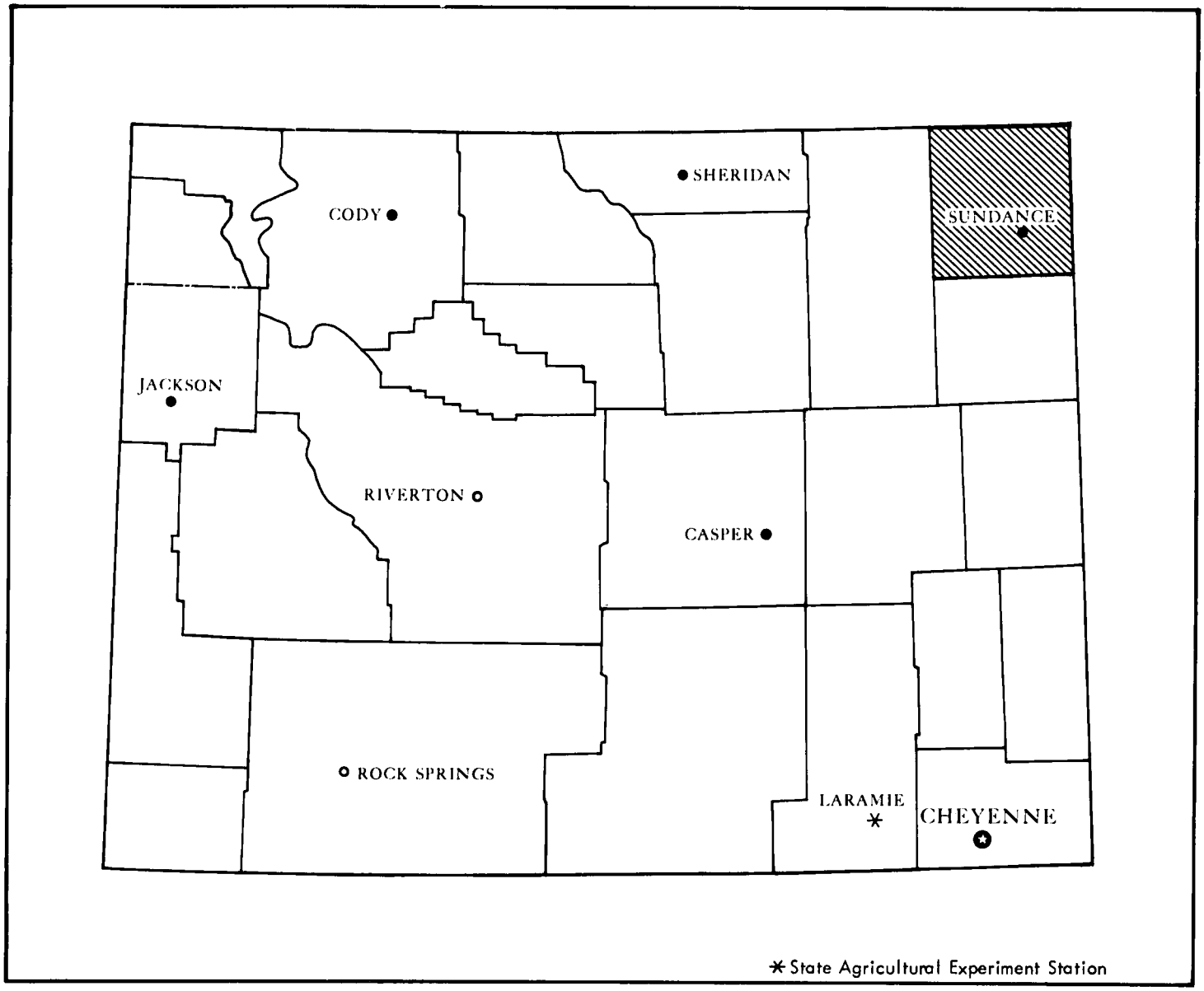
This soil survey contains information that can be used in land-planning programs in Crook County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of 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. Mine operators can use the survey in developing mining plans that reduce environmental damage and in developing mine reclamation plans that 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. 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.

Frank Dickson
State Conservationist
Soil Conservation Service



Location of Crook County in Wyoming.

soil survey of
Crook County, Wyoming

By W. G. Elwonger, Soil Conservation Service

Soils surveyed by W. G. Elwonger, J. Dotolo, R. Johnson, M. Cheney, J. Stephens, E. Herron, and A. Bauer, Soil Conservation Service and D. Hoeft, Forest Service

United States Department of Agriculture
Soil Conservation Service and Forest Service
in cooperation with the
Wyoming Agricultural Experiment Station

general nature of the survey area

CROOK COUNTY is in the northeast corner of Wyoming. It is bounded on the north by Carter and Powder River Counties, Montana, on the east by Butte and Laurence Counties, South Dakota, on the south by Weston County, Wyoming, and on the west by Campbell County, Wyoming. The county has a total of 1,840,640 acres, or about 2,862 square miles.

About 6,085 acres is irrigated cropland, 110,830 acres dryfarmed cropland, 1,297,225 acres rangeland, and 366,430 acres woodland. Included within each are acreages used for miscellaneous purposes.

climate

The climate of Crook County differs greatly in different parts of the county. There are two major areas—the mountainous and foothill area and the plains area.

Climatic data from the Sundance Station are used for the mountainous and foothill area. The average annual air temperature is 43.6 degrees F. The lowest temperature on record, which occurred in February, is 42 degrees below zero. The highest temperature recorded, which occurred in July, is 105 degrees. The average annual precipitation is 17.41 inches. The low was 11.58 inches in 1954, and the high 25.38 inches in 1964. The average seasonal snowfall is 64 inches. The maximum was 105 inches, and the minimum 40 inches. Maximum snow depth on Warren Peak, which occurred in March of 1977, was 61 inches.

Data from Colony are used for the plains area. The average annual air temperature is 46.2 degrees F. The lowest temperature recorded, which occurred in February, is 38 degrees below zero. The highest recorded temperature, which occurred in August, is 108 degrees. The average annual precipitation is 15.33 inches. The low was 9.15 inches in 1952, and the high 22.84 inches in 1962.

Most of the precipitation occurs as thunderstorms during the growing season, April through July. Tornados are not common. Winds are generally from the west or northwest. Wind erosion is not a serious problem in the county.

physiography, relief, and drainage

The county has two distinct topographic regions: The Black Hills uplift, which dominates the southeastern two-thirds of the county, and the rolling plains of the Powder River Basin, which covers the western third along the Montana border. Elevation ranges from 3,125 feet above sea level where the Belle Fourche River leaves the county to 6,800 feet on Warren Peak. Other physiographic features are Devils Tower, Missouri Buttes, Sundance Mountain, Green Mountain, and Inyan Kara Mountain.

Most of the drainage of the county is to the northeast or east. The major drainageways are the Belle Fourche

and Little Missouri Rivers and Redwater Creek. These drainageways are deeply entrenched and have only narrow valleys through the uplands.

There are several large bodies of water. Keyhole Reservoir, storing more than 200,000 acre-feet of water for irrigation and recreation, is the largest.

transportation

Several major local, state, and federal highways serve Crook County: Interstate 90, which bisects the southern fourth east to west; U.S. 16 from Moorcroft southeast to Upton; U.S. 14 from Sundance to Moorcroft; State Highway 24 from Tower Junction west of Sundance through Hulett and east to the State line; and State Highways 116 and 585, which connect Sundance with Upton and Newcastle, respectively.

Two railroads cross Crook County. One in the northeast corner connects Colony with routes to the east, and the other crosses the southwest corner of the county, passing through Moorcroft.

There are two small landing fields. One is at Sundance, and the other at Pine Haven, near Keyhole State Park. No commercial airline service is available in Crook County. The nearest commercial airports are at Rapid City, South Dakota, and Gillette, Wyoming.

natural resources

Important natural resources in Crook County are the soil, minerals, timber, and grasses.

Mineral resources in Crook County are gold, silver, bentonite, uranium, coal, oil, and gas. Bentonite, uranium, oil, and gas are an important part of the economy. Bentonite is processed in three plants in the county. Uranium is mined and shipped to processing plants out of the county. Gas and oil leave the county by pipeline and by truck. A gas processing plant is located southwest of Moorcroft.

history

Mary S. Garman, Crook County Historical Society, prepared this section.

Crook County, Wyoming, was named for General George Crook, a well-known soldier of the Plains and Southwest. It was organized as a county in 1885. In 1890, Weston County and, in 1911, Campbell County were organized from parts of Crook County. Crook County encompasses not only the pine-covered Bear Lodge Mountains, a western extension of the Black Hills of South Dakota, but also windswept sagebrush prairies. The most outstanding landmark is Devils Tower, proclaimed the first national monument in 1906. Other landmarks of note in the county are Sundance Mountain and Inyan Kara Mountain.

The county's first inhabitants were the prehistoric Indians, traces of whom are found in archeological sites and pictographs scattered throughout the county. In historic times the nomadic Plains Indians, such as the Kiowa, Sioux, and Cheyenne, roamed the land hunting buffalo and other game. According to legend, some tribes held their annual Sun Dance at the top of Sundance Mountain.

The first documented exploration of the county was in 1811, when the Wilson Price Hunt party entered the area from the northeast and followed the Belle Fourche River before turning west. Sir George Gore of Ireland and his party of hunters camped near Inyan Kara Mountain in 1854. A United States Military Expedition first entered Crook County in 1857. It was led by Lt. G. K. Warren for whom Warren Peak, the highest point in the Bear Lodge Mountains, was named. This expedition came only as far as Inyan Kara Mountain. In 1874 an expedition headed by General George A. Custer entered Crook County from the northeast, traveled south as far as Inyan Kara Mountain, where his name is carved in the rocks, and turned east entering the Black Hills. It was this expedition that verified the rumors of gold in the Black Hills, paving the way for the Black Hills Gold Rush of 1876.

The discovery of gold led to an influx into the region. The largest single expedition was in 1876 from Montana on what is called the Montana Road. Gold miners also scouted the Bear Lodge Mountains looking for riches.

In the 1880's great herds of cattle were brought to Crook County via the Texas Trail, which ran just west of Moorcroft and then north into Montana. The cattle thrived on the native grasses as the buffalo had before them. During this same period a slow but steady stream of homesteaders made its way into the county. Cowboys who were hired to ride herd on the cattle also stayed and filed homesteads.

In 1885 there were only two towns in the county—Beulah and Sundance. In 1891, Moorcroft became the first town in the county with access to a railroad. Hulett, located close to the center of the county, is the town nearest Devils Tower. Aladdin, once a thriving community, was located near a coal mine.

Livestock is still the main industry of Crook County. Recreation, both summer and winter, is important to the county's economy.

how this survey was made

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

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

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

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

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

general soil map units

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

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

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

soil descriptions

Well drained soils formed in alluvium; on terraces and flood plains

In this group are loamy, sandy, and clayey soils formed in alluvium. They are susceptible to blowing unless the plant cover is adequate. The sloping soils are subject to water erosion. Many areas of these soils are used for crops. Some are used for pasture and hay.

1. Haverson-Lohmiller-Glenberg

Very deep, nearly level, dominantly loamy soils; on flood plains and terraces

This map unit is on flood plains and low terraces along the Belle Fourche River (fig. 1). It is nearly level except for the old floodwater channels and short-sloped rises at different levels in the stream valley.

This unit makes up about 4 percent of the county. It is about 30 percent Haverson soils, 25 percent Lohmiller soils, 10 percent Glenberg soils, and 35 percent less extensive soils.

The Haverson soils formed in stratified, calcareous alluvium. The surface layer is pale brown loam. The underlying material is pale brown, calcareous loam stratified with clay loam and fine sandy loam. Permeability is moderate, and the available water capacity is high.

The Lohmiller soils formed in clayey alluvium. The surface layer is grayish brown silty clay loam. The underlying material is grayish brown, calcareous clay loam stratified with loam and clay. Permeability is slow, and the available water capacity is high.

The Glenberg soils formed in stratified alluvial sediment. The surface layer is light brownish gray fine sandy loam. The underlying material is light brownish gray, calcareous sandy loam stratified with loam and loamy sand. Permeability is moderately rapid, and the available water capacity is moderate.

Less extensive are Bankard and Stetter soils and Riverwash on the Belle Fourche River bottom and low terraces. Sugardee and Bidman soils occur on high terraces and fans at outer edges of the valley.

This unit is used for irrigated crops, dryfarmed crops, hay, range, and wildlife habitat.

These soils have properties that are favorable for irrigation. Soil blowing is a hazard in some areas. Many areas are cultivated, but only a few are irrigated. Small grain, alfalfa, and grass are the main crops. These soils produce abundant food and cover for wildlife. They are generally suitable for community and industrial development.

2. Stetter

Very deep, nearly level loamy soils; on flood plains

This map unit is on bottom land along the Little Missouri River (fig. 2). It is nearly level except for the short-sloped rises from flood plains to terraces along streams.

This unit makes up about 1 percent of the county. It is about 60 percent Stetter soils and 40 percent less extensive soils.

Stetter soils formed in clayey alluvium on flood plains. The surface layer is grayish brown silty clay loam. The underlying material is light brownish gray silty clay loam stratified with silt loam and clay loam. Permeability is moderately slow, and the available water capacity is high.

Less extensive are Absted, Bone, Lohmiller, Twotop, and Limon soils on terraces and fans and Haverson soils on flood plains.

This unit is used for irrigated crops, dryfarmed crops, hay, range, and wildlife habitat.

These soils have properties that are favorable for irrigation. Much of the acreage is used as hayland with grass or grass and alfalfa as the principal crops. The soils produce abundant food and cover for wildlife. They

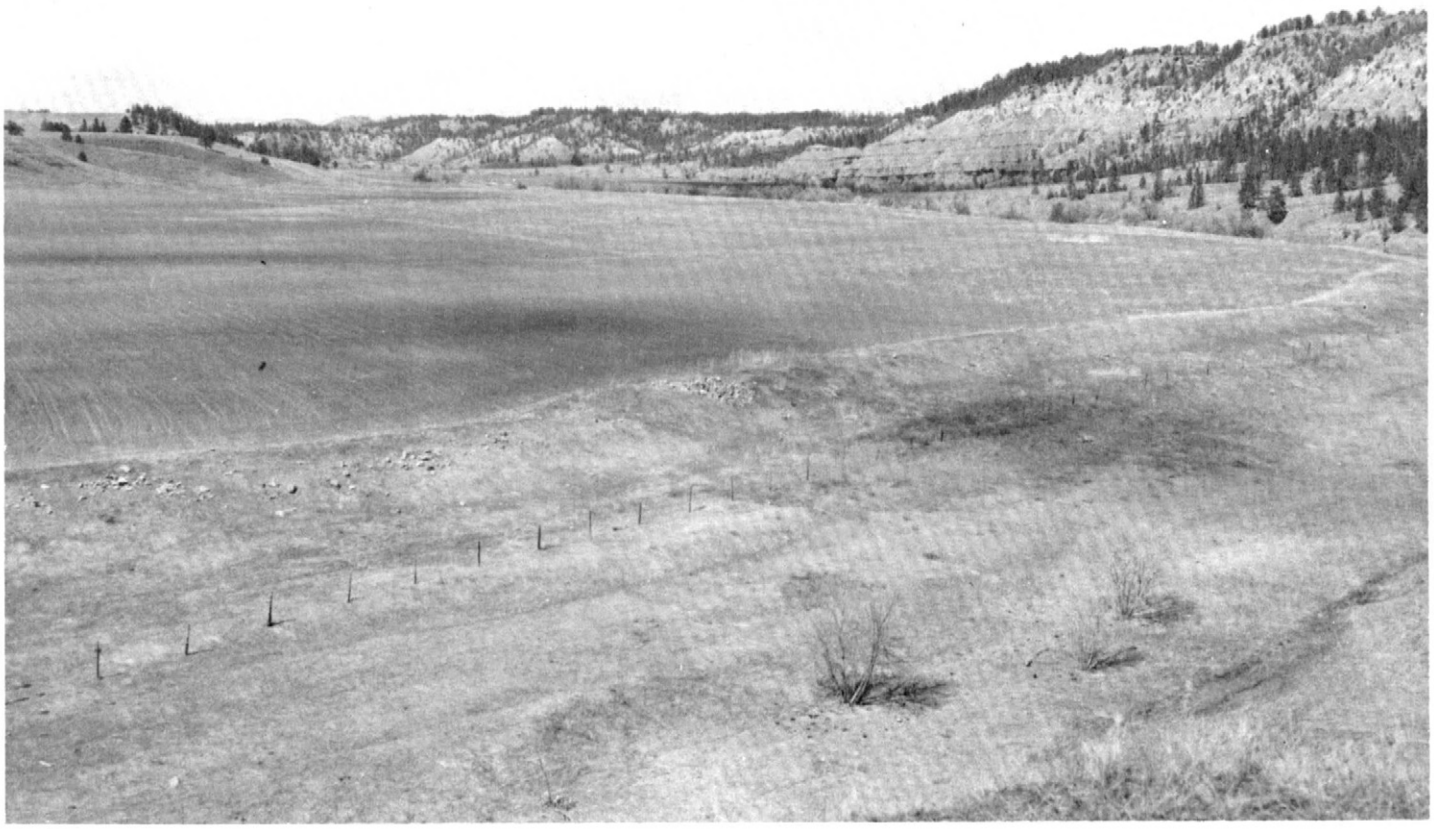


Figure 1.—Typical landscape of the Haverson-Lohmiller-Glenberg map unit along the Belle Fourche River. Haverson soils are in the foreground.

are generally suitable for community and industrial development.

Well drained and somewhat excessively drained, nearly level to very steep soils formed in material derived from sedimentary rock; on uplands

In this group are loamy and silty soils formed in material weathered from siltstone, sandstone, and shale. Soil blowing and water erosion are hazards unless the plant cover is adequate. Some of the best cropland occurs in these areas. Most of the soils used for crops in the county are in this group. Some areas are used for pasture and hay.

3. Shingle-Fort Collins-Cushman

Shallow to very deep, gently sloping to steep loamy soils formed in material derived from sandstone and shale

This map unit is on uplands along the west boundary of the county (fig. 3). It is gently sloping to steep. The steeper soils are on rough, deeply dissected uplands. The less sloping soils are on fans along drainageways.

This unit makes up about 12 percent of the county. It is about 25 percent Shingle soils, 25 percent Fort Collins and similar soils, 10 percent Cushman and similar soils, and 40 percent less extensive soils.

The shallow Shingle soils formed in loamy residuum of soft, interbedded sandstone and shale. The surface layer is light brownish gray loam. The underlying material is light gray, calcareous loam. Soft shale is at a depth of 16 inches. Permeability is moderate, and the available water capacity is very low.

The very deep Fort Collins soils formed in alluvium on alluvial fans, foot slopes, and terraces. The surface layer is grayish brown loam. The subsoil is brown clay loam. The substratum is light gray, calcareous loam.

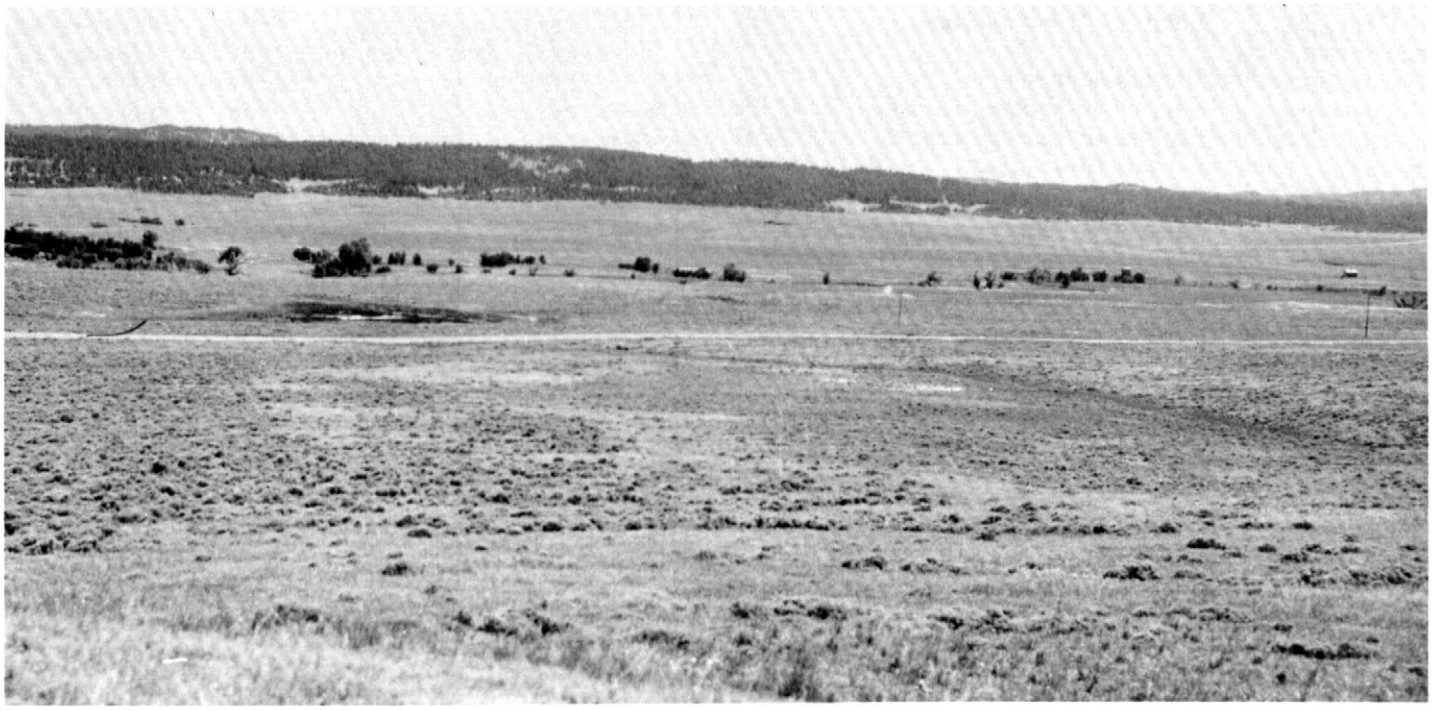


Figure 2.—Typical landscape of the Stetter map unit along the Little Missouri River. Lohmiller soils are in the center.

Figure 3.—Typical landscape of the Shingle-Fort Collins-Cushman map unit. Fort Collins and Cushman soils are in the foreground, and Shingle soils are on the ridges in the background.

Permeability is moderate, and the available water capacity is high.

The moderately deep Cushman soils formed in calcareous material from interbedded sandstone and shale of the uplands. The surface layer is grayish brown loam. The subsoil is light brownish gray clay loam. The substratum is light brownish gray, calcareous clay loam. Soft loamstone is at a depth of 30 inches. Permeability is moderate, and the available water capacity is moderate.

Less extensive in the unit are Ascalon, Renohill, Samsil, Tassel, Ulm, and Vona soils. Ascalon, Tassel, and Vona soils occur on uplands in the more sandy areas. Samsil, Ulm, and Renohill soils occur in upland areas of shale.

This unit is used for crops, hay, range, and wildlife habitat.

Conserving moisture is the main management concern on the less sloping soils.

Control of erosion is a concern on the sloping soils. Soil blowing is a hazard in some areas. Most of the area is in native grass and is grazed. The soils produce fair food and cover for wildlife. They are generally suitable for community and industrial development.

4. Gaynor-Butche-Boneek

Shallow to deep, nearly level to very steep, dominantly loamy soils formed in material derived from siltstone, sandstone, and shale

This map unit is on broad uplift ridges that occur as old peneplains surrounding the Bear Lodge Mountains on the north and west. These plains are deeply dissected by major drainageways from the mountains. Nearly level to moderately sloping soils are along drainageways and on broad divides (fig. 4).

This unit makes up about 26 percent of the county. It is about 15 percent Gaynor soils, 15 percent Butche soils, 15 percent Boneek and similar soils, and 55 percent less extensive soils.

The well drained, moderately deep Gaynor soils formed in residuum or in sediments locally transported from sedimentary rock. The surface layer is light brownish gray clay loam. The underlying material is grayish brown clay. Shale is at a depth of 32 inches. Permeability is slow, and the available water capacity is moderate.

The somewhat excessively drained, shallow Butche soils formed in residuum of hard, fine-grained sandstone. The surface layer is light brownish gray fine sandy loam. The underlying material is light gray fine sandy loam. Sandstone is at a depth of 12 inches. Permeability is moderately rapid, and the available water capacity is very low.

The well drained, deep Boneek soils formed in silty sediment underlain by sandstone, siltstone, or loess. The surface layer is dark grayish brown loam. The subsoil is brown silty clay loam. The substratum is very pale brown

Figure 4.—Typical landscape of the Gaynor-Butche-Boneek map unit. Butche soils are on the breaks and steep slopes. Gaynor soils are on foot slopes. Boneek soils are on the upland divides.

silt loam underlain by sandstone. Permeability is moderately slow, and the available water capacity is high.

Less extensive in the unit are Larkson, Kim, Lakoa, Nunn, Samsil, Satanta, Spangler, and Wages soils. Kim, Satanta, and Wages soils occur on rolling uplands over siltstone and sandstone. Samsil and Nunn soils occur on uplands over shale. Spangler soils occur on uplands over noncalcareous sandstone. Larkson and Lakoa soils occur in canyons and on steep slopes of deeply dissected areas. Less extensive also are Cushman, Onita, and Lynx soils.

This unit is used for crops, hay, range, and wildlife habitat.

Conservation of moisture is the main management concern on the nearly level soils. Control of erosion is a concern on sloping soils. Soil blowing is a hazard in some areas. Winter wheat is the main dryfarmed crop, but other small grain and alfalfa are also grown. Much of the acreage is in native grasses and is grazed. Some areas are wooded and are used for grazing and for wood fiber production. The soils produce abundant food and cover for wildlife. They are generally suited to community and industrial development.

Well drained, nearly level to steep soils formed in material derived from clay shale; on uplands

In this group are clayey soils formed in material weathered from clay shale. Most of the soils are clays and are very deep to shallow over shale. Permeability is dominantly slow and very slow. Most areas are in native grass and are used for range.

5. Orella-Petrie

Shallow and very deep, nearly level to steep, dominantly loamy soils formed in material derived from saline clay shale

This map unit is on uplands in the northern and northeastern parts of the county. The steep soils are on upland ridges, and the nearly level soils are along drainageways. Most are high in content of salts and gypsum.

This unit makes up about 3 percent of the county. It is about 25 percent Orella soils, 15 percent Petrie soils, and 60 percent less extensive soils.

The shallow Orella soils formed on uplands in residuum of shale that contained a considerable amount of sodium or salts. The surface layer is light gray silty clay loam. The underlying material is grayish brown clay. Alkaline shale is at a depth of 12 inches. Permeability is very slow, and the available water capacity is very low.

The very deep Petrie soils are on alluvial fans, valley filling side slopes, and the bottoms of drainageways. They formed in thick, calcareous, very alkaline sediments derived from sedimentary rock. The surface layer is light gray clay loam. The underlying material is light brownish gray clay. Permeability is very slow, and the available water capacity is high.

Less extensive in the unit are Cadoma, Gaynor, Limon, Renohill, Samsil, and Shingle soils. Gaynor, Renohill, and Samsil soils overlie upland shale that does not have a high concentration of salts. Limon soils occur on terraces and fans where there is no concentration of salts. Shingle soils occur in upland areas of silty and loamy soil.

This unit is used for range and wildlife habitat.

The major soils of this unit are low in fertility. All areas are in native grass and are used for grazing. Because most soils are strongly saline and alkaline, use is restricted to range. Food and cover for wildlife are sparse. The soils are poorly suited to community and industrial development.

6. Bidman-Razor-Winler

Very deep and moderately deep, nearly level to moderately steep loamy and clayey soils formed in material derived from shale

This map unit is on uplands in the northern and western parts of the county. It is mostly gently sloping (fig. 5) to moderately sloping. It is nearly level along drainageways. The soils are dominantly clays and clay loams.

This unit makes up about 9 percent of the county. It is about 20 percent Bidman soils, 20 percent Razor soils, 10 percent Winler soils, and about 50 percent less extensive soils.

The very deep Bidman soils formed in material weathered from sedimentary rock. The surface layer is light gray loam. The subsoil is grayish brown clay. The substratum is light brownish gray, calcareous clay loam. Permeability is slow, and the available water capacity is high.

The moderately deep Razor soils are on uplands. They formed in clay loam residuum or transported material overlying clay loam shale. The surface layer is grayish brown clay loam. The subsoil is dark grayish brown clay loam. The substratum is brown clay loam. Shale is at a depth of 30 inches. Permeability is slow, and the available water capacity is low.

The moderately deep Winler soils are on uplands. They formed in clayey deposits weathered from shale. The surface layer is light brownish gray clay loam. The subsoil is grayish brown clay. The substratum is light brownish gray clay. Clay shale is at a depth of 29 inches. Permeability is very slow, and the available water capacity is very low.

Less extensive in the unit are Absted, Briggsdale, Gaynor, Limon, Renohill, Samsil, Twotop, and Ulm soils. The gently sloping to moderately sloping Briggsdale, Gaynor, Renohill, and Samsil soils are on uplands. Absted, Twotop, Limon, and Ulm soils are on fans and terraces along streams. Bidman, Briggsdale, and Absted soils have a claypan in the subsoil.

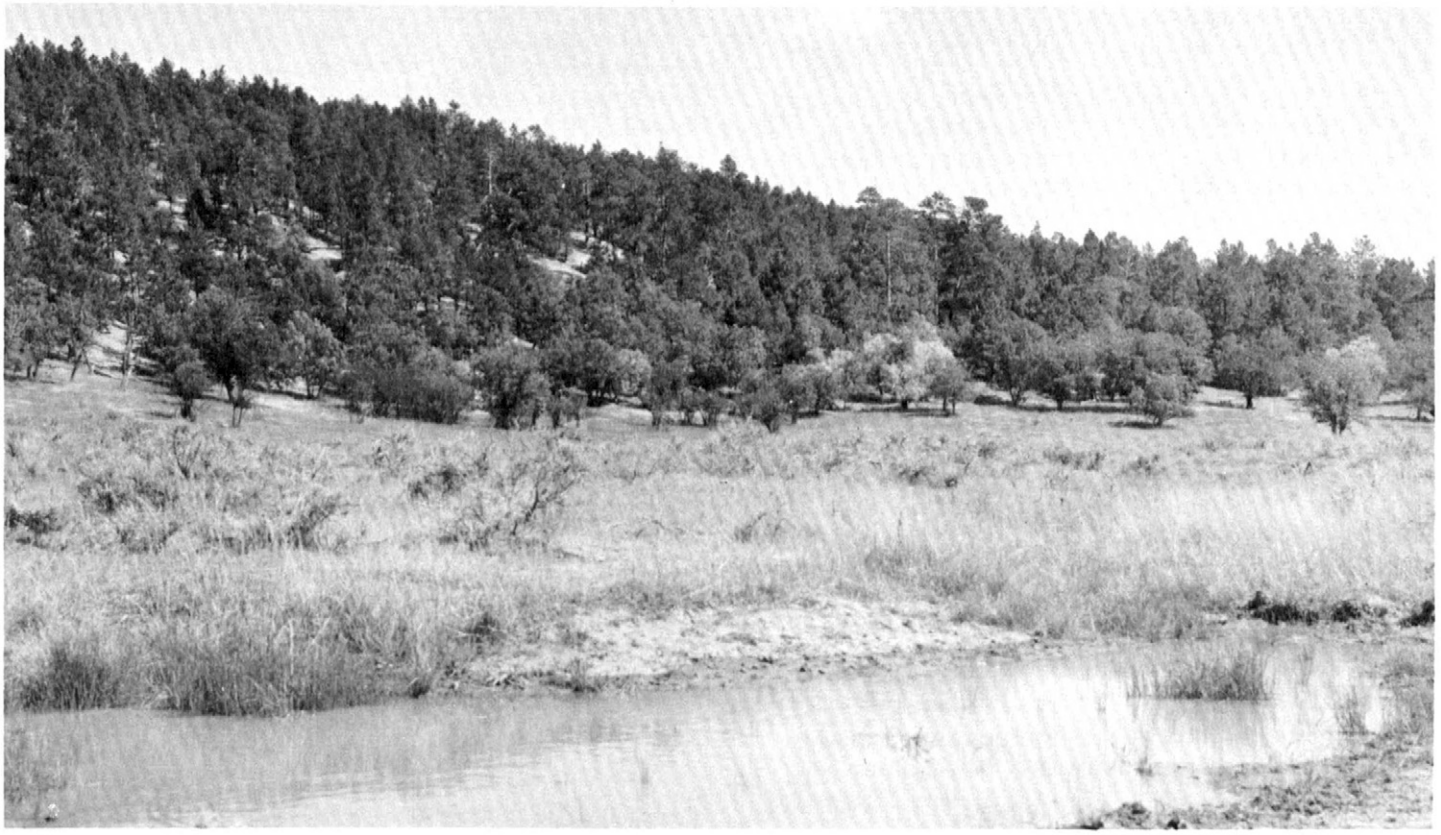


Figure 5.—Typical landscape of the Bidman-Razor-Winler map unit, in the foreground, and the Louviers-Grummit map unit, on the slope.

This unit is used as range and wildlife habitat. Most areas are in native grasses and are used for grazing. Some are used for hay. The soils produce fair food and cover for wildlife. They have some limitations for community and industrial development.

7. Louviers-Grummit

Shallow, gently sloping to steep, dominantly clayey soils formed in material derived from acid shale

This map unit is on uplands in the northern and western parts of the county that circle the foothills of the Bear Lodge Mountains. Most of the area is moderately sloping to steep. It is gently sloping along the drainageways.

This unit makes up about 19 percent of the county. It is about 25 percent Louviers soils, 15 percent Grummit soils, and 60 percent less extensive soils.

The Louviers soils are on uplands. They formed in a thin layer of residuum of noncalcareous shale. The surface layer is grayish brown clay. The underlying material is dark grayish brown clay. Clay shale is at a depth of 20 inches. Permeability is slow, and the available water capacity is very low.

The Grummit soils are on uplands. They formed in clayey residuum of acid shale. The surface layer is grayish brown shaly clay loam. The underlying material is light brownish gray, acid shaly clay. Platy shale is at a depth of 11 inches. Permeability is moderate, and the available water capacity is low.

Less extensive in the unit are Bone, Demar, Maggin, Razor, Renohill, Rhoame, Topemen, Winler, Ulm, and Querc soils. The nearly level Bone, Rhoame, Topeman, Ulm, and Demar soils are near drainageways.

The shallowness and low available water capacity of Louviers and Grummit soils limit the use of this unit. Control of erosion and soil blowing is a major concern of management.

This unit is rangeland, woodland, and wildlife habitat.

Most of this unit is in native vegetation and is used for grazing. The native vegetation on Querc and Maggin soils includes scattered to dense stands of bur oak and ponderosa pine. The underlying shale in parts of the map unit is a source of bentonite. The soils of this unit provide good food and cover for wildlife. They are not well suited to community and industrial development.

Well drained soils formed in red material derived from siltstone, shale, and sandstone; on uplands

In this group are loamy and silty soils formed in material weathered from siltstone, shale, and sandstone and material washed from the Bear Lodge Mountains. Many of the soils are well suited to crops, but wind and water erosion can be a hazard unless the soil is protected.

8. Nevee-Tilford-Vale

Deep and very deep, nearly level to moderately steep silty and loamy soils

This map unit is on uplands in the red bed trough east and south of Sundance. The steeper soils are near canyons and buttes that occur throughout the area. Nearly level soils (fig. 6) occur along the major drainageways of Redwater, Sand, and Sundance Creeks.

This unit makes up about 9 percent of the county. It is about 20 percent Nevee soils, 15 percent Tilford soils, 5 percent Vale and similar soils, and 60 percent less extensive soils.

The deep Nevee soils formed on uplands, terraces, and fans in silty alluvium weathered from reddish silty shale, siltstone, and sandstone. The surface layer is reddish brown silt loam. The underlying material is light reddish brown silt loam. Red siltstone is at a depth of 48 inches or more. Permeability is moderate, and the available water capacity is high.

The very deep, rolling Tilford soils are on uplands, terraces, and fans and along streams. They formed in silty alluvium weathered from red silty shale. The surface layer is brown silt loam. The subsoil is reddish brown silt loam. The substratum is reddish yellow loam. Permeability is moderate, and the available water capacity is high.

The very deep, nearly level to gently sloping Vale soils are on terraces, fans, and uplands. They formed in silty alluvium derived from reddish silty shale. The surface layer is brown silt loam. The subsoil is reddish brown silty clay loam. The substratum is light reddish brown silt

Figure 6.—Typical landscape of the Nevee-Tilford-Vale map unit east of Sundance. Vale and Tilford soils are in the foreground. Nevee soils are on the foot slopes. Intermingled areas of Spearfish soils and Rock outcrop are in the background.

loam. Permeability is moderate, and the available water capacity is high.

Less extensive in the unit are Barnum, Gaynor, Gypnevee, Kim, Nihill, Nunn, Rekop, Satanta, Spearfish, Sugardee, and Suglo soils and Rock outcrop. Barnum soils are on flood plains along Sand Creek. Sugardee, Suglo, and Nihill soils are on gravelly fans and terraces washed from the Bear Lodge Mountains. Spearfish soils are near exposed bedrock. Satanta, Kim, Gaynor, and Nunn soils are adjacent to areas of sandstone and shale. Rekop and Gypnevee soils are in areas of gypsum bedrock.

This unit is used for crops, hay, range, and wildlife habitat. Many areas are cultivated. Small areas are irrigated.

Conserving moisture is the main management concern on the nearly level soils. Controlling erosion is a major concern on sloping soils. Soil blowing is a hazard in some areas. Winter wheat is the main dryfarmed crop, but other small grain and alfalfa are also grown. Most of the area is in native grass and is used for grazing. The soils produce fair food and cover for wildlife. They are generally suited for community and industrial development.

Well drained soils formed in material derived from sandstone, shale, and limestone; on mountains

In this group are clayey and loamy soils formed in material weathered from sandstone, shale, and limestone. Vegetation is dominantly ponderosa pine and an understory of quaking aspen, bur oak, shrubs, and grasses. Some areas have been burned and have revegetated to bearberry, kinnikinnick, and ceanothus. The soils are very deep. Many contain large quantities of stones.

9. Larkson-Lakoa-Citadel

Very deep and deep, gently sloping to very steep loamy soils

This map unit is on uplands (fig. 7) of the Bear Lodge Mountains and the Black Hills.

This unit makes up about 15 percent of the county. It is about 30 percent Larkson soils, 15 percent Lakoa

Figure 7.—Typical landscape of the Larkson-Lakoa-Citadel map unit near Cement Ridge. Citadel soils are in the foreground. Larkson and Lakoa soils are in the background.

soils, 10 percent Citadel soils, and 45 percent less extensive soils.

The Larkson soils formed in sediments from interbedded sandstone and shale. The surface layer is dark gray loam. The subsurface layer is light brownish gray loam. The subsoil is yellowish brown clay. The substratum is very pale brown clay loam. Permeability is slow, and the available water capacity is high.

The Lakoa soils formed in sediments from interbedded sandstone and shale. The surface layer is dark grayish brown loam. The subsurface layer is light brownish gray loam. The subsoil is brown clay loam. The substratum is pale brown, calcareous clay loam. Permeability is moderate, and the available water capacity is high.

The Citadel soils formed in residuum of calcareous sandstone, limestone, and soft shale. The surface layer is dark brown loam. The subsurface layer is pinkish gray silt loam. The subsoil is reddish brown clay loam. The substratum is reddish yellow silt loam. Permeability is moderately slow, and the available water capacity is high.

Less extensive in the unit are Butche, Cordeston, Gaynor, Grizzly, Onita, Maitland, McCaffery, Lail, Lynx, Stovho, Work, and Vanocker soils. Butche, Lail, Stovho, and Vanocker soils are in areas of red shale. Gaynor and Work soils are in areas not covered with ponderosa pine. Cordeston, Onita, Lynx, and Maitland soils are in swales and along drainageways. Grizzly soils are on mountain peaks. McCaffery soils are in the sandier areas.

This map unit is almost entirely in woodland. Ponderosa pine is the dominant vegetation. The understory is bur oak, quaking aspen, and other shrubs and grasses. The site index for ponderosa pine ranges from 50 to 80. Wildlife habitat is a major use of these soils.

Woodland conservation practices and grazing management are needed if these soils are to be well managed. This unit provides excellent food and cover for wildlife. It is suited to community and industrial development but may not be accessible in winter.

Well drained soils formed in material weathered from siltstone, sandstone, and limestone and Rock outcrop; on uplands

In this group are loamy and silty soils formed over sandstone, limestone, and siltstone. Much of the area is Rock outcrop. Areas of deep soils are well suited to crops.

10. Norka-Rock outcrop-Vanocker

Very deep, gently sloping to very steep loamy and channery soils and Rock outcrop

This map unit is on uplands of the Rifle Pit Divide and the Williams Divide east of Sundance. The old high divides are deeply dissected by drainageways.

This unit makes up about 2 percent of the county. It is about 30 percent Norka soils, 25 percent Rock outcrop, 25 percent Vanocker soils, and 20 percent less extensive soils.

The Norka soils are on uplands. They formed in silty material derived from siltstone and sandstone. The surface layer is grayish brown loam. The subsoil is brown silty clay loam. The substratum is light brownish gray, calcareous silt loam. Permeability is moderately slow, and the available water capacity is high.

Rock outcrop is barren limestone or gypsum. In these areas there is less than 10 inches of soil.

The Vanocker soils are in the mountains. They formed in material weathered from sedimentary rock. The surface layer is dark grayish brown loam. The subsoil is brown, very channery clay loam. The substratum is pale brown, very channery clay loam. Permeability is moderate, and the available water capacity is moderate.

Less extensive in the unit are Larkson, Lakoa, Laporte, Nevee, Tilford, and Vale soils. Larkson and Lakoa soils are in timbered canyons. Nevee, Tilford, and Vale soils are in areas where the redbeds have not completely eroded from the limestone. Laporte soils are in areas of limestone bedrock.

This unit is used for crops, hay, range, and wildlife habitat. Some areas are cultivated. Small grain is the principal crop.

Conservation of moisture is the main management concern in nearly level areas. Control of erosion is a concern on sloping soils. Most of the area is in native grasses. Larkson and Lakoa soils support ponderosa pine. Grazing and wood fiber production are the primary uses. These soils produce fair food and cover for wildlife. They are generally suited to community and industrial development.

detailed soil map units

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

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

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

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

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Ulm loam, 0 to 1 percent slopes, is one of several phases in the Ulm series.

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

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Absted-Bone complex, 0 to 3 percent slopes, is an example.

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

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop, limestone, 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 1 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

10—Absted-Bone complex, 0 to 3 percent slopes. These nearly level soils are on alluvial fans and valley filling side slopes. They formed in alluvium. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Absted soil makes up about 65 percent of the map unit, and the Bone soil 25 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Absted soil is similar to the Bone soil but has a thicker surface layer and subsoil. Bidman, Ulm, and Wyarno soils make up 10 percent of this complex.

The very deep, well drained Absted soil formed in strongly alkaline alluvial deposits derived mostly from sedimentary rock.

Typically, the surface layer is pale brown very fine sandy loam 3 inches thick. The subsurface layer is pale brown very fine sandy loam 4 inches thick. The subsoil is dark grayish brown clay 5 inches thick. The substratum is light brownish gray, calcareous clay to 60 inches or more.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is more than 60 inches. Surface runoff is slow, and the erosion hazard moderate. The hazard of soil blowing is moderate.

The Bone soil is very deep, moderately well drained, and strongly saline. It formed in moderately alkaline alluvial deposits derived mostly from sedimentary rock.

Typically, the surface layer is white loam 2 inches thick. The subsoil is grayish brown clay loam 3 inches thick. The substratum is grayish brown, calcareous clay loam to 60 inches or more.

Permeability is very slow. The available water capacity is low. The effective rooting depth is about 60 inches or more. Surface runoff is slow, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Absted soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Bone soil is mainly western wheatgrass, gardner saltbush, inland saltgrass, Indian ricegrass, and alkali sacaton. If the ecological condition deteriorates, greasewood and inland saltgrass are dominant. The potential plant community produces about 600 pounds of annual air-dry herbage per acre. The yield varies between 800 pounds in favorable years and 400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbit, and other small animals. Sagebrush and forbs provide some food and cover for wildlife.

The capability unit is IVs-12 dryland. The range site is Loamy for the Absted soil and Saline Upland for the Bone soil.

11—Alice fine sandy loam, 2 to 6 percent slopes. This very deep, well drained, nearly level to gently sloping soil is on alluvial fans and terraces. It formed in alluvium from sedimentary rock. The elevation is 3,500 to 5,000 feet. The slope ranges from 2 to 6 percent but is mostly about 4 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of more sloping Alice soils and of Vona, Terry, Satanta, Wages, and Thedalund soils were included in mapping.

Typically, the surface layer of the Alice soil is dark grayish brown fine sandy loam 10 inches thick. The subsoil is light brownish gray fine sandy loam 18 inches thick. The substratum is very pale brown, calcareous fine sandy loam to 60 inches or more.

Permeability is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community consists mainly of prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-5 dryland and irrigated. The range site is Sandy.

12—Alice fine sandy loam, 6 to 10 percent slopes. This very deep, well drained, sloping soil is on alluvial fans and terraces. It formed in material weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The slope ranges from 6 to 10 percent but is mostly about 8 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of an Alice soil that differs in slope and areas of Vona, Terry, Satanta, Wages, and Thedalund soils were included in mapping.

Typically, the surface layer of the Alice soil is dark grayish brown fine sandy loam 10 inches thick. The subsoil is light brownish gray fine sandy loam 18 inches thick. The substratum is very pale brown, calcareous fine sandy loam to 60 inches or more.

Permeability is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high. The hazard of soil blowing is moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs

are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-5 dryland and irrigated. The range site is Sandy.

13—Alice-Thedalund complex, 3 to 10 percent slopes. These gently sloping to rolling soils are on uplands. They formed in residuum from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is 46 degrees F. The frost-free season is about 120 days.

The Alice soil makes up about 60 percent of the map unit, and the Thedalund soil makes up 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Alice soil is similar to the Thedalund soil but is coarser textured. Tassel and Kim soils make up 10 percent of this complex.

The very deep, well drained Alice soil formed in valley fill.

Typically, the surface layer is dark grayish brown fine sandy loam 10 inches thick. The subsoil is light brownish gray fine sandy loam 18 inches thick. The substratum is very pale brown, calcareous fine sandy loam to 60 inches or more.

Permeability is moderately rapid. The available water capacity is moderate. The effective rooting depth is more than 60 inches. Surface runoff is rapid, and the erosion hazard high. The hazard of soil blowing is moderate.

The moderately deep, well drained Thedalund soil formed in residuum of sandstone and other sedimentary rock.

Typically, the surface layer is light brownish gray loam 4 inches thick. The underlying material is light gray and white, calcareous loam 18 inches thick. Bedrock is at 22 inches.

Permeability is moderate. The effective rooting depth is 20 to 40 inches. The available water capacity is low. Surface runoff is rapid, and the erosion hazard severe.

This unit is pastureland, hayland, rangeland, and wildlife habitat.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The potential plant community on the Alice soil is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The potential plant community on the Thedalund soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This map unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide food and cover for wildlife.

The capability unit is IVe-5 dryland. The range site is Sandy for the Alice soil and Loamy for the Thedalund soil.

14—Alice-Thedalund complex, 10 to 30 percent slopes. These moderately steep and steep soils are on uplands. They formed in residuum of sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is 46 degrees F. The frost-free season is about 120 days.

The Alice soil makes up 60 percent of the map unit, and the Thedalund soil about 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Alice soil is similar to the Thedalund soil but is coarser textured. Tassel and Kim soils make up 10 percent of this unit.

The very deep, well drained Alice soil formed in upland valley fill.

Typically, the surface layer is dark grayish brown fine sandy loam 10 inches thick. The subsoil is light brownish gray fine sandy loam 18 inches thick. The substratum is very pale brown, calcareous fine sandy loam to 60 inches or more.

Permeability is moderately rapid. The available water capacity is moderate. The effective rooting depth is more than 60 inches. Surface runoff is rapid, and the erosion hazard high. The hazard of soil blowing is moderate.

The moderately deep, well drained Thedalund soil formed in residuum of sandstone and sedimentary rock.

Typically, the surface layer is light brownish gray loam 4 inches thick. The underlying material is light gray and white, calcareous loam 18 inches thick. Bedrock is at a depth of 22 inches.

Permeability is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Alice soil is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000

pounds in favorable years and 1,500 pounds in unfavorable years.

The potential plant community on the Thedalund soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIe-5 dryland. The range site is Sandy for the Alice soil and Loamy for the Thedalund soil.

15—Ascalon sandy loam, 2 to 6 percent slopes. This very deep, well drained, nearly level to undulating soil is on uplands. It formed in material weathered from sandy shale and sandstone. The elevation is 3,500 to 5,000 feet. The slope ranges from 2 to 6 percent but is mostly about 4 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of more sloping Ascalon soils and of Terry, Cushman, and Satanta soils were included in mapping.

Typically, the surface layer is grayish brown sandy loam 7 inches thick. The subsoil is grayish brown sandy clay loam and light brownish gray and light gray loam 13 inches thick. The substratum is light gray, calcareous sandy clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate. The hazard of soil blowing is moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needleandthread, prairie sandreed, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies from 3,000 pounds in favorable years to 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbit, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-5 dryland. The range site is Sandy.

16—Ascalon sandy loam, 6 to 10 percent slopes. This very deep, well drained, rolling soil is on uplands. It formed in material weathered from sandy shale and sandstone. The elevation is 3,500 to 5,000 feet. The slope ranges from 6 to 10 percent but is mostly about 8 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of an Ascalon soil that differs in slope and areas of Terry, Cushman, and Satanta soils were included in mapping.

Typically, the surface layer of the Ascalon soil is grayish brown sandy loam 7 inches thick. The subsoil is grayish brown sandy clay loam and light brownish gray and light gray loam 13 inches thick. The substratum is light gray, calcareous sandy clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high. The hazard of soil blowing is moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needleandthread, prairie sandreed, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbit, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-5 dryland. The range site is Sandy.

17—Ascalon-Satanta complex, 1 to 10 percent slopes. These nearly level to rolling soils are on uplands. They formed in material weathered from sandy shale and sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is 46 degrees F. The frost-free season is about 120 days.

The Ascalon soil makes up about 60 percent of the map unit, and the Satanta soil about 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Ascalon soil is similar to the Satanta soil but is 35 percent or more fine sand and coarser material. Terry, Shingle, and Thedalund soils and more sloping Ascalon and Satanta soils make up 10 percent of this unit.

The very deep, well drained Ascalon soil formed in residuum of sandy shale and sandstone.

Typically, the surface layer is grayish brown sandy loam 7 inches thick. The subsoil is grayish brown sandy clay loam and light brownish gray and light gray loam 13 inches thick. The substratum is light gray, calcareous sandy clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate. The hazard of soil blowing is moderate.

The very deep, well drained Satanta soil is on alluvial fans. It formed in material weathered from sandstone.

Typically, the surface layer is grayish brown loam 6 inches thick. The subsoil is brown and grayish brown clay loam 16 inches thick. The substratum is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This unit is pastureland, hayland, rangeland, and wildlife habitat.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community on the Ascalon soil is mainly needleandthread, prairie sandreed, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Satanta soil is mainly rhizomatous wheatgrass, needleandthread, needlegrass, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbit, and other small animals. Sagebrush and forbs provide some food and cover for wildlife.

The capability unit is IVe-5 dryland. The range site is Sandy for the Ascalon soil and Loamy for the Satanta soil.

18—Ascalon-Tassel complex, 3 to 10 percent slopes. These gently sloping to rolling soils are on uplands. They formed in material weathered mainly from sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is 46 degrees F. The frost-free season is about 120 days.

The Ascalon soil makes up about 70 percent of the map unit, and the Tassel soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Tassel soil is shallower than the Ascalon soil. Terry and Otero soils make up 10 percent of this unit.

The very deep, well drained Ascalon soil formed in residuum of sandy shale and sandstone.

Typically, the surface layer is grayish brown sandy loam 7 inches thick. The subsoil is grayish brown sandy clay loam and light brownish gray and light gray loam 13 inches thick. The substratum is light gray, calcareous sandy clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard high. The hazard of soil blowing is severe.

The shallow, well drained Tassel soil formed in residuum of sandstone.

Typically, the surface layer is brown fine sandy loam 3 inches thick. The underlying material is light brownish gray and light gray, calcareous fine sandy loam 12 inches thick. Calcareous gray sandstone is at a depth of 15 inches.

Permeability is moderately rapid. The available water capacity is very low. The effective rooting depth is less than 20 inches. Surface runoff is rapid, and the erosion hazard high. The hazard of soil blowing is high.

This unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Ascalon soil is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Tassel soil is mainly prairie sandreed, needleandthread, and bluebunch wheatgrass. If the ecological condition deteriorates, threadleaf sedge and fringed sagewort are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbit, and other small animals. Sagebrush and forbs provide some food and cover for wildlife.

The capability unit is VIe-5 dryland. The range site is Sandy for the Ascalon soil and Shallow Sandy for the Tassel soil.

19—Bankard loamy fine sand, 0 to 3 percent slopes. This very deep, excessively drained, nearly level soil is on flood plains. It formed in sandy alluvium. The elevation is 3,200 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Glenberg soil, Haverson soil, and Riverwash were included in mapping.

Typically, the surface layer is pale brown loamy fine sand 4 inches thick. The underlying material is pale brown or very pale brown, calcareous fine sand and loamy fine sand to 60 inches or more.

Permeability is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight. The hazard of soil blowing is high. Flooding occurs for brief periods in spring.

This map unit is rangeland. It provides grazing and wildlife habitat. It can be used for irrigated crops if water is available.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVs-4 dryland and IIIs-4 irrigated. The range site is Lowland.

20—Bankard-Glenberg complex, 0 to 3 percent slopes. These nearly level soils are on flood plains. They formed in alluvium. The elevation is 3,200 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Bankard soil makes up about 50 percent of the map unit, and the Glenberg soil 40 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. They are similar except that Glenberg soil is dominantly sandy loam and Bankard soil is dominantly loamy sand. Riverwash and Haverson soil make up 10 percent of this unit.

The Bankard soil is very deep and excessively drained.

Typically, the surface layer is pale brown loamy fine sand 4 inches thick. The underlying material is pale brown and very pale brown, calcareous fine sand and loamy fine sand to 60 inches or more.

Permeability is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight. The hazard of soil blowing is high. Flooding occurs for brief periods in spring.

The very deep, well drained Glenberg soil is on flood plains and terraces.

Typically, the surface layer is light brownish gray fine sandy loam 5 inches thick. The underlying material is light brownish gray, calcareous sandy loam stratified with loam and loamy sand to 60 inches or more.

Permeability is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight. The hazard of soil blowing is moderate. Flooding occurs for very brief periods in spring.

This unit is rangeland. It provides grazing and wildlife habitat.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVs-4 dryland and IIIs-4 irrigated. The range site is Lowland.

21—Barnum silt loam, 0 to 3 percent slopes. This very deep, well drained, nearly level soil formed on flood plains in alluvium from red-bed shale and sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nevee and Colombo soils were included in mapping.

Typically, the surface layer of the Barnum soil is light reddish brown silt loam 8 inches thick. The underlying material is reddish yellow, calcareous silt loam stratified with clay loam and fine sandy loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Most of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Some areas are irrigated and cropped to small grain, corn, and hay. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIc-2 dryland and IIe-2 irrigated. The range site is Lowland.

22—Bidman loam, 0 to 1 percent slopes. This very deep, well drained, nearly level soil is on alluvial fans and valley filling side slopes. It formed in material weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Bone, Briggsdale, and Absted soils and the more sloping Bidman soil were included in mapping.

Typically, the surface layer of the Bidman soil is light gray loam 6 inches thick. The subsoil is grayish brown and light brownish gray clay 13 inches thick. The substratum is light brownish gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Intermediate, pubescent, and crested wheatgrasses and brome are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, bluegrama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbit, and other small animals. Sagebrush and forbs provide some food and cover for wildlife.

The capability unit is IIIc-2 dryland. The range site is Loamy.

23—Bidman loam, 1 to 6 percent slopes. This deep, well drained, nearly level to gently sloping soil is on alluvial fans and valley filling side slopes. It formed in material weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Bone, Briggsdale, and Absted soils and the more sloping Bidman soils were included in mapping.

Typically, the surface layer of the Bidman soil is light gray loam 6 inches thick. The subsoil is dark grayish brown and light brownish gray clay 13 inches thick. The substratum is light brownish gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbit, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

24—Bidman loam, 6 to 10 percent slopes. This deep, well drained, sloping and rolling soil is on uplands and valley filling side slopes. It formed in material weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is 120 days. Small areas of Bone, Briggsdale, and Absted soils and a Bidman soil that differs in slope were included in mapping.

Typically, the surface layer of the Bidman soil is light gray loam 6 inches thick. The subsoil is dark grayish

brown and light brownish gray clay 13 inches thick. The substratum is light brownish gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbit, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

25—Bidman-Bone loams, 0 to 2 percent slopes. These nearly level soils are on alluvial fans and valley filling side slopes. They formed in material weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Bidman soil makes up about 70 percent of the map unit, and the Bone soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Bidman soil is on hummocks, and the Bone soil is in depressions. The Bidman soil has a thicker surface layer and subsoil than the Bone soil. The Bone soil in this map unit may have more gypsum than is typical for the series. Briggsdale, Absted, Twotop, and Ulm soils make up 10 percent of this unit. In the western part of the county, the Absted soil may make up 20 percent.

The Bidman soil is very deep and well drained.

Typically, the surface layer is light gray loam 6 inches thick. The subsoil is dark grayish brown and light brownish gray clay 13 inches thick. The substratum is light brownish gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

The very deep, moderately well drained Bone soil formed in moderately alkaline alluvial deposits derived mostly from sedimentary rock.

Typically, the surface layer is white loam 2 inches thick. The subsoil is grayish brown clay loam 3 inches thick. The substratum is grayish brown, calcareous clay loam to 60 inches or more.

Permeability is very slow. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Bidman soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Bone soil is mainly western wheatgrass, gardner saltbush, inland saltgrass, Indian ricegrass, and alkali sacaton. If the ecological condition deteriorates, greasewood and inland saltgrass are dominant. The potential plant community produces about 600 pounds of annual air-dry herbage per acre. The yield varies between 800 pounds in favorable years and 400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbit, and other small animals. Sagebrush and forbs provide some food and cover for wildlife.

The capability unit is IIIs-2 dryland. The range site is Loamy for the Bidman soil and Saline Upland for the Bone soil.

26—Bidman-Bone loams, 2 to 6 percent slopes. These nearly level to gently sloping soils are on alluvial fans and valley filling side slopes. They formed in material weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Bidman soil makes up about 70 percent of the map unit, and the Bone soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Bidman soil is on hummocks, and the Bone soil is in depressions. The Bidman soil has a thicker surface layer and subsoil than the Bone soil. The Bone soil in this map unit may have more gypsum than is typical for the series. Briggsdale, Absted, Twotop, and Ulm soils make up 10 percent of this unit. In the western part of the county, Absted soil may make up 20 percent.

The Bidman soil is very deep and well drained.

Typically, the surface layer is light gray loam 6 inches thick. The subsoil is dark grayish brown and light brownish gray clay 13 inches thick. The substratum is light brownish gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

The very deep, moderately well drained Bone soil formed in moderately alkaline deposits derived mostly from sedimentary rock.

Typically, the surface layer is white loam 2 inches thick. The subsoil is grayish brown clay loam 3 inches thick. The substratum is grayish brown, calcareous clay loam to 60 inches or more.

Permeability is very slow. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Bidman soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Bone soil is mainly western wheatgrass, gardner saltbush, inland saltgrass, Indian ricegrass, and alkali sacaton. If the ecological condition deteriorates, greasewood and inland saltgrass are dominant. The potential plant community produces about 600 pounds of annual air-dry herbage per acre. The yield varies between 800 pounds in favorable years and 400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbit, and other small animals. Sagebrush and forbs provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy for the Bidman soil and Saline Upland for the Bone soil.

27—Bone loam, 0 to 3 percent slopes. This very deep, moderately well drained, nearly level soil is on alluvial fans and valley filling side slopes. It formed in moderately alkaline deposits derived mainly from sedimentary rock. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Absted, Bidman, Briggsdale, Rhoame, Ulm, and Wyarno soils were included in mapping.

Typically, the surface layer of the Bone soil is white loam 2 inches thick. The subsoil is grayish brown clay loam 3 inches thick. The substratum is grayish brown, calcareous clay loam to 60 inches or more.

Permeability is very slow. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard moderate.

This map unit is rangeland and wildlife habitat.

The plant community is mainly western wheatgrass, gardner saltbush, inland saltgrass, Indian ricegrass, and alkali sacaton. If the ecological condition deteriorates, greasewood and inland saltgrass are dominant. The potential plant community produces about 600 pounds of annual air-dry herbage per acre. The yield varies between 800 pounds in favorable years and 400 pounds in unfavorable years.

This map unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIs-12 dryland. The range site is Saline Upland.

28—Boneek loam, 0 to 2 percent slopes. This deep, well drained, nearly level soil is on uplands and high terraces. On the uplands, it formed in silty sediment underlain by sandstone, siltstone, or loess. On the terraces, it formed in silty alluvium. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of the Fort Collins soil and areas of Norka, Nunn, and Kadoka soils and of Boneek soils that are more than 60 inches deep to bedrock were included in mapping.

Typically, the surface layer of the Boneek soil is dark grayish brown loam 9 inches thick. The subsoil is brown silty clay loam 12 inches thick. The substratum is very pale brown, calcareous silt loam 37 inches thick. Bedrock is at a depth of 58 inches.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 40 to 60 inches. Surface runoff is slow, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 60 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds

of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIc-2 dryland. The range site is Loamy.

29—Boneek loam, 2 to 6 percent slopes. This deep, well drained, nearly level to undulating soil is on uplands and high terraces. On the uplands, it formed in silty sediment underlain by sandstone, siltstone, or loess. On the terraces, it formed in silty alluvium. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of the Fort Collins soil and areas of Norka, Nunn, and Kadoka soils and of Boneek soils that are more than 60 inches deep over bedrock were included in mapping.

Typically, the surface layer of the Boneek soil is dark grayish brown loam or silt loam 9 inches thick. The subsoil is brown silty clay loam 12 inches thick. The substratum is very pale brown, calcareous silt loam 37 inches thick. Bedrock is at a depth of 58 inches.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 40 to 60 inches. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 50 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

30—Boneek loam, 6 to 10 percent slopes. This deep, well drained, sloping soil is on uplands and high terraces. On the uplands, it formed in silty sediment underlain by sandstone, siltstone, or loess. On the terraces, it formed in silty alluvium. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of the Fort Collins soil and areas of Norka, Nunn, and Kadoka soils and of Boneek soils that are more than 60 inches deep over bedrock were included in mapping.

Typically, the surface layer of the Boneek soil is dark grayish brown loam or silt loam 9 inches thick. The subsoil is brown silty clay loam 12 inches thick. The substratum is very pale brown, calcareous silt loam 37 inches thick. Bedrock is at a depth of 58 inches.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 40 to 60 inches. Surface runoff is rapid, and the erosion hazard high.

The map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 40 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

31—Briggsdale loam, 1 to 6 percent slopes. This moderately deep, well drained, nearly level to undulating soil is on uplands. It formed in material weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Renohill, Bidman, and Bone soils, a soil that has higher reaction in the subsoil, and Briggsdale soils that have slope of more than 6 percent were included in mapping.

Typically, the surface layer of the Briggsdale soil is light brownish gray loam 4 inches thick. The subsurface layer is light gray silt loam 2 inches thick. The subsoil is brown and light brownish gray clay 14 inches thick. The substratum is light gray, calcareous clay loam 16 inches thick. Clay shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is slow, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

32—Briggsdale loam, 6 to 10 percent slopes. This moderately deep, well drained, rolling soil is on uplands. It formed in material weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Renohill, Bidman, and Bone soils, a soil that has higher reaction in the subsoil, and Briggsdale soils that differ in slope were included in mapping.

Typically, the surface layer of the Briggsdale soil is light brownish gray loam 4 inches thick. The subsurface layer is light gray silt loam 2 inches thick. The subsoil is brown and light brownish gray clay 14 inches thick. The substratum is light gray, calcareous clay loam 16 inches thick. Clay shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is slow, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

33—Briggsdale-Bone loams, 0 to 2 percent slopes. These nearly level soils formed in material weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Briggsdale soil makes up about 70 percent of the map unit, and the Bone soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Briggsdale soil is on hummocks, and the Bone soil is in depressions. The Briggsdale soil has a thicker surface layer and subsoil than the Bone soil. The Bone soil in this map unit may contain more gypsum than is typical for the series. Absted, Bidman, and Renohill soils make up 10 percent of this unit.

The Briggsdale soil is moderately deep and well drained.

Typically, the surface layer is light brownish gray loam 4 inches thick. The subsurface layer is light gray silt loam 2 inches thick. The subsoil is brown and light brownish gray clay 14 inches thick. The substratum is light gray, calcareous clay loam 16 inches thick. Clay shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is slow, and the erosion hazard slight.

The very deep, moderately well drained Bone soil is on alluvial fans and valley filling side slopes. It formed in moderately alkaline alluvial deposits derived mostly from sedimentary rock.

Typically, the surface layer is white loam 2 inches thick. The subsoil is grayish brown clay loam 3 inches

thick. The substratum is grayish brown, calcareous clay loam to a depth of 60 inches.

Permeability is very slow. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Briggsdale soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Bone soil is mainly western wheatgrass, gardner saltbush, inland saltgrass, Indian ricegrass, and alkali sacaton. If the ecological condition deteriorates, greasewood and inland saltgrass become dominant. The potential plant community produces about 600 pounds of annual air-dry herbage per acre. The yield varies between 800 pounds in favorable years and 400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIs-2 dryland. The range site is Loamy for the Briggsdale soil and Saline Upland for the Bone soil.

34—Briggsdale-Bone loams, 2 to 6 percent slopes. These nearly level to undulating soils are on uplands. They formed in material weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Briggsdale soil makes up about 70 percent of the map unit, and the Bone soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Briggsdale soil is on hummocks, and the Bone soil is in depressions. The Briggsdale soil has a thicker surface layer and subsoil than the Bone soil. The Bone soil in this map unit may contain more gypsum than is typical for the series. Absted, Bidman, and Renohill soils make up 10 percent of this unit.

The moderately deep, well drained Briggsdale soil formed in residuum of sedimentary rock.

Typically, the surface layer is light brownish gray loam 4 inches thick. The subsurface layer is light gray silt loam 2 inches thick. The subsoil is brown and light brownish gray clay 14 inches thick. The substratum is light gray, calcareous clay loam 16 inches thick. Clay shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard moderate.

The very deep, moderately well drained Bone soil is on alluvial fans and valley filling side slopes. It formed in moderately alkaline alluvial deposits derived mainly from sedimentary rock.

Typically, the surface layer is white loam 2 inches thick. The subsoil is grayish brown clay loam 3 inches thick. The substratum is grayish brown, calcareous clay loam to 60 inches or more.

Permeability is very slow. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Briggsdale soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Bone soil is mainly western wheatgrass, gardner saltbush, inland saltgrass, Indian ricegrass, and alkali sacaton. If the ecological condition deteriorates, greasewood and inland saltgrass are dominant. The potential plant community produces about 600 pounds of annual air-dry herbage per acre. The yield varies between 800 pounds in favorable years and 400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy for the Briggsdale soil and Saline Upland for the Bone soil.

35—Briggsdale-Bone loams, 6 to 10 percent slopes. These sloping soils are on uplands. They formed in material weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Briggsdale soil makes up about 70 percent of the map unit, and the Bone soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately to the scale of mapping used. The Briggsdale soil is on hummocks, and the Bone soil is in depressions. The Briggsdale soil has a thicker surface layer and subsoil than the Bone soil. The Bone soil in this map unit may contain more gypsum than is typical for the series. Absted, Bidman, and Renohill soils make up 10 percent of this unit.

The Briggsdale soil is moderately deep and well drained.

Typically, the surface layer is light brownish gray loam 4 inches thick. The subsurface layer is light gray silt loam 2 inches thick. The subsoil is brown and light brownish gray clay 14 inches thick. The substratum is light gray, calcareous clay loam 16 inches thick. Clay shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The very deep, moderately well drained Bone soil is on alluvial fans and valley filling side slopes. It formed in moderately alkaline alluvial deposits derived mainly from sedimentary rock.

Typically, the surface layer is white loam 2 inches thick. The subsoil is grayish brown clay loam 3 inches thick. The substratum is grayish brown, calcareous clay loam to 60 inches or more.

Permeability is very slow. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Briggsdale soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies from 3,000 pounds in favorable years to 1,500 pounds in unfavorable years.

The plant community on the Bone soil is mainly western wheatgrass, gardner saltbush, inland saltgrass, Indian ricegrass, and alkali sacaton. If the ecological condition deteriorates, greasewood and inland saltgrass are dominant. The potential plant community produces about 600 pounds of annual air-dry herbage per acre. The yield varies between 800 pounds in favorable years and 400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy for the Briggsdale soil and Saline Upland for the Bone soil.

36—Butche fine sandy loam, 3 to 10 percent slopes, eroded. This shallow, somewhat excessively drained, gently sloping to rolling soil is on uplands. It formed in material weathered from hard, fine-grained sandstone. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average air temperature is about 46 degrees F. The frost-free season is about 120 days. The surface layer of this map unit has been disturbed by erosion. On about one-third of the map unit, soil has been removed by erosion, and on about one-third additional soil has been deposited as coppice mounds. The erosion and deposition make the surface hummocky. Small areas of Cushman and Spangler soils and a saline soil were included in mapping.

Typically, the surface layer of the Butche soil is light brownish gray fine sandy loam 4 inches thick. The underlying material is light gray and light brownish gray fine sandy loam 8 inches thick. Sandstone is at a depth of 12 inches.

Permeability is moderately rapid. The available water capacity is very low. The effective rooting depth is 7 to 20 inches. Surface runoff is moderate, and the erosion hazard high. The hazard of soil blowing is moderate.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, threadleaf sedge and blue grama are abundant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Loamy.

37—Butche-Spangler complex, 3 to 10 percent slopes. These gently sloping to rolling soils are on uplands. They formed in material weathered from sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Butche soil makes up about 60 percent of the map unit, and the Spangler soil about 20 percent. The Butche soil occurs on the crest of ridges, on knolls, and near the edge of rimrock. The Spangler soil occurs on wider divides and in level areas or depressions. The Butche soil is shallower over bedrock than the Spangler soil. Rock outcrop, Cushman and Lakoa soils, and a soil similar to the Butche soil but deeper over bedrock make up about 20 percent of this unit.

Typically, the surface layer is light gray fine sandy loam 4 inches thick. The underlying material is light gray and light brownish gray fine sandy loam 8 inches thick. Sandstone is at 12 inches.

Permeability is moderately rapid. The available water capacity is very low. The effective rooting depth is 7 to 20 inches. Surface runoff is rapid, and the erosion hazard high. The hazard of soil blowing is moderate.

The moderately deep, well drained Spangler soil formed in noncalcareous material derived from sandstone.

Typically, the surface layer is light brownish gray loam 6 inches thick. The subsoil is brown clay loam 18 inches

thick. The substratum is pale brown loam and clay loam 12 inches thick. Noncalcareous sandstone is at 36 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Butche soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, threadleaf sedge and blue grama are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies from 1,800 pounds in favorable years to 900 pounds in unfavorable years.

The plant community on the Spangler soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This map unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIe-14 dryland. The range site is Shallow Loamy for the Butche soil and Loamy for the Spangler soil.

38—Butche-Spangler complex, 10 to 30 percent slopes. These moderately steep and steep soils are on uplands. They formed in material weathered from sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Butche soil makes up about 60 percent of the map unit, and the Spangler soil 20 percent. The Butche soil is on crests of ridges, on knolls, and near the edge of rimrock. The Spangler soil is in level areas or in depressions. The Butche soil is shallower over bedrock than the Spangler soil. Rock outcrop, Cushman and Lakoa soils, and a soil similar to Butche but deeper over bedrock make up 20 percent of this unit.

The shallow, somewhat excessively drained Butche soil formed in material weathered from hard, fine-grained sandstone.

Typically, the surface layer is light gray fine sandy loam 4 inches thick. The underlying material is light gray and light brownish gray fine sandy loam 8 inches thick. Sandstone is at a depth of 12 inches.

Permeability is moderately rapid. The available water capacity is very low. The effective rooting depth is 7 to 20 inches. Surface runoff is rapid, and the erosion hazard high. The hazard of soil blowing is moderate.

The moderately deep, well drained Spangler soil formed in noncalcareous material derived from sandstone.

Typically, the surface layer is light brownish gray loam 6 inches thick. The subsoil is brown clay loam 18 inches thick. The substratum is pale brown loam and clay loam 12 inches thick. Noncalcareous sandstone is at a depth of 36 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Butche soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, threadleaf sedge and blue grama are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

The plant community on the Spangler soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Loamy for the Butche soil and Loamy for the Spangler soil.

39—Cadoma clay, 2 to 10 percent slopes. This moderately deep, well drained, nearly level to sloping soil is on uplands. It formed in fine textured material weathered from shale containing considerable amounts of sodium or salts. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Orella, Petrie, Gaynor, and Absted soils were included in mapping.

Typically, the surface layer of the Cadoma soil is light brownish gray clay 4 inches thick. The subsoil is light brownish gray, very strongly alkaline clay 8 inches thick. The substratum is light brownish gray, strongly alkaline clay 18 inches thick. Alkaline shale is at a depth of 30 inches.

Permeability is very slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community is mainly western wheatgrass, gardner saltbush, inland saltgrass, Indian ricegrass, and alkali sacaton. If the ecological condition deteriorates, greasewood and inland saltgrass are dominant. The potential plant community produces about 600 pounds of annual air-dry herbage per acre. The yield varies between 800 pounds in favorable years and 400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIs-12 dryland. The range site is Saline Upland.

40—Citadel-McCaffery complex, 3 to 10 percent slopes. These gently sloping and sloping soils are in the mountains. They formed in material derived from calcareous sandstone, limestone, and soft shale. The elevation is 4,000 to 6,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days.

The Citadel soil makes up about 60 percent of the map unit, the McCaffery soil 15 percent, and the Paunsaugunt soil 15 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. Larkson, Cordeston, Lakoa, and Maitland soils and Rock outcrop make up 10 percent of this unit.

The Citadel soil is very deep and well drained.

Typically, the surface layer is dark brown loam 3 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is brown and pinkish gray silt loam 16 inches thick. The subsoil is reddish brown and light reddish brown clay loam 27 inches thick. The substratum is reddish yellow, calcareous silt loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard high.

The very deep, well drained McCaffery soil formed in sandy material from fine-grained sandstone.

Typically, the surface layer is pale brown fine sand 4 inches thick. It is covered with 1 inch of organic mulch. The subsurface is very pale brown fine sand 16 inches thick. The subsoil is very pale brown fine sand with bands of brown loamy fine sand. It extends to a depth of 60 inches or more.

Permeability is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard slight. The hazard of soil blowing is high.

The shallow, well drained Paunsaugunt soil is on uplands. It formed in material weathered from limestone.

Typically, the surface layer is dark grayish brown loam 8 inches thick. The underlying material is light brownish gray, calcareous very channery loam 4 inches thick. Hard limestone is at a depth of 12 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches except for ponderosa pine, which has a root system that will penetrate deep into rock fractures. Surface runoff is slow, and the erosion hazard high.

This map unit is woodland. It provides grazing, wood fiber, and wildlife habitat. The site index for ponderosa pine is about 71 for Citadel and McCaffery soils and 50 for Paunsaugunt soil. Good woodland and grazing management is needed to help offset or minimize the limitations of these soils.

This unit may be seasonally saturated during snowmelt and periods of high rainfall. Logging with heavy equipment should be restricted when soils are wet to reduce rutting and soil compaction. Logging in winter may reduce the rutting and compaction problems.

The understory is bluegrass, Columbia needlegrass, snowberry, ceanothus, Oregon-grape, danthonia, chokecherry, and quaking aspen. Production of the understory ranges from 400 pounds dry weight per acre per year in the dense stands of pine to 1,200 pounds dry weight per acre per year in the more open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. The understory provides some food and cover for wildlife.

The capability unit is IVe-2, dryland.

41—Citadel-McCaffery complex, 10 to 30 percent slopes. These moderately steep and steep soils are in the mountains. They formed in material derived from calcareous sandstone, limestone, and soft shale. The elevation is 4,000 to 6,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days.

The Citadel soil makes up about 60 percent of the map unit, the McCaffery soil 15 percent, and the Paunsaugunt soil 15 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. Larkson, Cordeston, Lakoa, and Maitland soils and Rock outcrop make up 10 percent of this unit.

The Citadel soil is deep and well drained.

Typically, the surface layer is dark brown loam 3 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is brown and pinkish gray silt loam 16 inches thick. The subsoil is reddish brown clay loam 27 inches thick. The substratum is reddish yellow, calcareous silt loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

The very deep, well drained McCaffery soil formed in sandy material from fine-grained sandstone.

Typically, the surface layer is pale brown fine sand 4 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is very pale brown fine sand 16 inches thick. The subsoil is very pale brown fine sand with bands of brown loamy fine sand. It extends to a depth of 60 inches or more.

Permeability is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high. The hazard of soil blowing is high.

The shallow, well drained Paunsaugunt soil formed in uplands in material weathered from limestone.

Typically, the surface layer is dark grayish brown loam 8 inches thick. The underlying material is light brownish gray, calcareous very channery loam 4 inches thick. Hard limestone is at a depth of 12 inches.

Permeability is moderate. The available water capacity is very low. Effective rooting depth is 10 to 20 inches except for ponderosa pine, which has a root system that will penetrate deep in rock fractures. Surface runoff is rapid, and the erosion hazard high.

This map unit is woodland. It provides grazing, wood fiber, and wildlife habitat. The site index for ponderosa pine is about 71 for Citadel and McCaffery soils and 50 for Paunsaugunt soil. Included soils that have slope of more than 40 percent limit the use of certain types of harvesting equipment. They are subject to landslides during periods of snowmelt and high rainfall. Landslides can occur on undisturbed slopes or in roadcuts. Good woodland and grazing management is needed to offset or minimize the limitations of these soils.

The understory is bluegrass, Columbia needlegrass, snowberry, danthonia, and quaking aspen. Production of the understory ranges from 400 pounds dry weight per acre per year in dense stands of pine to 1,200 pounds dry weight per acre per year in more open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. The understory provides some food and cover for wildlife.

The capability unit is VIe-2 dryland.

42—Colombo loam, 0 to 3 percent slopes. This very deep, well drained, nearly level soil is on flood plains. It formed in alluvium. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 110 days. Small areas of Lynx and Cordeston soils, Colombo soil, flooded, and a soil similar to this Colombo soil except that it has a water table at a depth of 40 inches were included in mapping.

Typically, the surface layer of the Colombo soil is very dark grayish brown, dark brown, and dark grayish brown loam 16 inches thick. The underlying material is brown and grayish brown loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 50 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIc-46 dryland. The range site is Lowland.

43—Colombo loam, occasionally flooded, 0 to 3 percent slopes. This very deep, well drained, nearly level soil is on flood plains. It formed in alluvium. It is subject to occasional overflow. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 110 days. Small areas of Lynx and Cordeston soils and a soil that is similar to this Colombo soil but has a water table at a depth of 40 inches were included in mapping.

Typically, the surface layer of the Colombo soil is very dark grayish brown loam 16 inches thick. The underlying material is grayish brown and brown loam to a depth of 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight. Flooding may occur during high intensity rainstorms.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community is mainly green needlegrass, western wheatgrass, prairie sandreed, perennial forbs, and woody plants. If the ecological condition deteriorates, snowberry, American licorice, western yarrow, green sagewort, and goldenrod are dominant. The potential plant community produces about 3,000 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIc-46 dryland. The range site is Overflow.

44—Cordeston loam, 1 to 6 percent slopes. This very deep, well drained, nearly level to gently sloping soil is on valley filling alluvial fans. It has a thick dark surface layer. The elevation ranges from 5,200 to 6,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days. Small areas of Larkson, Lakoa, and Maitland soils and a soil that is similar to Cordeston but has a water table at 40 inches were included in mapping.

Typically, the surface layer is dark grayish brown and dark gray loam 8 inches thick. The subsoil is dark gray loam 32 inches thick. The substratum is brown loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate. Flooding may occur for brief periods during high intensity rainstorms.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Lowland.

45—Cordeston loam, 6 to 10 percent slopes. This very deep, well drained, sloping soil is on valley filling alluvial fans. It has a thick dark surface layer. The elevation ranges from 5,200 to 6,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days. Small areas of Larkson, Lakoa, and Maitland soils were included in mapping.

Typically, the surface layer of the Cordeston soil is dark grayish brown loam 8 inches thick. The subsoil is dark gray loam 32 inches thick. The substratum is brown loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high. Flooding may occur for very brief periods during high intensity rainstorms.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping.

Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

46—Cordeston-Lakoa loams, 2 to 6 percent slopes. These nearly level and gently sloping soils are on valley filling alluvial fans. They formed in alluvium in the mountains. The elevation is 4,500 to 6,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days.

The Cordeston soil makes up about 40 percent of the map unit, and the Lakoa soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Cordeston soil has a dark layer more than 20 inches thick in the upper part. The Lakoa soil has a light colored loam subsurface layer over a dark subsoil. Larkson and Maitland soils make up 30 percent of this complex.

The very deep, well drained Cordeston soil is on valley filled side slopes. It formed in alluvium.

Typically, the surface layer is dark grayish brown loam 8 inches thick. The subsoil is dark gray loam 32 inches thick. The substratum is brown loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more.

Surface runoff is slow, and the erosion hazard moderate. Flooding may occur for brief periods during high intensity rainstorms.

The deep, well drained Lakoa soils are in the mountains. They formed in sediment weathered from interbedded sandstone and shale.

Typically, the surface layer is dark grayish brown loam 2 inches thick. The subsurface layer is light brownish gray sandy loam 8 inches thick. The subsoil is brown clay loam 20 inches thick. The substratum is pale brown, calcareous clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is rangeland, woodland, and wildlife habitat.

Native vegetation is a 10- to 50-percent canopy of oak and ponderosa pine. Ponderosa pine has a site index of 72. The plant community in open areas is mainly green needlegrass, big bluestem, Canada wildrye, and perennial forbs. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Lowland.

47—Cushman loam, 1 to 6 percent slopes. This moderately deep, well drained, nearly level and undulating soil is on uplands. It formed in calcareous material from interbedded sandstone, shale, and loamstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Fort Collins, Zigweid, Renohill, Shingle, and Terry soils were included in mapping.

Typically, the surface layer of the Cushman soil is grayish brown loam 3 inches thick. The subsoil is light brownish gray clay loam 8 inches thick. The substratum is light brownish gray, calcareous clay loam 19 inches thick. Soft loamstone is at a depth of 30 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

48—Cushman loam, 6 to 10 percent slopes. This moderately deep, well drained, rolling soil is on uplands. It formed in calcareous material from interbedded sandstone, shale, and loamstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Fort Collins, Zigweid, Renohill, Shingle, and Terry soils were included in mapping.

Typically, the surface layer of the Cushman soil is grayish brown loam 3 inches thick. The subsoil is a light brownish gray clay loam 8 inches thick. The substratum is light brownish gray, calcareous clay loam 19 inches thick. Soft loamstone is at a depth of 30 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The

potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

49—Cushman-Fort Collins loams, 1 to 6 percent slopes. These nearly level and undulating soils are on uplands. They formed in calcareous material. The elevation ranges from 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Cushman soil makes up about 65 percent of the map unit, and the Fort Collins soil 25 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Cushman soil occurs on the upper and steeper slopes and on knolls. The Fort Collins soil occurs on lower and flatter slopes. Kim, Zigweid, and Thedalund soils make up 10 percent of this unit.

The moderately deep, well drained Cushman soil formed in calcareous material from interbedded sandstone, shale, and loamstone.

Typically, the surface layer is grayish brown loam 3 inches thick. The subsoil is light brownish gray clay loam 8 inches thick. The substratum is light brownish gray, calcareous clay loam 19 inches thick. Soft loamstone is at a depth of 30 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard moderate.

The very deep, well drained Fort Collins soil formed in calcareous loamy sediment on foot slopes.

Typically, the surface layer is grayish brown loam 8 inches thick. The subsoil is brown and light brownish gray clay loam 14 inches thick. The substratum is light gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

50—Cushman-Fort Collins loams, 6 to 10 percent slopes. These sloping soils are on uplands. They formed in calcareous material. The elevation ranges from 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Cushman soil makes up about 65 percent of the map unit, and the Fort Collins soil 25 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Cushman soil occurs on the upper and steeper parts of the landscape as well as on knolls. The Fort Collins soil occurs on the lower and flatter parts. Kim, Zigweid, and Thedalund soils make up 10 percent of this unit.

The moderately deep, well drained Cushman soil formed in calcareous material from interbedded sandstone, shale, and loamstone.

Typically, the surface layer is grayish brown loam 3 inches thick. The subsoil is light brownish gray clay loam 8 inches thick. The substratum is light brownish gray, calcareous clay loam 19 inches thick. Soft loamstone is at a depth of 30 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The very deep, well drained Fort Collins soil is on foot slopes. It formed in calcareous loamy sediments.

Typically, the surface layer is grayish brown loam 8 inches thick. The subsoil is brown and light brownish gray clay loam 14 inches thick. The substratum is light gray calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system

because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

51—Cushman-Renohill loams, 6 to 10 percent slopes. These sloping soils are on uplands. They formed in calcareous material from interbedded sandstone and shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Cushman soil makes up about 60 percent of the map unit, and the Renohill soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Renohill soil is finer textured than the Cushman soil. Shingle, Zigweid, Samsil, and Ulm soils make up 10 percent of this unit.

The moderately deep, well drained Cushman soil formed in calcareous material from interbedded sandstone, shale, and loamstone.

Typically, the surface layer is grayish brown loam 3 inches thick. The subsoil is a light brownish gray clay loam 8 inches thick. The substratum is light brownish gray, calcareous clay loam 19 inches thick. Soft loamstone is at a depth of 30 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The moderately deep, well drained Renohill soil formed in sediment weathered from sedimentary rock.

Typically, the surface layer is light brownish gray loam and grayish brown clay loam 5 inches thick. The subsoil is grayish brown and gray clay 16 inches thick. The substratum is grayish brown, calcareous clay loam 15 inches thick. Soft shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, big sagebrush and short grasses—mainly blue grama—are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

52—Cushman-Renohill loams, 10 to 30 percent slopes. These moderately steep and steep soils are on uplands. They formed in calcareous material from interbedded sandstone and shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Cushman soil makes up about 60 percent of the map unit, and the Renohill soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Renohill soil is finer textured than the Cushman soil. Shingle and Zigweid soils make up 10 percent of this unit.

The moderately deep, well drained Cushman soil formed in calcareous material from interbedded sandstone, shale, and loamstone.

Typically, the surface layer is grayish brown loam 3 inches thick. The subsoil is light brownish gray clay loam 8 inches thick. The substratum is light brownish gray, calcareous clay loam 19 inches thick. Soft loamstone is at a depth of 30 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The moderately deep, well drained Renohill soil formed in sediment weathered from sedimentary rock.

Typically, the surface layer is light brownish gray loam and grayish brown clay loam 5 inches thick. The subsoil is grayish brown and gray clay 16 inches thick. The substratum is grayish brown, calcareous clay loam 15 inches thick. Soft shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIe-2 dryland. The range site is Loamy.

53—Cushman-Shingle loams, 6 to 10 percent slopes. These sloping soils are on uplands. They formed in residuum of sandstone and shale. The elevation ranges from 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Cushman soil makes up about 40 percent of the map unit, the Shingle soil 30 percent, and the Zigweid soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Shingle soil is on crests of ridges and knolls, and the Cushman and Zigweid soils are on side slopes. In contrast to the Cushman soil, the Shingle soil is less than 20 inches deep over bedrock. The Zigweid soil has a more weakly defined subsoil than the Cushman soil. Kim and Thedalund soils make up 10 percent of this unit.

The moderately deep, well drained Cushman soil formed in calcareous material derived from interbedded sandstone, shale, and loamstone.

Typically, the surface layer is grayish brown loam 3 inches thick. The subsoil is a light brownish gray clay loam 8 inches thick. The substratum is light brownish gray, calcareous clay loam 19 inches thick. Soft loamstone is at a depth of 30 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The shallow, well drained Shingle soil formed in material weathered from soft, interbedded sandstone and shale.

Typically, the surface layer is light brownish gray loam 3 inches thick. The underlying material is light gray, calcareous loam 13 inches thick. Soft shale is at a depth of 16 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The very deep, well drained Zigweid soil formed in calcareous loamy alluvium washed from sedimentary rock. It is on terraces of rivers and streams, on alluvial fans in valleys, and on foot slopes.

Typically, the surface layer is grayish brown loam 6 inches thick. The subsoil is grayish brown clay loam 8 inches thick. The substratum is light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community on Cushman and Zigweid soils is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Shingle soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy for the Cushman and Zigweid soils and Shallow Loamy for the Shingle soil.

54—Cushman-Shingle loams, 10 to 30 percent slopes. These moderately steep and steep soils are on uplands. They formed in sediment from sandstone and loamstone. The elevation ranges from 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Cushman soil makes up about 40 percent of the map unit, the Shingle soil 30 percent, and the Zigweid soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Shingle soil is on crests of ridges and on knolls, and Cushman and Zigweid soils are on side slopes. In contrast to the Cushman soil, the Shingle soil is less than 20 inches deep over bedrock. The Zigweid soil has a more weakly defined subsoil than the Cushman soil. Kim and Thedalund soils make up 10 percent of this unit.

The moderately deep, well drained Cushman soil formed in calcareous material from interbedded sandstone, shale, and loamstone.

Typically, the surface layer is grayish brown loam 3 inches thick. The subsoil is light brownish gray clay loam 8 inches thick. The substratum is light brownish gray, calcareous clay loam 19 inches thick. Soft loamstone is at a depth of 30 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The shallow, well drained Shingle soil formed in material weathered from soft interbedded sandstone and shale.

Typically, the surface layer is light brownish gray loam 3 inches thick. The underlying material is light gray, calcareous loam 13 inches thick. Soft shale is at a depth of 16 inches.

Permeability is moderate. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The deep, well drained Zigweid soil formed in calcareous loamy alluvium washed from sedimentary rock. It is on terraces of rivers and streams, on alluvial fans in valleys, and on foot slopes.

Typically, the surface layer is grayish brown loam 6 inches thick. The subsoil is grayish brown clay loam 8 inches thick. The substratum is light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland. It provides grazing and wildlife habitat.

The plant community on Cushman and Zigweid soils is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Shingle soil is mainly little bluestem, bluebunch wheatgrass, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebush and forbs provide food and cover for wildlife.

The capability unit is VIe-2 dryland. The range site is Loamy for Cushman and Zigweid soils and Shallow Loamy for the Shingle soil.

55—Cushman-Terry complex, 6 to 10 percent slopes. These sloping soils are on uplands. They formed in calcareous material. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Cushman soil makes up about 60 percent of the map unit, and the Terry soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Cushman soil is on all positions of the slope, and the Terry soil occurs on sandy knolls and on the windward side of hills. The Terry soil is coarser textured than the Cushman soil. Shingle and Zigweid soils make up 10 percent of this unit.

The moderately deep, well drained Cushman soil formed in calcareous material from interbedded sandstone, shale, and loamstone.

Typically, the surface layer is grayish brown loam 3 inches thick. The subsoil is light brownish gray clay loam 8 inches thick. The substratum is light brownish gray, calcareous clay loam 19 inches thick. Soft loamstone is at a depth of 30 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The moderately deep, well drained Terry soil formed in residuum of soft sandstone.

Typically, the surface layer is grayish brown loamy fine sand 5 inches thick. The subsoil is brown fine sandy loam 11 inches thick. The substratum is light gray, calcareous loamy fine sand 16 inches thick. Soft fine-grained sandstone is at a depth of about 32 inches.

Permeability is moderately rapid. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is slow, and the erosion hazard high. The hazard of soil blowing is high.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community on the Cushman soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years, and 1,500 pounds in unfavorable years.

The plant community on the Terry soil is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small

animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy for the Cushman soil and Sandy for the Terry soil.

56—Cushman-Terry complex, 10 to 30 percent slopes. These moderately steep and steep soils are on uplands. They formed in calcareous material. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Cushman soil makes up about 60 percent of the map unit, and the Terry soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Cushman soil is in all positions on the slope, and the Terry soil is on sandy knolls and on slopes on the windward side of hills. The Terry soil is coarser textured than the Cushman soil. Shingle and Zigweid soils make up 10 percent of this unit.

The moderately deep, well drained Cushman soil formed in calcareous material from interbedded sandstone, shale, and loamstone.

Typically, the surface layer is grayish brown loam 3 inches thick. The subsoil is light brownish gray clay loam 8 inches thick. The substratum is light brownish gray, calcareous clay loam 19 inches thick. Soft loamstone is at a depth of 30 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The moderately deep, well drained Terry soil formed in residuum from soft sandstone.

Typically, the surface layer is grayish brown loamy fine sand 5 inches thick. The subsoil is brown fine sandy loam 11 inches thick. The substratum is light gray, calcareous loamy fine sand 16 inches thick. Soft fine-grained sandstone is at a depth of about 32 inches.

Permeability is moderately rapid. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is slow, and the erosion hazard high. The hazard of soil blowing is high.

This unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Cushman soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Terry soil is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIe-2 dryland. The range site is Loamy for the Cushman soil and Sandy for the Terry soil.

57—Emigrant loam, 1 to 6 percent slopes. This moderately deep, well drained, nearly level and undulating soil is on uplands. It formed in calcareous material over sandstone or shale bedrock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nunn, Razor, and Renohill soils and areas of the more sloping Emigrant soils were included in mapping.

Typically, the surface layer is grayish brown loam 5 inches thick. The subsoil is grayish brown clay 21 inches thick. The substratum is light gray, calcareous clay 6 inches thick. Soft shale is at a depth of 32 inches.

Permeability is moderately slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard moderate.

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 20 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

58—Emigrant loam, 6 to 10 percent slopes. This moderately deep, well drained, rolling soil is on uplands. It formed in calcareous material overlying sandstone or shale bedrock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nunn, Razor, and Renohill soils and an Emigrant soil differing in slope were included in mapping.

Typically, the surface layer of the Emigrant soil is grayish brown loam 5 inches thick. The subsoil is grayish brown clay 21 inches thick. The substratum is light gray, calcareous clay 6 inches thick. Soft shale is at a depth of 32 inches.

Permeability is moderately slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 20 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue use or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

59—Emigrant clay loam, 2 to 6 percent slopes. This moderately deep, well drained, nearly level to undulating soil is on uplands. It formed in calcareous material over sandstone or shale bedrock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nunn, Razor, and Renohill soils and the more sloping Emigrant soils were included in mapping.

Typically, the surface layer is grayish brown clay loam 5 inches thick. The subsoil is grayish brown clay 21 inches thick. The substratum is light gray, calcareous clay 6 inches thick. Soft shale is at a depth of 32 inches.

Permeability is moderately slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff and the erosion hazard are moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 20 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-1 dryland. The range site is Clayey.

60—Fort Collins loam, 0 to 1 percent slopes. This very deep, well drained, nearly level soil is on terraces and alluvial fans. It formed in alluvium. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Cushman, Vona, and Ulm soils and the more sloping Fort Collins soils were included in mapping.

Typically, the surface layer of the Fort Collins soil is grayish brown loam 8 inches thick. The subsoil is brown and light brownish gray clay loam 14 inches thick. The substratum is light gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 25 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIc-2 dryland. The range site is Loamy.

61—Fort Collins loam, 1 to 6 percent slopes. This very deep, well drained, nearly level to gently sloping soil is on terraces and on alluvial fans. It formed in alluvium. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Cushman, Vona, and Ulm soils and the more sloping Fort Collins soils were included in mapping.

Typically, the surface layer of the Fort Collins soil is grayish brown loam 8 inches thick. The subsoil is brown and light brownish gray clay loam 14 inches thick. The substratum is light gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff and the erosion hazard are moderate.

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 25 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

62—Fort Collins loam, 6 to 10 percent slopes. This very deep, well drained, sloping soil is on upland valley fills and on alluvial fans. It formed in alluvium. The elevation is 3,000 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Cushman, Vona, and Ulm soils and a Fort Collins soil that differs in slope were included in mapping.

Typically, the surface layer of the Fort Collins soil is grayish brown loam 8 inches thick. The subsoil is brown and light brownish gray clay loam 14 inches thick. The substratum is light gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

63—Fort Collins-Vona complex, 6 to 10 percent slopes. These sloping soils are on uplands and on alluvial fans. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Fort Collins soil makes up about 50 percent of the map unit, and the Vona soil 40 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Fort Collins soil is on lower slopes, and the Vona soil is on the upper slopes and ridges. The Vona soil is over 35 percent fine sand and coarser material. Cushman and Terry soils and Fort Collins-Vona complex that differs in slope make up 10 percent of this unit.

The very deep, well drained Fort Collins soil formed in alluvium on terraces and alluvial fans.

Typically, the surface layer is grayish brown loam 8 inches thick. The subsoil is brown clay loam 14 inches thick. The substratum is light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard high.

The very deep, well drained Vona soil formed in eolian or partly wind-reworked material on the uplands.

Typically, the surface layer is light brownish gray loamy fine sand 5 inches thick. The subsoil is brown and pale brown fine sandy loam 9 inches thick. The substratum is light yellowish brown, calcareous loamy sand to 60 inches or more.

Permeability is rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard is high. The hazard of soil blowing is high.

This unit is pastureland, hayland, rangeland, and wildlife habitat.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community on the Fort Collins soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Vona soil is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy for the Fort Collins soil and Sandy for the Vona soil.

64—Frazerton silty clay loam, 0 to 3 percent slopes. This very deep, well drained, nearly level soil formed in stratified alluvium. It is on narrow flood plains at an elevation of 3,200 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Haverson, Lohmiller, Stetter, and Twotop soils were included in mapping.

Typically, the surface layer of the Frazerton soil is dark grayish brown silty clay loam 14 inches thick. The underlying material is grayish brown silty clay and silty clay loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and the erosion hazard slight. Flooding may occur for brief periods in spring.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Most of this unit is cropland. Grass and alfalfa hay are the principal crops. Some small grain is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIc-46 dryland. The range site is Lowland.

65—Gaynor clay loam, 2 to 10 percent slopes. This moderately deep, well drained, nearly level to undulating soil is on uplands. It formed in residuum or in material locally transported from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Samsil, Limon, Renohill, and Nunn soils were included in mapping.

Typically, the surface layer of the Gaynor soil is light brownish gray and grayish brown, calcareous clay loam 5 inches thick. The underlying material is grayish brown, calcareous clay 27 inches thick. Shale is at a depth of 32 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey.

66—Gaynor-Limon clay loams, 6 to 10 percent slopes. These sloping soils are on uplands. They formed in residuum or in material locally transported from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Gaynor soil makes up about 45 percent of the map unit, the Limon soil 25 percent, and the Renohill soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Gaynor soil is on the upper parts of slopes and on knolls and ridges. The Limon soil is in depressions and on the lower parts of slopes. The Renohill soil is on the more residual slopes. Kim, Nunn, Samsil, and Thedalund soils make up 10 percent of this unit.

The moderately deep, well drained Gaynor soil formed in calcareous sediment weathered from sedimentary rock.

Typically, the surface layer is light brownish gray and grayish brown clay loam 5 inches thick. The underlying material is grayish brown, calcareous clay 27 inches thick. Shale is at a depth of 32 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard is high.

The very deep, well drained Limon soil formed in alluvial deposits on alluvial fans and terraces.

Typically, the surface layer is light brownish gray clay loam 7 inches thick. The underlying material is light brownish gray, calcareous clay to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard is high.

The moderately deep, well drained Renohill soil formed in sediment weathered from sedimentary rock.

Typically, the surface layer is light brownish gray clay loam 3 inches thick. The subsoil is grayish brown clay 18 inches thick. The substratum is grayish brown, calcareous clay 15 inches thick. Soft shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard is high.

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey.

67—Gaynor-Limon clay loams, 10 to 30 percent slopes. These moderately steep and steep soils formed in residuum or in material locally transported from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Gaynor soil makes up about 45 percent of the map unit, the Limon soil 25 percent, and the Renohill soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Gaynor soil is on the upper parts of slopes and on knolls and ridges. The Limon soil is in depressions and on lower parts of slopes. The Renohill soil is on the more residual slopes. Kim, Nunn, Samsil, and Thedalund soils make up 10 percent of this unit.

The moderately deep, well drained Gaynor soil formed in calcareous sediment weathered from sedimentary rock on uplands.

Typically, the surface layer is light brownish gray and grayish brown clay loam 5 inches thick. The underlying material is grayish brown, calcareous clay 27 inches thick. Shale is at a depth of 32 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The very deep, well drained Limon soil formed in alluvial deposits on alluvial fans and terraces.

Typically, the surface layer is light brownish gray clay loam 7 inches thick. The underlying material is light brownish gray, calcareous clay to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard is high.

The moderately deep, well drained Renohill soil formed in sediment weathered from sedimentary rock on uplands.

Typically, the surface layer is light brownish gray clay loam 3 inches thick. The subsoil is grayish brown clay 18 inches thick. The substratum is grayish brown, calcareous clay 15 inches thick. Soft shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland. It provides grazing and wildlife habitat.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIe-1 dryland. The range site is Clayey.

68—Glenberg fine sandy loam, 0 to 3 percent slopes. This very deep, well drained, nearly level soil is on flood plains and low terraces. It formed in thick, highly stratified alluvial sediments. The elevation is 3,200 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is 46 degrees F. The frost-free season is about 120 days. Small areas of Riverwash, of Bankard, Haverson, and Lohmiller soils, and of a Glenberg soil that receives additional moisture were included in mapping.

Typically, the surface layer of the Glenberg soil is light brownish gray fine sandy loam 5 inches thick. The underlying material is light brownish gray, calcareous sandy loam stratified with loam and loamy sand to 60 inches or more.

Permeability is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight. The hazard of soil blowing is moderate. Flooding may occur in spring.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Approximately 50 percent of this unit is cropland. Some areas are irrigated. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIc-5 dryland and IIs-5 irrigated. The range site is Lowland.

69—Grizzly-Virkula complex, 6 to 15 percent slopes. These sloping and moderately steep soils are on uplands of the mountains. They formed in material weathered from igneous and metamorphic rock. The elevation is 5,000 to 7,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days.

The Grizzly soil makes up about 45 percent of the map unit, and the Virkula soil 25 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. Citadel, Larkson, Cordeston, Onita, and Vanocker soils, Rock outcrop, and a soil that is similar to the Grizzly soil except that it has thicker horizons make up 30 percent of this unit.

The very deep, well drained Grizzly soil formed in material weathered from igneous rock.

Typically, the surface layer is grayish brown very channery loam 3 inches thick. The subsurface layer is pale brown and light yellowish brown very channery loam 14 inches thick. The subsoil is light brown very channery clay loam 35 inches thick. The substratum is light brown very channery clay loam to 60 inches or more.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 60 inches or more for trees. Surface runoff is rapid, and the erosion hazard high.

The Virkula soil is very deep and well drained.

Typically, the surface layer is brown silt loam 2 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is very pale brown silt loam 11 inches thick. The subsoil is brown clay 14 inches thick. It is underlain by brownish yellow gravelly clay loam, which extends to a depth of 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This unit is woodland. It provides grazing, production of wood fiber, and wildlife habitat. Some areas do not have forest cover and are used only for grazing. The site index for ponderosa pine is about 70 on the Virkula soil and 60 on the Grizzly soil. Good woodland and grazing management is needed to offset or minimize the limitations of these soils.

This unit may be seasonally saturated during snowmelt and periods of high rainfall. Logging with heavy equipment should be restricted when the soils are wet to reduce rutting and soil compaction. Logging in winter may reduce the rutting and compaction.

The understory is bluegrass, Columbia needlegrass, snowberry, Oregon-grape, quaking aspen, ceanothus, chokecherry, and danthonia. Production of the understory ranges from 400 pounds dry weight per acre per year in dense stands of pine to 1,200 pounds dry weight per acre per year in open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. The understory provides some food and cover for wildlife.

The capability unit is VIe-14 dryland.

70—Grizzly-Virkula complex, 15 to 60 percent slopes. These moderately steep to very steep soils are on uplands of the mountains. They formed in material weathered from igneous and metamorphic material. The elevation is 5,000 to 7,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days.

The Grizzly soil makes up about 60 percent of the map unit, and the Virkula soil 25 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. Citadel, Larkson, Onita, Cordeston, and Vanocker soils, Rock outcrop, and a soil that is similar to the Grizzly soil but has thicker horizons make up 15 percent of this unit.

The very deep, well drained Grizzly soil formed in material weathered from igneous rock.

Typically, the surface layer is grayish brown very channery loam 3 inches thick. The subsurface layer is brown and light yellowish brown channery clay loam 35 inches thick. The substratum is light brown very channery loam 14 inches thick. The subsoil is light brown very flaggy clay loam to 60 inches or more.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 60 inches or more for trees. Surface runoff is rapid, and the erosion hazard high.

The Virkula soil is deep and well drained.

Typically, the surface layer is brown silt loam 2 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is very pale brown silt loam 11 inches thick. The subsoil is brown clay 14 inches thick. It is underlain by brownish yellow gravelly clay loam, which extends to a depth of 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is woodland. It provides grazing, production of wood fiber, and wildlife habitat. Some areas do not have forest cover and are used only for grazing. The site index for ponderosa pine is about 70 for the Virkula soil and 60 for the Grizzly soil. Slope of over 40 percent may limit the use of certain types of harvesting equipment. Good woodland and grazing management is needed to offset or minimize the limitations of these soils.

The understory is bluegrass, Columbia needlegrass, snowberry, Oregon-grape, quaking aspen, ceanothus, chokecherry, and danthonia. Production of the understory ranges from 400 pounds dry weight per acre per year in dense stands of pine to 1,200 pounds dry weight per acre per year in open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. The understory provides some food and cover for wildlife.

The capability unit is VIIe-14 dryland.

71—Grummit shaly clay loam, 6 to 30 percent slopes. This shallow, well drained, undulating and steep soil is on uplands in a narrow band on the Mowry shale. It formed in clayey material weathered from acid shale. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Maggin soil and Rock outcrop were included in mapping.

Typically, the surface layer of the Grummit soil is light brownish gray shaly clay loam 4 inches thick. The underlying material is light brownish gray, acid shaly clay 7 inches thick. Platy shale is at a depth of 11 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 7 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community is mainly little bluestem, prairie sandreed, and sun sedge. If the ecological condition deteriorates, sun sedge and threeawn are dominant. The potential plant community produces about 1,300 pounds of annual air-dry herbage per acre. The yield varies between 1,600 pounds in favorable years and 800 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIIe-1 dryland. The range site is Shallow Porous Clay.

72—Grummit-Maggin complex, 3 to 10 percent slopes. These undulating and sloping soils are on

uplands. They formed in clayey material weathered from acid shales. They occur in a narrow band on the Mowry shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Grummit soil makes up about 50 percent of the map unit, the Maggin soil 20 percent, and the Shingle soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Grummit soil is on ridges and the upper part of slopes. The Maggin soil is in depressions and along drainageways. The Shingle soil is on isolated remnants of soft shale bedrock. Rock outcrop and Querc soils make up 10 percent of this unit.

The Grummit soil is shallow and well drained. Typically, the surface layer is light brownish gray clay loam 4 inches thick. The underlying material is light brownish gray, acid shaly clay 7 inches thick. Platy shale is at a depth of 11 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 7 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The Maggin soil is moderately deep and well drained. Typically, the surface layer is dark grayish brown shaly clay loam 3 inches thick. The underlying material is dark grayish brown, strongly acid clay 33 inches thick. Shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard moderate.

The shallow, well drained Shingle soil formed in material weathered from soft interbedded sandstone and shale.

Typically, the surface layer is light brownish gray loam 3 inches thick. The underlying material is light gray, calcareous loam 13 inches thick. Soft shale is at a depth of 16 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Grummit soil is mainly little bluestem, prairie sandreed, and sun sedge. If the ecological condition deteriorates, sun sedge and threeawn are dominant. The potential plant community produces about 1,300 pounds of annual air-dry herbage per acre. The yield varies between 1,600 pounds in favorable years and 800 pounds in unfavorable years.

The plant community on the Maggin soil is mainly little bluestem, prairie sandreed, and sun sedge. If the ecological condition deteriorates, sun sedge and threeawn are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Shingle soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIe-14 dryland. The range site is Shallow Porous Clay for the Grummit soil, Porous Clay for the Maggin soil, and Shallow Loamy for the Shingle soil.

73—Grummit-Maggin complex, 10 to 60 percent slopes. These moderately steep to very steep soils are on uplands. They formed in clayey material weathered from acid shale. They occur in a narrow band on the Mowry shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Grummit soil makes up about 50 percent of the map unit, the Maggin soil 20 percent, and the Shingle soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Grummit soil is on ridges and the upper part of slopes. The Maggin soil is in depressions and along drainageways. The Shingle soil is on isolated remnants of soft shale bedrock. Rock outcrop and Querc soil make up 10 percent of this unit.

The Grummit soil is shallow and well drained. Typically, the surface layer is light brownish gray shaly clay loam 4 inches thick. The underlying material is light brownish gray, acid shaly clay 7 inches thick. Platy shale is at a depth of 11 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 7 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The Maggin soil is moderately deep and well drained. Typically, the surface layer is dark grayish brown shaly clay loam 3 inches thick. The underlying material is dark grayish brown, strongly acid clay 33 inches thick. Shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The shallow, well drained Shingle soil formed in material weathered from soft interbedded sandstone and shale.

Typically, the surface layer is light brownish gray loam 3 inches thick. The underlying material is light gray, calcareous loam 13 inches thick. Soft shale is at a depth of 16 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20

inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Grummit soil is mainly little bluestem, prairie sandreed, and sun sedge. If the ecological condition deteriorates, sun sedge and threeawn are dominant. The potential plant community produces about 1,300 pounds of annual air-dry herbage per acre. The yield varies between 1,600 pounds in favorable years and 800 pounds in unfavorable years.

The plant community on the Maggin soil is mainly little bluestem, prairie sandreed, and sun sedge. If the ecological condition deteriorates, sun sedge and threeawn are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Shingle soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Porous Clay for the Grummit soil, Porous Clay for the Maggin soil, and Shallow Loamy for the Shingle soil.

74—Grummit-Querc complex, 3 to 10 percent slopes. These gently sloping and sloping soils are on a narrow ridge of the Mowry shale on uplands. They formed in clayey material weathered from acid shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is 46 degrees F. The frost-free season is about 120 days.

The Grummit soil makes up about 30 percent of the map unit, the Querc soil 20 percent, and the Maggin soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Grummit soil is on the crests of ridges and knolls. The Maggin soil is on side slopes. The Querc soil is intermingled with the other soils. Louviers, Razor, Rhoame, Samsil, and Winler soils and Rock outcrop make up 30 percent of the unit. In the area around New Haven and in the northern part of the county, soils having a subsurface layer and soils having a silty surface layer were included in this map unit.

The Grummit soil is shallow and well drained. Typically, the surface layer is light brownish gray shaly clay loam 4 inches thick. The underlying material is light brownish gray, acid shaly clay 7 inches thick. Platy shale is at a depth of 11 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 7 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The Querc soil is moderately deep and well drained. Typically, the surface layer is grayish brown silt loam 5 inches thick. The subsoil is grayish brown silty clay loam 9 inches thick. The substratum is light brownish gray, slightly acid shaly silty clay loam 21 inches thick. Shale is at a depth of 35 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The Maggin soil is moderately deep and well drained. Typically, the surface layer is dark grayish brown shaly clay loam 3 inches thick. The underlying material is dark grayish brown, strongly acid very shaly clay 33 inches thick. Shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland. It provides grazing and wildlife habitat.

There are scattered areas of ponderosa pine. In some places, the trees are large enough for harvest, but the site index is generally low—about 50. Production of wood does not justify woodland management practices. Seedling establishment is poor. The trees provide shelter for livestock and wildlife.

The plant community on the Grummit soil is mainly little bluestem, prairie sandreed, and sun sedge. If the ecological condition deteriorates, sun sedge and threeawn are dominant. The potential plant community produces about 1,300 pounds of annual air-dry herbage per acre. The yield varies between 1,600 pounds in favorable years and 800 pounds in unfavorable years.

The plant community on the Querc soil is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama, big sagebrush, oak, and ponderosa pine are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

The plant community on the Maggin soil is mainly little bluestem, prairie sandreed, oak, and sun sedge. If the ecological condition deteriorates, sun sedge and threeawn are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIe-1 dryland. The range site is Shallow Porous Clay for the Grummit soil, Clayey for the Querc soil, and Porous Clay for the Maggin soil.

75—Grummit-Querc complex, 10 to 60 percent slopes. These moderately steep to very steep soils are on a narrow ridge of Mowry shale on uplands. They formed in clayey material weathered from acid shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Grummit soil makes up about 30 percent of the map unit, the Querc soil 20 percent, and the Maggin soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Grummit soil is on crests of ridges and knolls. The Maggin soil is on side slopes. The Querc soil is intermingled with the other soils. Louviers, Razor, Samsil, and Winler soils and Rock outcrop make up 30 percent of this unit.

The Grummit soil is shallow and well drained. Typically, the surface layer is light brownish gray shaly clay loam 4 inches thick. The underlying material is light brownish gray, acid shaly clay 7 inches thick. Platy shale is at a depth of 11 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 7 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The Querc soil is moderately deep and well drained. Typically, the surface layer is grayish brown silt loam 5 inches thick. The subsoil is grayish brown silty clay loam 9 inches thick. The substratum is light brownish gray, slightly acid shaly silty clay loam 21 inches thick. Shale is at a depth of 35 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The Maggin soil is moderately deep and well drained. Typically, the surface layer is dark grayish brown shaly clay loam 3 inches thick. The underlying material is dark grayish brown, strongly acid very shaly clay 33 inches thick. Shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland. It provides grazing and wildlife habitat.

There are scattered areas of ponderosa pine. In some places, the trees are large enough for harvest, but the site index is generally low. Production of wood does not justify woodland management practices. Seedling establishment is poor. The trees provide shelter for livestock and wildlife.

The plant community on the Grummit soil is mainly little bluestem, prairie sandreed, and sun sedge. If the ecological condition deteriorates, sun sedge and threeawn are dominant. The potential plant community produces about 1,300 pounds of annual air-dry herbage per acre. The yield varies between 1,600 pounds in favorable years and 800 pounds in unfavorable years.

The plant community on the Querc soil is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama, big sagebrush, oak, and ponderosa pine are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

The plant community on the Maggin soil is mainly little bluestem, prairie sandreed, oak, and sun sedge. If the ecological condition deteriorates, sun sedge and threeawn are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Porous Clay for the Grummit soil, Clayey for the Querc soil, and Porous Clay for the Maggin soil.

76—Gullied land. Gullied land consists of highly dissected valleys and uplands entrenched by numerous steep-sided actively eroding gullies. The areas consist of deeply entrenched drainageways or a network of gullies. Because the gullies dominate the landscape, the areas of this miscellaneous area are typically unusable. Small isolated bodies of soils are between the gullies in many places and may afford limited grazing.

Gullied land is used for grazing and wildlife habitat.

The capability unit is VIIIe-82.

77—Haverson loam, 0 to 1 percent slopes. This very deep, well drained, nearly level soil is on flood plains and low terraces of the major streams. It formed in stratified calcareous alluvium. The elevation is 3,200 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Glenberg and Lohmiller soils and areas of Haverson soils that differ in slope or receive additional moisture were included in mapping.

Typically, the surface layer of the Haverson soil is pale brown loam 4 inches thick. The underlying material is pale brown, calcareous loam stratified with thin lenses of clay loam and fine sandy loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is used for cropland, pastureland, hayland, and wildlife habitat.

Approximately 50 percent of this unit is cropland. Some areas are irrigated. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIc-2 dryland and IIe-2 irrigated. The range site is Lowland.

78—Haverson loam, 1 to 6 percent slopes. This very deep, well drained, nearly level to gently sloping soil is on flood plains and low terraces of the major streams. It formed in stratified calcareous alluvium. The elevation is 3,200 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Glenberg and Lohmiller soils and areas of Haverson soils that differ in slope or receive additional moisture were included in mapping.

Typically, the surface layer of the Haverson soil is pale brown loam 4 inches thick. The underlying material is pale brown, calcareous loam stratified with thin lenses of clay loam and fine sandy loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 50 percent of this unit is cropland. Some areas are irrigated. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland and IIe-2 irrigated. The range site is Lowland.

79—Haverson loam, saline, 0 to 3 percent slopes. This very deep, well drained, nearly level saline soil is on flood plains and low terraces of the major streams. It formed in stratified calcareous alluvium. The elevation is 3,200 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Glenberg and Lohmiller soils and areas of Haverson soils that differ in slope or receive additional moisture were included in mapping.

Typically, the surface layer of the Haverson soil is pale brown moderately saline loam 4 inches thick. The underlying material is pale brown, moderately saline loam stratified with thin lenses of clay loam and fine sandy loam to 60 inches or more.

Permeability is moderate. The available water capacity is moderately high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community is mainly alkali sacaton, western wheatgrass, inland saltgrass, and greasewood. If the ecological condition deteriorates, inland saltgrass and greasewood are dominant. The potential plant community produces about 2,900 pounds of annual air-dry herbage per acre. The yield varies between 3,500 pounds in favorable years and 1,900 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIs-71 dryland. The range site is Saline Lowland.

80—Haverson silty clay loam, 0 to 2 percent slopes. This very deep, well drained, nearly level soil is on flood plains and low terraces of the major streams. It formed in stratified calcareous alluvium. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Glenberg and Lohmiller soils and areas of Haverson soils that differ in slope or receive additional moisture were included in mapping.

Typically, the surface layer of the Haverson soil is pale brown silty clay loam 4 inches thick. The underlying material is pale brown, calcareous loam stratified with thin lenses of clay loam and fine sandy loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 50 percent of this unit is cropland. Some areas are irrigated. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIc-1 dryland and IIs-16 irrigated. The range site is Lowland.

81—Haverson silty clay loam, 2 to 6 percent slopes. This very deep, well drained, nearly level to gently sloping soil is on flood plains and low terraces of major streams. It formed in stratified calcareous alluvium. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Glenberg and Lohmiller soils and areas of Haverson soils that differ in slope or receive additional moisture were included in mapping.

Typically, the surface layer of the Haverson soil is pale brown silty clay loam 4 inches thick. The underlying material is pale brown, calcareous loam stratified with thin lenses of clay loam and fine sandy loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 50 percent of this unit is cropland. Some areas are irrigated. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-1 dryland and irrigated. The range site is Lowland.

82—Heldt clay loam, 0 to 2 percent slopes. This very deep, well drained, nearly level soil is on alluvial fans and valley filling side slopes. It formed in fine-textured alluvial sediments derived mainly from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Razor, Gaynor, Limon, and Twotop soils and a more sloping Heldt soil were included in mapping.

Typically, the surface layer of the Heldt soil is light brownish gray clay loam 2 inches thick. The subsoil is grayish brown clay 20 inches thick. The substratum is light brownish gray, calcareous clay to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIs-1 dryland. The range site is Clayey.

83—Heldt clay loam, 2 to 6 percent slopes. This very deep, well drained, nearly level to gently sloping soil is on alluvial fans and valley filling side slopes. It formed in fine-textured alluvial sediments derived mainly from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The

average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Razor, Gaynor, Limon, and Twotop soils and a more sloping Heldt soil were included in mapping.

Typically, the surface layer of the Heldt soil is light brownish gray clay loam 2 inches thick. The subsoil is grayish brown clay 20 inches thick. The substratum is light brownish gray, calcareous clay to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-1 dryland. The range site is Clayey.

84—Higgins silt loam, 0 to 3 percent slopes. This is a very deep, poorly drained, nearly level, and highly gypsiferous soil. It is on large alluvial fans or valley fill on red beds. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Gypnevee, Nevee, Tilford, and Vale soils and soils that are similar to the Higgins soil but do not contain red material were included in mapping.

Typically, the surface layer of the Higgins soil is light brownish gray silt loam 10 inches thick. The subsoil is pinkish gray and reddish yellow silt loam 23 inches thick. It contains large quantities of gypsum. The substratum is reddish yellow silt loam containing large quantities of gypsum to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight. The water table is 1/2 foot to 2 feet below the surface from October to July. The soil is subject to common flooding of brief duration from March to October.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community is mainly alkali cordgrass, alkali sacaton, western wheatgrass, and greasewood. If the ecological condition deteriorates, inland saltgrass is dominant. The potential plant community produces about 4,000 pounds of annual air-dry herbage per acre. The yield varies between 5,000 pounds in favorable years and 2,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIw-70 dryland. The range site is Saline Subirrigated.

85—Kadoka loam, 1 to 6 percent slopes. This moderately deep, well drained, nearly level and undulating soil is on uplands on high divides in the foothills. It formed in silty material weathered or locally transported from siltstone and sandstone. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Boneek, Norka, and Butche soils and more sloping Kadoka soils were included in mapping.

Typically, the surface layer of the Kadoka soil is grayish brown loam 7 inches thick. The subsoil is brown silty clay loam 6 inches thick. The substratum is pale brown and light brownish gray, calcareous silt loam 18 inches thick. Soft sandstone is at a depth of about 31 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 25 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, fox, coyote, bobcats, and other small animals. Oak and hawthorn provide food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

86—Kadoka loam, 6 to 10 percent slopes. This moderately deep, well drained, rolling soil is on high divides in the foothills. It formed in silty material weathered or locally transported from siltstone and sandstone. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Boneek, Norka, and Butche soils and a Kadoka soil that differs in slope were included in mapping.

Typically, the surface layer of the Kadoka soil is grayish brown loam 7 inches thick. The subsoil is brown silty clay loam 6 inches thick. The substratum is pale brown and light brownish gray, calcareous silt loam 18 inches thick. Soft sandstone is at a depth of 31 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 25 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

87—Kim loam, 1 to 6 percent slopes. This very deep, well drained, nearly level to gently sloping soil is on alluvial fans. It formed in sediments derived from a variety of bedrock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 115 days. Small areas of Alice, Shingle, and Zigweid soils and areas of Kim soils that differ in slope and in texture of the surface layer were included in mapping.

Typically, the surface layer of the Kim soil is brown loam 4 inches thick. The underlying material is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

88—Kim loam, 6 to 10 percent slopes. This very deep, well drained, sloping soil is on alluvial fans. It formed in sediments derived from a variety of bedrock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 115 days. Small areas of Alice, Shingle, and Zigweid soils and areas of Kim soils that differ in slope and texture of the surface layer were included in mapping.

Typically, the surface layer of the Kim soil is brown loam 4 inches thick. The underlying material is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small area of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system

because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

89—Kim clay loam, 0 to 3 percent slopes. This very deep, well drained, nearly level soil is on alluvial fans. It formed in sediments derived from a variety of bedrock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degress F. The frost-free season is about 115 days. Small areas of Alice, Shingle, and Zigweid soils and areas of Kim soils that differ in slope and texture were included in mapping.

Typically, the surface layer of the Kim soil is grayish brown clay loam 4 inches thick. The underlying material is light brownish gray, calcareous clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Small areas of this soil are cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIc-1 dryland. The range site is Clayey.

90—Kim-Zigweid loams, 3 to 10 percent slopes. These gently sloping and sloping soils formed in sediments on locally transported material weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Kim soil makes up about 40 percent of the map unit, the Zigweid soil 30 percent, and the Thedalund soil 20 percent. These soils occur in such intermingled patterns that it was impractical to map them separately. The Thedalund soil differs from the Kim soil in having bedrock at 20 to 40 inches. The Zigweid soil differs from the Kim soil in having a subsoil. Cushman, Shingle, and Fort Collins soils make up 10 percent of this unit.

The very deep, well drained Kim soil formed in sediments derived from a variety of bedrock.

Typically, the surface layer is brown loam 4 inches thick. The underlying material is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

The very deep, well drained Zigweid soil is on terraces and fans. It formed in calcareous loamy alluvium washed from sedimentary rock.

Typically, the surface layer is grayish brown loam 6 inches thick. The subsoil is grayish brown clay loam 8 inches thick. The substratum is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

The moderately deep, well drained Thedalund soil is on uplands. It formed in residuum and localized alluvium from sedimentary rock.

Typically, the surface layer is light brownish gray loam 4 inches thick. The underlying material is light gray and white, calcareous loam 18 inches thick. Bedrock is at a depth of 22 inches.

Permeability is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland. It provides grazing and wildlife habitat.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The

potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

91—Lail-Stovho loams, 3 to 20 percent slopes. These gently sloping to steep soils are in the mountains. They formed in material derived from calcareous sandstone, limestone, and soft shale. The elevation is 6,200 to 6,600 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days.

The Lail soil makes up about 50 percent of the map unit, and the Stovho soil 20 percent. These soils occur in such intermingled patterns that it was impractical to map them separately. Soils that are similar to McCaffery soil but have a cooler temperature and soils that are similar to Lail soil but have bedrock at a depth of less than 60 inches make up 30 percent of this unit.

The very deep, well drained Lail soil formed in material weathered from sandstone, limestone, and soft shale.

Typically, the surface layer is pale brown loam 4 inches thick. It is covered with 2 inches of organic mulch. The subsurface layer is light brown clay loam 4 inches thick. The subsoil is reddish brown clay 34 inches thick. The substratum is light reddish brown clay loam to 60 inches or more.

Permeability is slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate to rapid, and the erosion hazard high.

The deep, well drained Stovho soil formed in material weathered from limestone.

Typically, the surface layer is dark grayish brown loam 3 inches thick. It is covered with 3 inches of organic mulch. The subsurface layer is light gray loam 6 inches thick. The subsoil is brown and light brown silty clay loam 33 inches thick. The substratum is pink clay loam 3 inches thick. Limestone is at a depth of 45 inches.

Permeability is moderately slow. Available water capacity is moderate. The effective rooting depth is 40 to 60 inches. Surface runoff is moderate, and the erosion hazard high.

This unit is woodland. It provides grazing, production of wood fiber, and wildlife habitat. The site index for ponderosa pine is about 71. Good woodland and grazing management is needed to offset or minimize the limitations of these soils.

This unit may have a seasonal high water table during snowmelt and periods of high rainfall. Logging with heavy equipment should be restricted when the soils are wet to reduce rutting and soil compaction. Limiting logging to winter can reduce rutting and compaction.

The understory is bluegrass, Columbia needlegrass, snowberry, Oregon-grape, quaking aspen, ceanothus, chokecherry, and danthonia. Production of the understory ranges from 400 pounds dry weight per acre per year in dense stands of pine to 1,200 pounds dry weight per acre per year in open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIe-2 dryland.

92—Lakoa-Butche complex, 3 to 10 percent slopes. These gently sloping and sloping soils are on uplands of foothills and in canyons. They formed in material weathered or locally transported from sandstone and shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 100 days.

The Lakoa soil makes up about 40 percent of the map unit, and the Butche soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Lakoa soil is on side slopes, and the Butche soil is on ridges and knolls. Because the Lakoa soil is under dense tree cover and has an organic mulch on the surface, it has a cooler soil temperature than the Butche soil, which is under a tree canopy of only about 10 percent. Larkson, McCaffery, Shingle, Thedalund, and Samsil soils and Rock outcrop make up 30 percent of the unit.

The deep, well drained Lakoa soil formed in sediments weathered from interbedded sandstone and shale.

Typically, the surface layer is dark grayish brown loam 2 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is light brownish gray loam 8 inches thick. The subsoil is brown clay loam 20 inches thick. The substratum is pale brown, calcareous clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 40 inches or more. Surface runoff is rapid, and the erosion hazard high.

The shallow, somewhat excessively drained Butche soil formed in material weathered from hard, fine-grained sandstone.

Typically, the surface layer is light brownish gray fine sandy loam 4 inches thick. The underlying material is light brownish gray and light gray fine sandy loam 8 inches thick. Sandstone is at a depth of 12 inches.

Permeability is moderately rapid. The available water capacity is very low. The effective rooting depth is 7 to 20 inches. Surface runoff is rapid, and the erosion hazard high. The hazard of soil blowing is moderate.

This unit is woodland. It provides grazing, production of wood fiber, and wildlife habitat. The site index for ponderosa pine is about 72 for the Lakoa soil and about 51 for the Butche soil. Good woodland and grazing management is needed to offset or minimize the limitations of these soils.

The understory is bluegrass, Columbia needlegrass, bromegrass, little bluestem, Oregon-grape, chokecherry, and juniper. Production of the understory ranges from 400 pounds dry weight per acre per year in dense stands of pine to 1,000 pounds dry weight per acre per year in open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland.

93—Lakoa-Butche complex, 10 to 60 percent slopes. These moderately steep to very steep soils are on uplands of foothills and in canyons. They formed in material weathered or locally transported from sandstone and shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 100 days.

The Lakoa soil makes up about 40 percent of the map unit, and the Butche soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Lakoa soil is on side slopes, and the Butche soil is on ridges and knolls. Because the Lakoa soil is under dense tree cover and has an organic mulch on the surface, it has a cooler soil temperature than the Butche soil, which is under a tree canopy of about only 10 percent. Shingle, Thedalund, Larkson, and Samsil soils and Rock outcrop make up 30 percent of the unit.

The deep, well drained Lakoa soil formed in sediments weathered from interbedded sandstone and shale.

Typically, the surface layer is dark grayish brown loam 2 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is light brownish gray sandy loam 8 inches thick. The subsoil is brown clay loam 20 inches thick. The substratum is pale brown, calcareous clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 40 inches or more. Surface runoff is rapid, and the erosion hazard high.

The shallow, somewhat excessively drained Butche soil formed in material weathered from hard, fine-grained sandstone.

Typically, the surface layer is light brownish gray fine sandy loam 4 inches thick. The underlying material is light gray and light brownish gray fine sandy loam 8 inches thick. Sandstone is at a depth of about 12 inches.

Permeability is moderately rapid. The available water capacity is very low. The effective rooting depth is 7 to 20 inches. Surface runoff is moderate, and the erosion hazard high. The hazard of soil blowing is moderate.

This unit is woodland. It provides grazing, production of wood fiber, and wildlife habitat. The site index for ponderosa pine is about 72 for the Lakoa soil and about 51 for the Butche soil. Slope of over 40 percent may limit the use of certain types of harvesting equipment. Areas where slopes are more than 40 percent are subject to landslides in times of snowmelt and periods of high rainfall. Landslides may occur on undisturbed slopes or in road cuts. Good woodland and grazing management is needed to offset or minimize the limitations of these soils.

The understory is bluegrass, Columbia needlegrass, bromegrass, little bluestem, Oregon-grape, chokecherry, and juniper. Production of the understory ranges from 400 pounds dry weight per acre per year in dense stands of pine to 1,000 pounds dry weight per acre per year in open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIe-2 dryland.

94—Lakoa-Satanta loams, 1 to 6 percent slopes. These nearly level to gently sloping soils are on uplands. They formed in material weathered or locally transported from sandstone and shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 110 days.

The Lakoa soil makes up about 40 percent of the map unit, and the Satanta soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Satanta soil has a dark colored surface layer. The Lakoa soil has a light colored surface layer. It generally occupies the timbered areas. Because it is under dense tree cover and has an organic mulch on the surface, it has a cooler soil temperature than the Satanta soil, which is in grass-covered parks that have a sparse cover of oak. Butche, Maitland, Samsil, Shingle, Wages, Kim, Larkson, and Thedalund soils make up 30 percent of this unit.

The deep, well drained Lakoa soil formed in sediments weathered from interbedded sandstone and shale.

Typically, the surface layer is dark grayish brown loam 2 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is light brownish gray sandy loam 8 inches thick. The subsoil is brown clay loam 20 inches thick. The substratum is pale brown, calcareous clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 40 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

The very deep, well drained Satanta soil is on alluvial fans. It formed in material weathered from sandstone.

Typically, the surface layer is grayish brown loam 6 inches thick. The subsoil is grayish brown and brown clay loam 12 inches thick. The substratum is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more.

Surface runoff is moderate, and the erosion hazard moderate.

This unit is cropland, pastureland, hayland, rangeland, woodland, and wildlife habitat.

Only a small part of this unit is used for cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

Pine has been cleared from the Lakoa soil. The plant community on that soil is mainly bluegrass, western and thickspike wheatgrass, green and Columbia needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, bluegrass and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Satanta soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

Areas of woodland are used for grazing, production of wood fiber, and wildlife habitat. The site index of ponderosa pine for the Lakoa soil is 72. Good woodland and grazing management is needed to offset or minimize the limitations of these soils. Some areas that were formerly in woodland but have been cleared to grow crops or hay could be planted to pine and managed as woodland.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy for the Satanta soil.

95—Lakoa-Satanta loams, 6 to 10 percent slopes. These rolling soils are on uplands. They formed in material weathered or locally transported from sandstone and shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 110 days.

The Lakoa soil makes up about 40 percent of the map unit, and the Satanta soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Satanta soil has a dark colored surface layer. The Lakoa soil has a light colored surface layer. It is mainly in the timbered areas. Because it is under dense tree cover and has an organic mulch on the surface, it has a cooler soil temperature than the Satanta soil, which is in grass-covered parks that have a sparse cover of oak. Butche, Maitland, Samsil, Shingle, Wages, Kim, Larkson, and Thedalund soils make up 30 percent of this unit.

The deep, well drained Lakoa soil formed in sediments weathered from interbedded sandstone and shale.

Typically, the surface layer is dark grayish brown loam 2 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is light brownish gray sandy loam 8 inches thick. The subsoil is brown clay loam 20 inches thick. The substratum is pale brown, calcareous clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 40 inches or more. Surface runoff is rapid, and the erosion hazard high.

The very deep, well drained loamy Satanta soil is on alluvial fans. It formed in material weathered from sandstone.

Typically, the surface layer is grayish brown loam 6 inches thick. The subsoil is grayish brown and brown clay loam 12 inches thick. The substratum is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This unit is pastureland, hayland, rangeland, woodland, and wildlife habitat.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

In places, the Lakoa soil has been cleared of trees. The plant community in these cleared areas is mainly bluegrass, western and thickspike wheatgrass, green and Columbia needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, bluegrass and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Satanta soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

Areas of woodland are used for grazing, production of wood fiber, and wildlife habitat. The site index of ponderosa pine for the Lakoa soil is 72. Good woodland and grazing management is needed to offset or minimize

the limitations of these soils. Some areas that were formerly in woodland but have been cleared to grow crops or hay could be planted to pine and managed as woodland.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy for the Satanta soil.

96—Lakoa-Satanta loams, 10 to 30 percent slopes. These moderately steep and steep soils are on uplands. They formed in material weathered or locally transported from sandstone and shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 110 days.

The Lakoa soil makes up about 40 percent of the map unit, and the Satanta soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Satanta soil has a dark colored surface layer. The Lakoa soil has a light colored surface layer. It usually is in the timbered areas. Because it is under dense tree cover and has organic mulch on the surface, it has a cooler soil temperature, than the Satanta soil, which is in grass-covered parks that have a sparse cover of oak. Butche, Maitland, Samsil, Shingle, Wages, Kim, Larkson, and Thedalund soils make up 30 percent of this unit.

The deep, well drained Lakoa soil formed in sediments weathered from interbedded sandstone and shale.

Typically, the surface layer is dark grayish brown loam 2 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is light brownish gray sandy loam 8 inches thick. The subsoil is brown clay loam 20 inches thick. The substratum is pale brown, calcareous clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 40 inches or more. Surface runoff is rapid, and the erosion hazard high.

The very deep, well drained loamy Satanta soil is on alluvial fans. It formed in material weathered from sandstone.

Typically, the surface layer is grayish brown loam 6 inches thick. The subsoil is grayish brown and brown clay loam 12 inches thick. The substratum is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard severe.

This unit is woodland. It provides grazing, production of wood fiber, and wildlife habitat. The site index of ponderosa pine for the Lakoa soil is 72. Good woodland and grazing management is needed to offset or minimize the limitations of these soils.

The potential plant community in areas where grasses are the dominant vegetation and on the Satanta soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIe-2 dryland. The range site is Loamy for the Satanta soil.

97—Larkson-Lakoa loams, 3 to 10 percent slopes. These gently sloping and sloping soils are on uplands. They formed in material weathered or locally transported from interbedded sandstone and shale. The elevation is 4,000 to 6,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 100 days.

The Larkson soil makes up about 60 percent of the map unit, and the Lakoa soil 25 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Lakoa soil is in areas near exposed sandstone. The soils differ only in the amount of clay in the profile. The Lakoa soil is less than 35 percent clay, and the Larkson soil is more than 35 percent clay. Butche, Citadel, Cordeston, Maitland, McCaffery, and Vanocker soils and a soil that is similar to the Larkson soil but has carbonates at a depth of less than 40 inches make up 15 percent of this unit.

The Larkson soil is very deep and well drained. Typically, the surface layer is dark gray loam 3 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is light brownish gray loam 19 inches thick. The subsoil is brown clay loam and yellowish brown clay 30 inches thick. The substratum is very pale brown, calcareous clay loam to 72 inches.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard high.

The Lakoa soil is deep and well drained. Typically, the surface layer is dark grayish brown loam 2 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is light brownish gray sandy loam 8 inches thick. The subsoil is brown clay loam 20 inches thick. The substratum is pale brown, calcareous clay loam to 60 inches.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 40 inches or more. Surface runoff is rapid, and the erosion hazard high.

This unit is woodland. It provides grazing, production of wood fiber, and wildlife habitat. The site index for ponderosa pine is about 74 for the Larkson soil and about 72 for the Lakoa soil. Good woodland and grazing

management is needed to offset or minimize the limitations of these soils. Brush such as oak, hawthorn, and plum invades this unit when ponderosa pine stands are thinned or removed.

This unit may be seasonally saturated during snowmelt and periods of high rainfall. Logging with heavy equipment should be restricted when soils are wet to reduce rutting and soil compaction. Limiting logging to winter can reduce rutting and compaction.

The understory is bluegrass, Columbia needlegrass, snowberry, danthonia, Oregon-grape, pinegrass, oak, and quaking aspen. Production of the understory ranges from 400 pounds dry weight per acre per year in dense stands of pine to 1,200 pounds dry weight per acre per year in more open stands of pine.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. The understory provides some food and cover for wildlife.

The capability unit is IVe-2 dryland.

98—Larkson-Lakoa loams, 10 to 60 percent slopes. These moderately steep to very steep soils are on uplands. They formed in material weathered or locally transported from interbedded sandstone and shale. The slope is 10 to 60 percent but dominantly 30 to 60 percent. The elevation is 4,000 to 6,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 100 days.

The Larkson soil makes up about 60 percent of the map unit, and the Lakoa soil 25 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Lakoa soil is in areas near exposed sandstone. These soils differ only in the amount of clay in the soil profile. The Lakoa soil is less than 35 percent clay, and the Larkson soil is more than 35 percent. Citadel, Cordeston, Maitland, McCaffery, and Vanocker soils and a soil that is similar to the Larkson soil but has carbonates at a depth of less than 40 inches make up 15 percent of this unit.

The Larkson soil is very deep and well drained.

Typically, the surface layer is dark gray loam 3 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is light brownish gray loam 19 inches thick. The subsoil is brown clay loam and yellowish brown clay 30 inches thick. The substratum is very pale brown clay loam to 72 inches.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

The Lakoa soil is deep and well drained.

Typically, the surface layer is dark grayish brown loam 2 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is light brownish gray sandy loam 8 inches thick. The subsoil is brown clay loam 20 inches thick. The substratum is pale brown, calcareous clay loam to 60 inches.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 40 inches or more. Surface runoff is rapid, and the erosion hazard high.

This unit is woodland. It provides grazing, production of wood fiber, and wildlife habitat. The site index for ponderosa pine is about 71. Slope of over 40 percent can limit the use of certain types of harvesting equipment. Areas where slopes are more than 40 percent are subject to landslides in times of snowmelt and periods of high rainfall. Landslides may occur on undisturbed slopes or in road cuts. Good woodland and grazing management is needed to offset or minimize the limitations of these soils.

The understory is bluegrass, Columbia needlegrass, snowberry, danthonia, Oregon-grape, pinegrass, oak, and quaking aspen. Production of the understory ranges from 400 pounds dry weight per acre per year in dense stands of pine to 1,200 pounds dry weight per acre per year in more open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. The understory provides some food and cover for wildlife.

The capability unit is VIe-2 dryland.

99—Limon clay loam, 0 to 2 percent slopes. This nearly level, very deep, well drained soil is on alluvial fans and terraces. It formed in alluvial deposits. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is 120 days. Small areas of Gaynor, Heldt, Twotop, and Petrie soils and more sloping Limon soils were included in mapping.

Typically, the surface layer of the Limon soil is light brownish gray clay loam about 7 inches thick. The underlying material is light brownish gray, calcareous clay to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIs-1 dryland. The range site is Clayey.

100—Limon clay loam, 2 to 6 percent slopes. This nearly level to gently sloping, very deep, well drained soil is on alluvial fans and terraces. It formed in alluvial deposits. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is 120 days. Small areas of Gaynor, Heldt, Twotop, and Petrie soils and a Limon soil that differs in slope were included in mapping.

Typically, the surface layer of the Limon soil is light brownish gray clay loam 7 inches thick. The underlying material is light brownish gray, calcareous clay to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

A small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-1 dryland. The range site is Clayey.

101—Lohmiller silty clay loam, 0 to 3 percent slopes. This very deep, well drained, nearly level soil is on flood plains. It formed in light colored clayey alluvium derived from clay shale. The elevation is 3,200 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Haverson and Stetter soils and areas of Lohmiller soil, occasionally flooded, were included in mapping.

Typically, the surface layer of the Lohmiller soil is grayish brown silty clay loam 5 inches thick. The underlying material is grayish brown, calcareous clay loam stratified with lenses of loam or clay to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 50 percent of this unit is cropland. Some areas are irrigated. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIs-1 dryland. The range site is Lowland.

102—Lohmiller silty clay loam, occasionally flooded, 0 to 3 percent slopes. This very deep, well drained, nearly level soil is on flood plains. It formed in light colored clayey alluvium derived from clay shale. It is subject to occasional overflow. The elevation is 3,200 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Haverson and Stetter soils were included in mapping.

Typically, the surface layer of the Lohmiller soil is grayish brown silty clay loam 5 inches thick. The underlying material is grayish brown, calcareous clay loam stratified with lenses of loam or clay to 60 inches or more. The water table may occur at 20 to 40 inches.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight. Flooding may occur during high intensity storms.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 50 percent of this unit is hayland or pastureland. The principal crops are native grass and grass and alfalfa. These soils need protection from flooding to reduce the erosion hazard and to increase yields.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, western wheatgrass, prairie sandreed, perennial forbs, and woody plants. If the ecological condition deteriorates, snowberry, American licorice, western yarrow, green sagewort, and goldenrod are dominant. The potential plant community produces about 3,000 pounds of annual air dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIc-46 dryland. The range site is Overflow.

103—Louviers clay, 3 to 30 percent slopes. This shallow, well drained, undulating to steep soil is on uplands. It formed in thin parent material weathered from noncalcareous shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Emigrant, Samsil, Grummit, and Winler soils were included in mapping.

Typically, the surface layer of the Louviers soil is grayish brown clay 3 inches thick. The underlying material is dark grayish brown, noncalcareous clay 17 inches thick. Clay shale is at a depth of 20 inches.

Permeability is slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community is mainly western wheatgrass, green needlegrass, little bluestem, and bluebunch wheatgrass. If the ecological condition deteriorates, big sagebrush and unpalatable forbs are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Clayey.

104—Louviers-Grummit complex, 10 to 30 percent slopes. These moderately steep and steep soils are on uplands. They formed in material weathered from clay shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 48 degrees F. The frost-free season is about 120 days.

The Louviers soil makes up about 45 percent of the map unit, and the Grummit soil 45 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. In contrast to the Louviers soil, the Grummit soil is acid. Maggin, Samsil, and Winler soils and Rock outcrop make up 10 percent of this unit.

The shallow, well drained Louviers soil formed in thin parent material weathered from noncalcareous shale.

Typically, the surface layer is grayish brown clay 3 inches thick. The underlying material is dark grayish brown, noncalcareous clay 17 inches thick. Clay shale is at a depth of 20 inches.

Permeability is slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The shallow, well drained Grummit soil formed in clayey material weathered from acid shale.

Typically, the surface layer is grayish brown shaly clay loam 4 inches thick. The underlying material is light brownish gray, acid shaly clay 7 inches thick. Platy shale is at a depth of 11 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 7 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Louviers soil is mainly western wheatgrass, green needlegrass, little bluestem, bluebunch wheatgrass, and juniper. If the ecological condition deteriorates, big sagebrush and unpalatable forbs are dominant. The potential plant community produces about 1,400 pounds of annual air dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

The plant community on the Grummit soil is mainly little bluestem, prairie sandreed, ponderosa pine, juniper, and sun sedge. If the ecological condition deteriorates, sun sedge and threeawn are dominant. The potential plant community produces about 1,300 pounds of annual air-dry herbage per acre. The yield varies between 1,600 pounds in favorable years and 800 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Clayey for the Louviers soil and Shallow Porous Clay for the Grummit soil.

105—Louviers-Rock outcrop complex, 3 to 30 percent slopes. This complex of gently sloping to steep

soil and Rock outcrop is on uplands. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Louviers soil makes up about 60 percent of the map unit, and Rock outcrop 30 percent. The areas of soil and miscellaneous areas occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. Bentonite pits and Maggin, Samsil, and Razor soils make up 10 percent of this unit.

The shallow, well drained Louviers soil formed in a thin layer of material weathered from noncalcareous shale.

Typically, the surface layer is grayish brown clay 3 inches thick. The underlying material is dark grayish brown, noncalcareous clay 17 inches thick. Clay shale is at a depth of 20 inches.

Permeability is slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The Rock outcrop is shale.

This unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Louviers soil is mainly western wheatgrass, green needlegrass, little bluestem, and bluebunch wheatgrass. If the ecological condition deteriorates, big sagebrush and unpalatable forbs are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Clayey for the Louviers soil.

106—Lynx silt loam, 0 to 3 percent slopes. This very deep, well drained, nearly level soil is on flood plains and alluvial fans. It formed in alluvium. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 100 days. Small areas of Lynx soil, occasionally flooded, Colombo and Onita soils, and a soil similar to Colombo soil but having a water table at 40 inches were included in mapping.

Typically, the surface layer of the Lynx soil is dark gray silt loam 27 inches thick. The underlying material is grayish brown silt loam and brown silty clay loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Most of this soil is cropland. Grass and alfalfa hay are the principal crops. Some areas are planted to small grain. The grain is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIc-46 dryland. The range site is Lowland.

107—Lynx silt loam, occasionally flooded, 0 to 3 percent slopes. This very deep, well drained, nearly level soil is on flood plains and alluvial fans. It formed in alluvium. It is subject to occasional overflow from adjacent streams. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 100 days. Small areas of Cordeston, Colombo, and Onita soils and a soil that is similar to the Colombo soil except that it has a water table at 40 inches were included in mapping.

Typically, the surface layer of the Lynx soil is dark gray silt loam 27 inches thick. The underlying material is grayish brown silt loam and brown silty clay loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight. Flooding may occur during high intensity rain storms.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community is mainly green needlegrass, western wheatgrass, prairie sandreed, perennial forbs, and woody plants. If the ecological condition deteriorates, snowberry, American licorice, western yarrow, green sagewort, and goldenrod are dominant. The potential plant community produces about 3,000 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and

other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIc-46 dryland. The range site is Overflow.

108—Maggin shaly clay loam, 2 to 6 percent slopes. This moderately deep, well drained, nearly level to undulating soil is on the upland. It formed in material weathered from acid shale. It occurs on a narrow ridge of the Mowry shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Grummit and Querc soils and Rock outcrop were included in mapping.

Typically, the surface layer of the Maggin soil is dark grayish brown shaly clay loam 3 inches thick. The underlying material is dark grayish brown, strongly acid clay 33 inches thick. Shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly little bluestem, prairie sandreed, oak, and sun sedge. If the ecological condition deteriorates, sun sedge and threeawn are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-1 dryland. The range site is Porous Clay.

109—Maggin shaly clay loam, 6 to 10 percent slopes. This moderately deep, well drained, rolling soil is on the upland on a narrow ridge of Mowry shale. It formed in material weathered from acid shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Grummit and Querc soils and Rock outcrop were included in mapping.

Typically, the surface layer of the Maggin soil is dark grayish brown shaly clay loam 3 inches thick. The underlying material is dark grayish brown, strongly acid clay 33 inches thick. Shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The potential plant community is mainly little bluestem, prairie sandreed, oak, and sun sedge. If the ecological condition deteriorates, sun sedge and threeawn are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Porous Clay.

110—Maitland loam, 6 to 10 percent slopes. This very deep, well drained, rolling soil is on uplands. It formed in material that weathered from interbedded sandstone and shale. The elevation is 4,000 to 6,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days. Small areas of Onita, Cordeston, and Lakoa soils and Maitland soils that differ in slope or have bedrock at 40 to 60 inches were included in mapping.

Typically, the surface layer of the Maitland soil is dark gray loam 5 inches thick. It is covered with 3 inches of organic mulch. The subsurface layer is light gray loam 4 inches thick. The subsoil is brown clay loam 27 inches thick. The substratum is grayish brown loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is woodland. It provides grazing and wildlife habitat. The site index for ponderosa pine is about 69. Good grazing management is needed to offset or minimize the limitation of this soil.

If woodland has been cleared, the plant community is mainly western and thickspike wheatgrass, bluegrass, green and Columbia needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland.

111—Maitland loam, 10 to 40 percent slopes. This very deep, well drained, hilly soil is on uplands. It formed

in material weathered from interbedded sandstone and shale. The elevation is 4,000 to 4,500 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days. Small areas of Butche, Larkson, Lakoa, Shingle, and Tassel soils are included in mapping.

Typically, the surface layer of the Maitland soil is dark gray loam 5 inches thick. It is covered with 3 inches of organic mulch. The subsurface layer is light gray loam 4 inches thick. The subsoil is dark brown clay loam 27 inches thick. The substratum is grayish brown loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is woodland. It provides grazing, production of wood fiber, and wildlife habitat. The site index for ponderosa pine is 69. Good grazing and woodland management is needed to offset or minimize the limitations of this soil.

If woodland has been cleared, management of the vegetation should be designed to increase the production of western wheatgrass and green needlegrass. Deferred grazing and proper grazing will improve deteriorated range.

The understory is bluegrass, Columbia needlegrass, bromegrass, little bluestem, Oregon-grape, chokecherry, and juniper. Production of the understory ranges from 400 pounds dry weight per acre per year in dense stands of pine to 1,000 pounds dry weight per acre per year in open stands.

If this unit has been cleared, the plant community is mainly bluegrass, western and thickspike wheatgrass, green and Columbia needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIe-2 dryland.

112—McCaffery-Larkson complex, 3 to 10 percent slopes. These gently sloping and sloping soils are in the Bear Lodge Mountains and on foothills to the northwest. They formed in sandy material from fine-grained sandstone. The elevation is 3,500 to 6,200 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days.

The McCaffery soil makes up about 55 percent of the map unit, and the Larkson soil 20 percent. These soils occur in such an intricate pattern that it is impractical to map them separately at the scale of mapping used. Butche soils, Rock outcrop, and Lakoa soils and a McCaffery soil that is underlain by bedrock at a depth of 40 to 60 inches make up 25 percent of this unit.

The very deep, well drained McCaffery soil formed in sandy material from fine-grained sandstone.

Typically, the surface layer is very pale brown and brown fine sand 4 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is very pale brown and pale brown fine sand 16 inches thick. The subsoil is very pale brown fine sand with bands of loamy fine sand. It extends to a depth of 60 inches or more.

Permeability is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is rapid, but of short duration, and the erosion hazard moderate. The hazard of soil blowing is high.

The very deep, well drained Larkson soil formed in sediments weathered from interbedded sandstone and shale.

Typically, the surface layer is dark gray loam 3 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is light brownish gray loam 19 inches thick. The subsoil is brown clay loam and yellowish brown clay 30 inches thick. The substratum is very pale brown clay loam to 72 inches.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard high.

This unit is woodland. It provides grazing, production of wood fiber, and wildlife habitat. The site index for ponderosa pine is 71. Good grazing and woodland management is needed to offset or minimize the limitations of these soils. Seedling establishment is poor.

The understory is bluegrass, Columbia needlegrass, snowberry, danthonia, Oregon-grape, pinegrass, oak, and quaking aspen. Production of the understory ranges from 400 pounds dry weight per acre per year in dense stands of pine to 1,200 pounds dry weight per acre per year in open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. The understory provides some food and cover for wildlife.

The capability unit is VIe-15 dryland.

113—McCaffery-Larkson complex, 10 to 60 percent slopes. These moderately steep to very steep soils are in the mountains. They formed in sandy material from fine-grained sandstone. The elevation is 3,500 to 6,200 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days.

The McCaffery soil makes up about 55 percent of the map unit, and the Larkson soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. Butche and Lakoa soils and Rock outcrop make up 25 percent of this unit.

The McCaffery soil is very deep and well drained.

Typically, the surface layer is very pale brown and brown fine sand 4 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is very pale brown and pale brown fine sand 16 inches thick. The subsoil is very pale brown fine sand with bands of loamy fine sand. It extends to a depth of 60 inches or more.

Permeability is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is rapid, but of short duration, and the erosion hazard high. The hazard of soil blowing is high.

The very deep, well drained Larkson soil formed in sediments weathered from interbedded sandstone and shale.

Typically, the surface layer is dark gray loam 3 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is light brownish gray loam 19 inches thick. The subsoil is brown clay loam and yellowish brown clay 38 inches thick. The substratum is very pale brown clay loam to 72 inches.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This unit is woodland. It provides wood fiber production, grazing, and wildlife habitat. The site index for ponderosa pine is 71. Good grazing and woodland management is needed to offset or minimize the limitations of these soils. Seedling establishment is poor.

The understory is bluegrass, Columbia needlegrass, snowberry, danthonia, Oregon-grape, pinegrass, oak, and quaking aspen. Production of the understory will range from 400 pounds dry weight per acre per year in dense stands of pine to 1,200 pounds dry weight per acre per year in the open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIIe-15 dryland.

114—Nevee silt loam, 1 to 6 percent slopes. This deep, well drained, nearly level to undulating soil is on uplands, terraces, and fans. It formed in silty alluvium weathered from reddish silty shale, siltstone, or sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Barnum, Gypnevee, Tilford, and Vale soils were included in mapping.

Typically, the surface layer of the Nevee soil is reddish brown silt loam 5 inches thick. The underlying material is light reddish brown and light red, calcareous silt loam 43 inches thick. Siltstone is at a depth of 48 inches.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 40 to 60 inches. Surface runoff is moderate, and the erosion hazard high.

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Approximately 25 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the erosion hazard.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland and irrigated. The range site is Loamy.

115—Nevee silt loam, 1 to 6 percent slopes, eroded. This deep, well drained, nearly level to undulating soil is on uplands, terraces, and fans. It formed in silty alluvium weathered from reddish silty shale, siltstone, or sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Most of the original surface layer has been removed by erosion, exposing the underlying material, which contains less organic matter and is redder. Small areas of Barnum, Gypnevee, Nevee, and Tilford soils were included in mapping.

Typically, the surface layer of the Nevee soil is light reddish brown silt loam 5 inches thick. The underlying material is light reddish brown and light red, calcareous silt loam 38 inches thick. Siltstone is at a depth of 43 inches.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 40 to 60 inches. Surface runoff is moderate, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 25 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long

slopes may need to be farmed across the slope to reduce runoff and the erosion hazard.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

116—Nevee silt loam, 6 to 10 percent slopes. This deep, well drained, sloping and rolling soil is on uplands, terraces, and fans. It formed in silty alluvium weathered from reddish silty shale, siltstone, or sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Barnum, Gypnevee, Tilford, and Vale soils were included in mapping.

Typically, the surface layer of the Nevee soil is reddish brown silt loam 5 inches thick. The underlying material is light reddish brown and light red, calcareous silt loam 43 inches thick. Siltstone is at a depth of 48 inches.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 40 to 60 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 25 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

117—Nevee silt loam, 6 to 10 percent slopes, eroded. This deep, well drained, sloping and rolling soil is on uplands, terraces, and fans. It formed in silty alluvium weathered from reddish silty shale, siltstone, or sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Most of the original surface layer has been removed by erosion, exposing the underlying material, which contains less organic matter and is redder. Small areas of Barnum, Gypnevee, Nevee, and Tilford soils were included in mapping.

Typically, the surface layer of the Nevee soil is light reddish brown silt loam 5 inches thick. The underlying material is light reddish brown and light red, calcareous silt loam 38 inches thick. Siltstone is at a depth of 43 inches.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 40 to 60 inches. Surface runoff is severe, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 25 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the erosion hazard.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-21 dryland. The range site is Loamy.

118—Nevee silt loam, 10 to 12 percent slopes. This deep, well drained, moderately steep soil is on uplands,

terraces, and fans. It formed in silty alluvium weathered from reddish silty shale, siltstone, or sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Barnum, Gypnevee, Tilford, and Vale soils were included in mapping.

Typically, the surface layer of the Nevee soil is reddish brown silt loam 5 inches thick. The underlying material is light reddish brown and light red, calcareous silt loam 43 inches thick. Siltstone is at a depth of 48 inches.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 40 to 60 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-21 dryland. The range site is Loamy.

119—Nevee silt loam, 10 to 30 percent slopes, eroded. This deep, well drained, rolling to steep soil is on uplands, terraces, and fans. It formed in silty alluvium weathered from reddish silty shale, siltstone, or sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Most of the original surface layer has been removed by erosion, exposing the underlying material, which contains less organic matter and is redder. Small areas of Nevee, Tilford, and Gypnevee soil and Rock outcrop are included in mapping.

Typically, the surface layer of the Nevee soil is light reddish brown silt loam 5 inches thick. The underlying material is light reddish brown and light red, calcareous silt loam 38 inches thick. Siltstone is at a depth of 43 inches.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 40 to 60 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland. It provides grazing and wildlife habitat.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIe-2 dryland. The range site is Loamy.

120—Nihill-Suglo complex, 10 to 40 percent slopes. These moderately steep and steep soils are on terrace breaks and fans. They formed in gravelly alluvium or outwash of mixed origin. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Nihill soil makes up about 50 percent of this map unit, and the Suglo soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Suglo soil is on the lower parts of slopes. Rock outcrop and Butche, Shingle, Spearfish, and Tassel soils make up 30 percent of this unit.

The very deep, excessively drained Nihill soil formed on terraces and sides of terraces in gravelly alluvium of mixed origin.

Typically, the surface layer is grayish brown gravelly loam 4 inches thick. The underlying material is pale brown, calcareous very gravelly loam to 60 inches or more.

Permeability is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

The very deep, well drained Suglo soil is on terraces and fans. It formed in gravelly alluvium of mixed origin.

Typically, the surface layer is dark brown and brown loam 11 inches thick. The subsoil is light brown gravelly loam 5 inches thick. The substratum is pink and light reddish brown, calcareous gravelly loam to 60 inches or more.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland and wildlife habitat.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies

between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIs-9 dryland. The range site is Loamy.

121—Norka loam, 1 to 6 percent slopes. This very deep, well drained, nearly level to gently sloping soil is on uplands on gently sloping benches and terraces adjacent to mountain ranges. It formed in silty material weathered from siltstone and sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Boneek, Butche, Kadoka, Laporte, Spangler, and Tilford soils and the more sloping Norka soils were included in mapping.

Typically, the surface layer of the Norka soil is a grayish brown loam 5 inches thick. The subsoil is brown silty clay loam 9 inches thick. The substratum is light brownish gray, calcareous silt loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 30 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

122—Norka loam, 6 to 10 percent slopes. This very deep, well drained, sloping soil is on benches and terraces adjacent to mountain ranges on the Dakota hogback that circles the Bear Lodge Mountains on the northwest and south. It formed in silty material weathered from siltstone or sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Boneek, Butche, Kadoka, Laporte, Spangler, and Tilford soils and a Norka soil that differs in slope were included in mapping.

Typically, the surface layer of the Norka soil is a grayish brown loam 5 inches thick. The subsoil is brown silty clay loam 9 inches thick. The substratum is light brownish gray, calcareous silt loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 30 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

123—Nunn clay loam, 0 to 2 percent slopes. This very deep, well drained, nearly level soil is on terraces, alluvial fans, and uplands. It formed in sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Boneek, Emigrant, Limon, Gaynor, and Ulm soils were included in mapping.

Typically, the surface layer of the Nunn soil is grayish brown clay loam 6 inches thick. The subsoil is grayish brown and light brownish gray clay 24 inches thick. The substratum is light brownish gray, calcareous clay loam to 60 inches or more.

Permeability is slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 30 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIs-1 dryland. The range site is Clayey.

124—Nunn clay loam, 2 to 6 percent slopes. This very deep, well drained, nearly level to undulating soil is on terraces, fans, and uplands. It formed in sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Boneek, Emigrant, Limon, Gaynor, and Ulm soils were included in mapping.

Typically, the surface layer of the Nunn soil is grayish brown clay loam 6 inches thick. The subsoil is grayish brown and light brownish gray clay 24 inches thick. The substratum is light brownish gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 30 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, big sagebrush and blue grama are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-1 dryland. The range site is Clayey.

125—Nunn clay loam, 6 to 10 percent slopes. This very deep, well drained, sloping and rolling soil is on terraces, fans, and uplands. It formed in sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Boneek, Emigrant, Limon, Gaynor, and Ulm soils were included in mapping.

Typically, the surface layer of the Nunn soil is grayish brown clay loam 6 inches thick. The subsoil is grayish brown and light brownish gray clay 24 inches thick. The substratum is light brownish gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 20 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, big sagebrush and blue grama are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey.

126—Nunn-Ascalon complex, 6 to 10 percent slopes. These sloping and rolling soils are on terraces, fans, and uplands. They formed in material weathered from sandstone and shale. The elevation is 3,500 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Nunn soil makes up about 60 percent of this map unit, and the Ascalon soil 25 percent. They occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Nunn soil is on exposed slopes, and the Ascalon is on lee slopes. Cushman, Shingle, and Tassel soils make up 15 percent of the unit.

The very deep, well drained Nunn soil is on terraces, fans, and uplands. It formed in sediments weathered from sedimentary rock.

Typically, the surface layer is grayish brown clay loam 6 inches thick. The subsoil is grayish brown and light brownish gray clay 24 inches thick. The substratum is light brownish gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

The very deep, well drained Ascalon soil formed in material weathered from sandy shale and sandstone.

Typically, the surface layer is grayish brown sandy loam 7 inches thick. The subsoil is grayish brown sandy clay loam and light brownish gray loam 9 inches thick. The substratum is light gray, calcareous sandy clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland and wildlife habitat.

The plant community on the Nunn soil is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

The plant community on the Ascalon soil is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey for the Nunn soil and Sandy for the Ascalon soil.

127—Nunn-Ascalon complex, 10 to 25 percent slopes. These moderately steep and hilly soils are on terraces, fans, and uplands. They formed in material weathered from sandstone and shale. The elevation is 3,500 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Nunn soil makes up about 60 percent of this map unit, and the Ascalon soil 25 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Nunn soil is on exposed slopes, and the Ascalon soil is on lee slopes. Cushman, Shingle, and Tassel soils make up 15 percent of the unit.

The very deep, well drained Nunn soil formed on terraces, fans, and uplands in sediments weathered from sedimentary rock.

Typically, the surface layer is grayish brown clay loam 6 inches thick. The subsoil is grayish brown and light brownish gray clay 24 inches thick. The substratum is light gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

The very deep, well drained Ascalon soil formed in material weathered from sandy shale and sandstone.

Typically, the surface layer is grayish brown sandy loam 7 inches thick. The subsoil is grayish brown sandy clay loam and light brownish gray loam 9 inches thick. The substratum is light brownish gray, calcareous sandy clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland and wildlife habitat.

The plant community on the Nunn soil is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

The plant community on the Ascalon soil is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIe-1 dryland. The range site is Clayey for the Nunn soil and Sandy for the Ascalon soil.

128—Onita loam, 1 to 6 percent slopes. This very deep, well drained, nearly level to gently sloping soil is on alluvial fans and valley filling side slopes. It formed in alluvium. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 110 days. Small areas of Cordeston, Colombo, Lynx, Nunn, and Satanta soils and the more sloping Onita soils were included in mapping.

Typically, the surface layer of the Onita soil is dark grayish brown loam 22 inches thick. The subsoil is brown silty clay loam 10 inches thick. The substratum is pale brown, calcareous clay loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff and the erosion hazard are moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Most of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years to 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland and irrigated. The range site is Lowland.

129—Onita loam, 6 to 10 percent slopes. This sloping, very deep, well drained soil is on alluvial fans and valley filling side slopes. It formed in alluvium. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 110 days. Small areas of Cordeston, Colombo, Lynx, Nunn, and Satanta soils and an Onita soil that differs in slope were included in mapping.

Typically, the surface layer of the Onita soil is dark grayish brown loam 22 inches thick. The subsoil is brown silty clay loam 10 inches thick. The substratum is pale brown, calcareous clay loam to 60 inches in depth.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Most of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland and irrigated. The range site is Loamy.

130—Orella silty clay loam, 3 to 30 percent slopes. This undulating to steep, shallow, well drained soil is on uplands. It formed in sediments weathered from shale containing considerable amounts of sodium or salts. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Cadoma, Samsil, and Shingle soils, Rock outcrop, and a soil that is similar to the Orella soil but contains less clay were included in mapping.

Typically, the surface layer of the Orella soil is light gray silty clay loam 2 inches thick. The underlying material is very strongly alkaline light gray clay loam and grayish brown clay 10 inches thick. Alkaline shale is at a depth of 12 inches.

Permeability is very slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland and wildlife habitat.

The plant community is mainly western wheatgrass, gardner saltbush, inland saltgrass, Indian ricegrass, and alkali sacaton. If the ecological condition deteriorates, greasewood and inland saltgrass are dominant. The

potential plant community produces about 600 pounds of annual air-dry herbage per acre. The yield varies between 800 pounds in favorable years and 400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIIs-12 dryland. The range site is Saline Upland.

131—Orella-Samsil complex, 3 to 30 percent slopes. These undulating to steep soils are on uplands. They formed in sediments weathered from shale containing considerable amounts of sodium or salts. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Orella soil makes up about 50 percent of the map unit, the Samsil soil 20 percent, and the Cadoma soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Orella and Samsil soils are on ridges, crests, and knolls. The Cadoma soil is in depressions and along drainageways. Gaynor, Petrie, Shingle, and Thedalund soils make up 10 percent of this unit.

The shallow, well drained Orella soil formed in sediments weathered from shale containing considerable amounts of sodium or salts.

Typically, the surface layer is light gray silty clay loam 2 inches thick. The underlying material is very strongly alkaline light gray clay loam and grayish brown clay 10 inches thick. Alkaline shale is at a depth of 12 inches.

Permeability is very slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The shallow, well drained Samsil soil formed in material weathered from clay shale.

Typically, the surface layer is grayish brown clay 3 inches thick. The underlying material is grayish brown, calcareous clay and light brownish gray, calcareous shaly clay 17 inches thick. Soft shale is at a depth of 20 inches.

Permeability is slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The moderately deep, well drained Cadoma soil formed in sediments weathered from shale containing considerable amounts of sodium and salts.

Typically, the surface layer is light brownish gray clay 4 inches thick. The subsoil is light brownish gray clay 8 inches thick. The substratum is light brownish gray, strongly alkaline clay 18 inches thick. Alkaline shale is at a depth of 30 inches.

Permeability is very slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is used for rangeland and wildlife habitat.

The plant community on Orella and Cadoma soils is mainly western wheatgrass, gardner saltbush, inland saltgrass, Indian ricegrass, and alkali sacaton. If the ecological condition deteriorates, greasewood and inland saltgrass are dominant. The potential plant community produces about 600 pounds of annual air-dry herbage per acre. The yield varies between 800 pounds in favorable years and 400 pounds in unfavorable years.

The plant community on the Samsil soil is mainly western wheatgrass, green needlegrass, little bluestem, and bluebunch wheatgrass. If the ecological condition deteriorates, big sagebrush and unpalatable forbs are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIIs-12 dryland. The range site is Saline Upland for the Orella and Cadoma soils and Shallow Clayey for the Samsil soil.

132—Otero sandy loam, 2 to 6 percent slopes. This nearly level and gently sloping, very deep, somewhat excessively drained soil is on alluvial fans and side slopes. It formed in alluvial sediments. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Glenberg, Terry, and Vona soils and an Otero soil that differs in slope were included in mapping.

Typically, the surface layer of the Otero soil is pale brown sandy loam 8 inches thick. The underlying material is pale brown, calcareous sandy loam and fine sandy loam to 60 inches or more.

Permeability is rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard moderate. The hazard of soil blowing is moderate.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Intermediate, pubescent, and crescent wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-5 dryland. The range site is Sandy.

133—Otero sandy loam, 6 to 10 percent slopes. This sloping, very deep, somewhat excessively drained soil is on alluvial fans and side slopes. It formed in alluvial sediments. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Glenberg, Terry, and Vona soils and an Otero soil that differs in slope were included in mapping.

Typically, the surface layer of the Otero soil is pale brown sandy loam 8 inches thick. The underlying material is pale brown, calcareous sandy loam and fine sandy loam to a depth of 60 inches or more.

Permeability is rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard moderate. The hazard of soil blowing is moderate.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-5 dryland. The range site is Sandy.

134—Peso-Paunsaugunt complex, 6 to 10 percent slopes. These sloping soils are in the mountains. They formed in material weathered from limestone. The elevation is 4,200 to 6,200 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days.

The Peso soil makes up about 50 percent of the map unit, and the Paunsaugunt soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. Larkson, Citadel, and Work soils and Rock outcrop make up 20 percent of this unit.

The Peso soil is moderately deep and well drained. Typically, the surface layer is dark grayish brown very channery silt loam 6 inches thick. It is covered with 1 inch of organic mulch. The subsoil is grayish brown very channery silt loam 10 inches thick. The substratum is very pale brown, calcareous very channery silt loam 14 inches thick. Hard fractured limestone is at a depth of 30 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 20 to 40 inches. Runoff is moderate, and the erosion hazard high.

The Paunsaugunt soil is shallow and well drained. Typically, the surface layer is grayish brown loam 8 inches thick. The underlying material is light grayish brown, calcareous very channery loam 4 inches thick. Hard fractured limestone is at a depth of 12 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and the erosion hazard high.

This unit is woodland. It provides grazing, production of wood fiber, and wildlife habitat. The site index for ponderosa pine is about 60 for Peso soil and about 50 for Paunsaugunt soil. Good woodland and grazing management are needed to offset or minimize the limitations of these soils.

This unit may have seasonal high water tables during snowmelt and periods of high rainfall. Logging with heavy equipment should be restricted when the soils are wet to reduce rutting and soil compaction problems. Limiting logging to winter can reduce rutting and compaction.

The hazard of windthrow is high because of the shallowness to impenetrable bedrock.

The understory is bluegrass, Columbia needlegrass, snowberry, Oregon-grape, quaking aspen, ceanothus, chokecherry, and danthonia. Production of the understory ranges from 400 pounds dry weight per acre in dense stands of pine to 1,200 pounds dry weight per acre in open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland.

135—Peso-Paunsaugunt complex, 10 to 60 percent slopes. These moderately steep to very steep soils are in the mountains. They formed in material weathered from limestone. The elevation is from 4,200 to 6,200 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days.

The Peso soil makes up about 50 percent of the map unit, and the Paunsaugunt soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. Larkson, Citadel, and Work soils and Rock outcrop make up 20 percent of this unit.

The Peso soil is moderately deep and well drained. Typically, the surface layer is dark grayish brown very

channery silt loam 6 inches thick. It is covered with 1 inch of organic mulch. The subsoil is light grayish brown very channery silt loam 10 inches thick. The substratum is very pale brown, calcareous very channery silt loam 14 inches thick. Hard fractured limestone is at a depth of 30 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and the erosion hazard high.

The Paunsaugunt soil is shallow and well drained. Typically, the surface layer is grayish brown loam 8 inches thick. The underlying material is light grayish brown, calcareous very channery loam 4 inches thick. Hard fractured limestone is at a depth of 12 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and the erosion hazard high.

This unit is woodland. It provides grazing, production of wood fiber, and wildlife habitat. The site index for ponderosa pine is about 60 for the Peso soil and about 50 for the Paunsaugunt soil. Good woodland and grazing management are needed to offset or minimize the limitations of these soils.

Areas where slopes are more than 40 percent are subject to landslides in times of snowmelt and periods of high rainfall. Landslides may occur on undisturbed slopes or in road cuts. Certain types of harvesting equipment are generally restricted to slopes of less than 40 percent.

The hazard of windthrow is high because of the shallowness to impenetrable bedrock.

The understory is bluegrass, Columbia needlegrass, snowberry, Oregon-grape, quaking aspen, ceanothus, chokecherry, and danthonia. Production of the understory will range from 400 pounds dry weight per acre per year in dense stands of pine to 1,200 pounds dry weight per acre per year in open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIe-2 dryland.

136—Petrie clay loam, 0 to 3 percent slopes. This nearly level, very deep, well drained soil is on alluvial fans, valley filling side slopes, and bottoms of small drainageways. It formed in thick calcareous, very alkaline sediments derived from sedimentary bedrock. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Absted, Bone, Cadoma, and Limon soils were included in mapping.

Typically, the surface layer of the Petrie soil is light gray and light brownish gray clay loam 2 inches thick. The underlying material is grayish brown and light brownish gray very strongly alkaline clay to 60 inches or more.

Permeability is very slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard high.

This map unit is rangeland and wildlife habitat.

The plant community is mainly western wheatgrass, gardner saltbush, inland saltgrass, Indian ricegrass, and alkali sacaton. If the ecological condition deteriorates, greasewood and inland saltgrass are dominant. The potential plant community produces about 600 pounds of annual air-dry herbage per acre. The yield varies between 800 pounds in favorable years and 400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIs-12 dryland. The range site is Saline Upland.

137—Pits, bentonite. This map unit consists of mine pits and of dumps—spoil banks of waste material—in areas of bentonite strip mining. Slopes are short and steep, sharp, and irregular. The areas are 3 to 640 acres.

Permeability is very slow. The available water capacity is low. The effective rooting depth is less than 10 inches. Runoff is rapid, and the erosion hazard high.

This map unit is used for grazing and wildlife habitat. Native vegetation is sparse, dominantly western wheatgrass.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIIIe-83 dryland.

138—Pits, gravel. This map unit consists of pits and of dumps—spoil areas of waste material—in areas of gravel mining. Slopes are short and steep. Areas are 3 to 25 acres.

Permeability is rapid. The available water capacity is low. The effective rooting depth is more than 60 inches. Runoff is rapid, and the erosion hazard high.

This map unit is used for grazing and wildlife habitat. Native vegetation is usually sparse, dominantly needleandthread and prairie sandreed.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIIIe-83 dryland.

139—Querc silt loam, 2 to 6 percent slopes. This nearly level to undulating, moderately deep, well drained soil is on uplands. It formed on a narrow ridge of the Mowry shale in material weathered from acid fissile shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average

annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of the Maggin soil and a Querc soil that differs in slope were included in mapping.

Typically, the surface layer of the Querc soil is grayish brown silt loam 5 inches thick. The subsoil is grayish brown silty clay loam 9 inches thick. The substratum is slightly acid shaly silty clay loam 21 inches thick. It is light brownish gray. Shale is at a depth of 35 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-1 dryland. The range site is Clayey.

140—Querc silt loam, 6 to 10 percent slopes. This rolling, moderately deep, well drained soil is on uplands on a narrow ridge of the Mowry shale. It formed in material weathered from acid fissile shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of the Maggin soil and a Querc soil that differs in slope were included in mapping.

Typically, the surface layer of the Querc soil is grayish brown silt loam 5 inches thick. The subsoil is grayish brown silty clay loam 9 inches thick. The substratum is light brownish gray, slightly acid shaly silty clay loam 21 inches thick. Shale is at a depth of 35 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey.

141—Razor clay loam, 2 to 10 percent slopes. This nearly level to rolling, moderately deep, well drained soil is on upland plains. It formed in clayey material overlying shale. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Heldt, Gaynor, Samsil, Twotop, and Winler soils were included in mapping.

Typically, the surface layer of the Razor soil is grayish brown clay loam 4 inches thick. The subsoil is dark grayish brown clay loam 6 inches thick. The substratum is brown, calcareous clay loam 20 inches thick. Shale is at a depth of 30 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland and wildlife habitat.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey.

142—Razor-Samsil complex, 3 to 10 percent slopes. These gently sloping and rolling soils are on

uplands. They formed in sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Razor soil makes up about 60 percent of the map unit, and the Samsil soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Samsil soil is on ridges and knolls. The Razor soil is on side slopes and in depressions. In contrast to the Samsil soil, the Razor soil is more than 20 inches deep over bedrock. Gaynor, Heldt, Renohill, Twotop, Winler, and Wyarno soils make up 10 percent of this unit.

The moderately deep, well drained Razor soil is on plains. It formed in clayey material overlying shale.

Typically, the surface layer is grayish brown clay loam 4 inches thick. The subsoil is dark grayish brown clay loam 6 inches thick. The substratum is brown, calcareous clay loam 20 inches thick. Shale is at a depth of 30 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. The surface runoff is rapid, and the erosion hazard high.

The shallow, well drained Samsil soil formed in material weathered from shale.

Typically, the surface layer is grayish brown clay 3 inches thick. The underlying material is grayish brown, calcareous clay and light brownish gray, calcareous shaly clay 17 inches thick. Soft shale is at a depth of 20 inches.

Permeability is slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland and wildlife habitat.

The plant community on the Razor soil is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

The potential plant community on the Samsil soil is mainly western wheatgrass, green needlegrass, little bluestem, and bluebunch wheatgrass. If the ecological condition deteriorates, big sagebrush and unpalatable forbs are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey for the Razor soil and Shallow Clayey for the Samsil soil.

143—Rekop-Gypnevee-Rock outcrop complex, 3 to 30 percent slopes. This complex consists of undulating to moderately steep soils on uplands. The soils formed in thin highly calcareous and gypsiferous sediments weathered from reddish brown gypsiferous siltstone, gyprock, and alabaster. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Rekop soil makes up about 25 percent of the map unit, the Gypnevee soil 25 percent, and Rock outcrop 25 percent. These areas of soil and miscellaneous areas occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. Nevee, Tilford, and Vale soils make up 25 percent of the unit.

The shallow, somewhat excessively drained Rekop soil formed in thin highly calcareous and gypsiferous sediments weathered from reddish brown gyprock.

Typically, the surface layer is reddish brown loam 6 inches thick. The underlying material is pinkish gray loam 10 inches thick. Gyprock is at a depth of 16 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is slow because there are sinkholes, and the erosion hazard is high.

The deep, well drained Gypnevee soil formed in material from weathered gyprock.

Typically, the surface layer is reddish brown silt loam 5 inches thick. The underlying material is light reddish brown and reddish yellow silt loam 41 inches thick. Bedrock is at a depth of 46 inches.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 40 to 60 inches. Surface runoff is slow, and the erosion hazard high.

Rock outcrop is areas of barren gyprock.

This unit is rangeland and wildlife habitat.

The plant community on the Rekop soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

The potential plant community on the Gypnevee soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Loamy for the Rekop soil and Loamy for the Gypnevee soil.

144—Renohill loam, 1 to 6 percent slopes. This nearly level to undulating, moderately deep, well drained soil is on uplands. It formed in sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Briggsdale, Cushman, Gaynor, Samsil, Ulm, and Wyarno soils were included in mapping.

Typically, the surface layer of the Renohill soil is light brownish gray loam and grayish brown clay loam 5 inches thick. The subsoil is grayish brown and gray clay 16 inches thick. The substratum is grayish brown, calcareous clay loam 15 inches thick. Soft shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard moderate.

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

145—Renohill loam, 6 to 10 percent slopes. This rolling, moderately deep, well drained soil is on uplands. It formed in sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Briggsdale, Cushman, Gaynor, Samsil, Ulm, and Wyarno soils were included in mapping.

Typically, the surface layer of the Renohill soil is light brownish gray loam and grayish brown clay loam 5 inches thick. The subsoil is grayish brown and gray clay 16 inches thick. The substratum is grayish brown, calcareous clay loam 15 inches thick. Soft shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

146—Renohill clay loam, 2 to 6 percent slopes. This nearly level and undulating, moderately deep, well drained soil is on uplands. It formed in sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Briggsdale, Cushman, Gaynor, Samsil, Ulm, and Wyarno soils were included in mapping.

Typically, the surface layer is light brownish gray and grayish brown clay loam 5 inches thick. The subsoil is grayish brown and gray clay 16 inches thick. The substratum is grayish brown, calcareous clay loam 15 inches thick. Soft shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-1 dryland. The range site is Clayey.

147—Renohill clay loam, 6 to 10 percent slopes. This rolling, moderately deep, well drained soil is on the upland. It formed in sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Briggsdale, Cushman, Gaynor, Samsil, Ulm, and Wyarno soils were included in mapping.

Typically, the surface layer of the Renohill soil is light brownish gray and grayish brown clay loam 5 inches thick. The subsoil is grayish brown and gray clay 16 inches thick. The substratum is grayish brown, calcareous clay loam 15 inches thick. Soft shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly needlegrass and rhizomatous wheatgrass. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey.

148—Renohill-Gaynor clay loams, 3 to 10 percent slopes. These gently sloping and sloping soils are on uplands. They formed in sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Renohill soil makes up about 40 percent of the map unit, the Gaynor soil 30 percent, and the Samsil soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Renohill soil is on more uniform slopes. The Gaynor soil is on ridges and knolls. Limon and Ulm soils make up 10 percent of this unit.

The Renohill soil is moderately deep and well drained. Typically, the surface layer is light brownish gray and grayish brown clay loam 5 inches thick. The subsoil is grayish brown and gray clay 16 inches thick. The substratum is grayish brown, calcareous clay loam 15 inches thick. Bedrock is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The moderately deep, well drained Gaynor soil formed in calcareous sediments weathered from sedimentary rock. Typically, the surface layer is light brownish gray and grayish brown clay loam 5 inches thick. The underlying material is grayish brown, calcareous clay 27 inches thick. Shale is at a depth of 32 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The shallow, well drained Samsil soil formed in material weathered from clay shale.

Typically, the surface layer is grayish brown clay 3 inches thick. The underlying material is grayish brown, calcareous clay and light brownish gray, calcareous shaly clay 17 inches thick. Soft shale is at a depth of 20 inches.

Permeability is slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland and wildlife habitat.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community on the Renohill and Gaynor soils is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

The plant community on the Samsil soil is mainly western wheatgrass, green needlegrass, little bluestem, and bluebunch wheatgrass. If the ecological condition deteriorates, big sagebrush and unpalatable forbs are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey for Renohill and Gaynor soils and Shallow Clayey for the Samsil soil.

149—Renohill-Gaynor clay loams, 10 to 30 percent slopes. These moderately steep and steep soils are on uplands. They formed in sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Renohill soil makes up about 40 percent of the map unit, the Gaynor soil 30 percent, and the Samsil soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Renohill soil is on more uniform slopes, the Gaynor soil is steeper and near ridges, and the Samsil soil is on ridges and knolls. Limon and Ulm soils make up about 10 percent of this unit.

The Renohill soil is moderately deep and well drained.

Typically, the surface layer is light brownish gray and grayish brown clay loam 5 inches thick. The subsoil is grayish brown and gray clay 16 inches thick. The substratum is grayish brown, calcareous clay loam 15 inches thick. Soft shale is at a depth of 36 inches.

Permeability is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The moderately deep, well drained Gaynor soil formed in calcareous sediments weathered from sedimentary rock.

Typically, the surface layer is light brownish gray and grayish brown clay loam 5 inches thick. The underlying material is grayish brown, calcareous clay 27 inches thick. Shale is at a depth of 32 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The shallow, well drained Samsil soil formed in material weathered from clay shale.

Typically, the surface layer is grayish brown clay 3 inches thick. The underlying material is grayish brown, calcareous clay and light brownish gray, calcareous shaly clay 17 inches thick. Soft shale is at a depth of 20 inches.

Permeability is slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland and wildlife habitat.

The plant community on Renohill and Gaynor soils is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds in favorable years and 1,400 pounds in unfavorable years.

The plant community on the Samsil soil is mainly western wheatgrass, green needlegrass, little bluestem, and bluebunch wheatgrass. If the ecological condition deteriorates, big sagebrush and unpalatable forbs are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIe-1 dryland. The range site is Clayey for Renohill and Gaynor soils and Shallow Clayey for the Samsil soil.

150—Rhoame clay loam, 0 to 3 percent slopes. This nearly level, very deep, well drained soil is on alluvial and colluvial fans. It formed in clayey sediments weathered from noncalcareous shale. The elevation is 3,200 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Bone, Limon, Louviers, Razor, and Topeman soils were included in mapping.

Typically, the surface layer of the Rhoame soil is pale brown clay loam 6 inches thick. The underlying material is light brownish gray clay loam to 60 inches or more.

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

This map unit is rangeland and wildlife habitat.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small

animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIs-1 dryland. The range site is Clayey.

151—Riverwash. Riverwash is recent deposits of alluvium along the Belle Fourche River. The slope ranges from 0 to 5 percent. The sediment ranges from sand to clay. The areas periodically receive fresh deposits of sediments and are subject to scouring action by floodwaters.

This map unit is used for grazing and wildlife habitat. Most areas support little or no vegetation. Scattered trees and grasses are in stabilized areas.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide food and cover for wildlife.

The capability unit is VIIIw-84 dryland.

152—Rock outcrop-Laporte complex, 3 to 30 percent slopes. This complex of gently sloping to steep soil and Rock outcrop are on uplands. The elevation is 3,500 to 6,500 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

Rock outcrop makes up about 50 percent of the map unit, the Laporte soil 20 percent, and the Tilford soil 20 percent. These areas of soil and miscellaneous areas occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. Tilford and Laporte soils are in depressions. Citadel, Nevee, Vale, and Norka soils and a very shallow soil similar to the Laporte soil make up about 10 percent of the unit.

Rock outcrop is barren limestone.

The Laporte soil is shallow and well drained. It formed in material weathered from limestone.

Typically, the surface layer is grayish brown loam 8 inches thick. The underlying material is light brownish gray, calcareous channery loam 4 inches thick. Hard limestone is at a depth of 12 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The very deep, well drained Tilford soil is on stream terraces and fans. It formed in silty alluvium weathered from reddish shale.

Typically, the surface layer is brown and reddish gray silt loam 9 inches thick. The subsoil is reddish brown and light reddish brown silt loam 22 inches thick. The substratum is light reddish yellow loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland and wildlife habitat.

The plant community on the Laporte soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

The plant community on the Tilford soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIIs-17 dryland. The range site is Shallow Loamy for the Laporte soil and Loamy for the Tilford soil.

153—Rock outcrop, limestone. This miscellaneous area is 90 percent barren rock and 10 percent Laporte and Rekop soil. The barren rock is limestone, hard sandstone, and gypsum of various geological formations. These rocks do not weather to large amounts of sediment. The elevation ranges from 4,500 to 6,500 feet.

Laporte and Rekop soils, in places, furnish limited grazing, although the vegetation is sparse. In many places there are scattered pines.

The capability unit is VIIIs-83 dryland.

154—Rock outcrop, shale. This miscellaneous area is 90 percent shale and 10 percent Orella and Samsil soils. It is steep to gently sloping upland. The elevation ranges from 3,500 to 5,000 feet. Areas of this map unit are highly erodible and weather large amounts of sediment.

The Rock outcrop consists of acid shale and alkaline shale.

Orella and Samsil soils, in places, furnish limited grazing. Native vegetation is sparse stands of western wheatgrass or gardner saltbush.

The capability unit is VIIIe-83 dryland.

155—Rock outcrop-Vanocker complex, 50 to 75 percent slopes. This complex of very steep soil and Rock outcrop is on uplands of the mountains. The elevation is 5,000 to 7,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 120 days.

Rock outcrop makes up about 40 percent of the map unit, and the Vanocker soil 30 percent. These

components occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. Rock outcrop occurs as cliffs and escarpments, and the Vanocker soil is on the steep slopes below. Butche, Citadel, Larkson, Cordeston, McCaffery, Lakoa, and Lynx soils make up 30 percent of this unit.

Rock outcrop is exposures of sedimentary rock.

The very deep, well drained Vanocker soil formed in material weathered from sedimentary rock.

Typically, the surface layer is dark grayish brown loam 2 inches thick. It is covered with 1 inch of organic mulch. The subsoil is light brown very channery clay loam 14 inches thick. The underlying material is pale brown, very channery clay loam to 60 inches or more.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is very rapid, and the erosion hazard high.

This unit is woodland and wildlife habitat.

The site index for ponderosa pine is about 60 for the Vanocker soil. Slopes limit the use of certain types of harvesting equipment. They are subject to landslides in times of snowmelt and periods of high rainfall. Landslides may occur on undisturbed slopes or in road cuts. Good woodland and grazing management is needed to offset or minimize the limitations of these soils.

The understory is bluegrass, Columbia needlegrass, snowberry, danthonia, Oregon-grape, pinegrass, oak, and quaking aspen. Production of the understory ranges from 400 pounds dry weight per acre per year in dense stands of pine to 1,000 pounds dry weight per acre per year in open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIIe-81 dryland.

156—Samsil-Gaynor complex, 2 to 10 percent slopes. These gently sloping to rolling soils are on uplands. They formed in material derived from shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Samsil soil makes up about 60 percent of the map unit, and the Gaynor soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Samsil soil is on ridges and knolls and in eroded areas, and the Gaynor soil is in depressions and on lower parts of slopes. The Gaynor soil differs from the Samsil soil in being more than 20 inches deep over bedrock. Shingle, Louviers, Limon, Razor, Renohill, and Orella soils make up 10 percent of this unit.

The shallow, well drained Samsil soil formed in material weathered from clay shale.

Typically, the surface layer is grayish brown clay 3 inches thick. The underlying material is grayish brown, calcareous clay and light brownish gray, calcareous shaly clay 17 inches thick. Soft shale is at a depth of 20 inches.

Permeability is slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The moderately deep, well drained Gaynor soil formed in calcareous sediment weathered from sedimentary rock.

Typically, the surface layer is light brownish gray and grayish brown clay loam 5 inches thick. The underlying material is grayish brown, calcareous clay 27 inches thick. Shale is at a depth of 32 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and the erosion hazard high.

This unit is rangeland and wildlife habitat.

The plant community on the Samsil soil is mainly western wheatgrass, green needlegrass, little bluestem, and bluebunch wheatgrass. If the ecological condition deteriorates, big sagebrush and unpalatable forbs are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

The potential plant community on the Gaynor soil is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIe-14 dryland. The range site is Shallow Clayey for the Samsil soil and Clayey for the Gaynor soil.

157—Samsil-Gaynor complex, 10 to 30 percent slopes. These moderately steep and steep soils formed in material from shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Samsil soil makes up about 60 percent of the map unit, and the Gaynor soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Samsil soil is on ridges and knolls and in eroded areas, and the Gaynor soil is in depressions and on lower parts of slopes. In contrast to the Samsil soil, the Gaynor soil is more than 20 inches deep over bedrock. Shingle, Louviers, Limon, Razor, Renohill, and Orella soils make up 10 percent of this unit.

The shallow, well drained Samsil soil is on uplands. It formed in material weathered from clay shale.

Typically, the surface layer is grayish brown clay 3 inches thick. The underlying material is grayish brown, calcareous clay and light brownish gray, calcareous shaly clay 17 inches thick. Soft shale is at a depth of 20 inches.

Permeability is slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The moderately deep, well drained Gaynor soil formed in calcareous sediment weathered from sedimentary rock.

Typically, the surface layer is light brownish gray and grayish brown clay loam 5 inches thick. The underlying material is grayish brown, calcareous clay 27 inches thick. Shale is at a depth of 32 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland and wildlife habitat.

The plant community on the Samsil soil is mainly western wheatgrass, green needlegrass, little bluestem, and bluebunch wheatgrass. If the ecological condition deteriorates, big sagebrush and unpalatable forbs are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

The plant community on the Gaynor soil is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Clayey for the Samsil soil and Clayey for the Gaynor soil.

158—Samsil-Razor complex, 2 to 10 percent slopes. These gently sloping to rolling soils are on uplands. They formed in sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Samsil soil makes up about 60 percent of the map unit, and the Razor soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Samsil soil is on ridges and knolls and in eroded areas, and the Razor soil is on gentle slopes and lower parts of slopes. In contrast to the Samsil soil, the Razor soil is more than 20 inches deep to bedrock. Orella, Limon, Heldt, and Winler soils and Rock outcrop make up 10 percent of this unit.

The shallow, well drained Samsil soil formed in material weathered from clay shale.

Typically, the surface layer is grayish brown clay 3 inches thick. The underlying material is grayish brown, calcareous clay and light brownish gray, calcareous shaly clay 17 inches thick. Soft shale is at a depth of 20 inches.

Permeability is slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The moderately deep, well drained Razor soil is on plains. It formed in clay loam on transported material overlying clay loam shale.

Typically, the surface layer is grayish brown clay loam 4 inches thick. The subsoil is dark grayish brown clay loam 6 inches thick. The substratum is brown, calcareous clay loam 20 inches thick. Shale is at a depth of 30 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland and wildlife habitat.

The plant community on the Samsil soil is mainly western wheatgrass, green needlegrass, little bluestem, and bluebunch wheatgrass. If the ecological condition deteriorates, big sagebrush and unpalatable forbs are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

The potential plant community on the Razor soil is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIe-14 dryland. The range site is Shallow Clayey for the Samsil soil and Clayey for the Razor soil.

159—Samsil-Razor complex, 10 to 30 percent slopes. These moderately steep and steep soils are on uplands. They formed in sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Samsil soil makes up about 60 percent of the map unit and the Razor soil 30 percent. These soils

occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Samsil soil is on ridges and knolls and in eroded areas, and the Razor soil is on gentle slopes and lower parts of slopes. In contrast to the Samsil soil, the Razor soil and is more than 20 inches deep to bedrock. Orella, Limon, Heldt, and Winler soils and Rock outcrop make up 10 percent of this unit.

The shallow, well drained Samsil soil formed in material weathered from clay shale.

Typically, the surface layer is grayish brown clay 3 inches thick. The underlying material is grayish brown, calcareous clay and light brownish gray, calcareous shaly clay 17 inches thick. Soft shale is at a depth of 20 inches.

Permeability is slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The moderately deep, well drained Razor soil is on plains. It formed in clay loam on transported material overlying clay loam shale.

Typically, the surface layer is grayish brown clay loam 4 inches thick. The subsoil is dark grayish brown clay loam 6 inches thick. The substratum is brown, calcareous clay loam 20 inches thick. Shale is at a depth of 30 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland and wildlife habitat.

The plant community on the Samsil soil is mainly western wheatgrass, green needlegrass, little bluestem, and bluebunch wheatgrass. If the ecological condition deteriorates, big sagebrush and unpalatable forbs are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

The plant community on the Razor soil is mainly of needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Clayey for the Samsil soil and Clayey for the Razor soil.

160—Satanta loam, 0 to 1 percent slopes. This nearly level, very deep, well drained soil is on alluvium. It formed in material weathered from sandstone. The elevation is 3,500 to 5,000 feet. The slope ranges from 0 to 1 percent and is mostly about 1 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Kim, Nunn, and Wages soils and a more sloping Satanta soil were included in mapping. In depressions, the surface layer of this Satanta soil has more clay than is typical.

Typically, the surface layer of the Satanta soil is grayish brown loam 6 inches thick. The subsoil is grayish brown and brown clay loam 12 inches thick. The substratum is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Approximately 60 percent of this soil is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIc-2 dryland and IIe-2 irrigated. The range site is Loamy.

161—Satanta loam, 1 to 6 percent slopes. This nearly level to undulating, very deep, well drained soil is on alluvium. It formed in material weathered from sandstone. The elevation is 3,500 to 5,000 feet. The slope ranges from 1 to 6 percent but is mostly about 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Kim, Nunn, and Wages soils and a more sloping Satanta soil were included in mapping. In depressions the surface layer of this Satanta soil has more clay than is typical.

Typically, the surface layer of the Satanta soil is grayish brown loam 6 inches thick. The subsoil is grayish brown and brown clay loam 12 inches thick. The substratum is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Approximately 50 percent of this soil is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland and irrigated. The range site is Loamy.

162—Satanta loam, 6 to 10 percent slopes. This sloping, very deep, well drained loamy soil is on alluvium. It formed in material weathered from sandstone. The elevation is 3,500 to 5,000 feet. The slopes range from 6 to 10 percent but are mostly about 8 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Kim, Nunn, and Wages soils and a Satanta soil that differs in slope were included in mapping.

Typically, the surface layer of the Satanta soil is grayish brown loam 6 inches thick. The subsoil is grayish brown and brown clay loam 12 inches thick. The substratum is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Approximately 40 percent of this soil is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland and irrigated. The range site is Loamy.

163—Satanta-Shingle loams, 1 to 6 percent slopes. These nearly level to undulating soils are on alluvium on uplands. They formed in material weathered mainly from sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Satanta soil makes up about 40 percent of the map unit, and the Shingle soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. In contrast to the Shingle soil, the Satanta soil is more than 20 inches deep over bedrock. Ascalon, Kim, and Thedalund soils make up 30 percent of this unit.

The Satanta soil is very deep and well drained. Typically, the surface layer is grayish brown loam 6 inches thick. The subsoil is grayish brown and brown clay loam 12 inches thick. The substratum is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

The Shingle soil is shallow and well drained. It formed in material weathered from soft interbedded sandstone and shale. Typically, the surface layer is light brownish gray loam 3 inches thick. The underlying material is light gray, calcareous loam 13 inches thick. Soft shale is at a depth of 16 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is moderate, and the erosion hazard moderate.

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 60 percent of this soil is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community on the Satanta soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Shingle soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy for the Satanta soil and Shallow Loamy for the Shingle soil.

164—Satanta-Shingle loams, 6 to 10 percent slopes. These sloping and rolling soils are on alluvium on uplands. They formed in material weathered from sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is 46 degrees F. The frost-free season is about 120 days.

The Satanta soil makes up about 40 percent of the map unit, and the Shingle soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. In contrast to the Shingle soil, the Satanta soil is more than 20 inches deep over bedrock. Ascalon, Kim, and Thedalund soils make up 30 percent of this unit.

The Satanta soil is very deep and well drained. Typically, the surface layer is grayish brown loam 6 inches thick. The subsoil is grayish brown and brown clay loam 16 inches thick. The substratum is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is severe, and the erosion hazard high.

The Shingle soil is shallow and well drained. It formed in material weathered from soft interbedded sandstone and shale. Typically, the surface layer is light brownish gray loam 3 inches thick. The underlying material is light gray, calcareous loam 13 inches thick. Soft shale is at a depth of 16 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is severe, and the erosion hazard high.

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 40 percent of this soil is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community on the Satanta soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Shingle soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy for the Satanta soil and Shallow Loamy for the Shingle soil.

165—Shingle-Rock outcrop complex, 25 to 60 percent slopes. This complex of steep and very steep soil and Rock outcrop is on uplands at an elevation of 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Shingle soil makes up about 40 percent of the map unit, and Rock outcrop 40 percent. This area of soil and miscellaneous area occur in such an intricate pattern that it was impractical to map them separately at

the scale of mapping used. The Shingle soil is on the ridges and knolls and in eroded areas, and Rock outcrop is throughout the mapped area. Kim, Samsil, and Tassel soils make up 20 percent of this unit.

The Shingle soil is shallow and well drained. It formed in material derived from soft, interbedded sandstone and shale. Typically, the surface layer is light brownish gray loam 3 inches thick. The underlying material is light gray, calcareous loam 13 inches thick. Soft shale is at a depth of 16 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The Rock outcrop is exposed sandstone and shale.

This unit is rangeland and wildlife habitat.

The plant community on the Shingle soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Loamy for the Shingle soil.

166—Shingle-Thedalund loams, 10 to 30 percent slopes. These moderately steep and steep soils are on uplands. They formed in material from soft interbedded sandstone and shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Shingle soil makes up about 60 percent of the map unit, and the Thedalund soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Shingle soil is on ridges and knolls and in eroded areas, and the Thedalund soil is on slopes. In contrast to the Shingle soil, the Thedalund soil is more than 20 inches deep over bedrock. Kim, Zigweid, and Tassel soils make up 10 percent of this unit.

The Shingle soil is shallow and well drained.

Typically, the surface layer is light brownish gray loam 3 inches thick. The underlying material is light gray, calcareous loam 13 inches thick. Soft shale is at a depth of 16 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

The moderately deep, well drained loamy Thedalund soil formed in material weathered from sedimentary rock.

Typically, the surface layer is light brownish gray loam 4 inches thick. The underlying material is light gray and white, calcareous loam 18 inches thick. Bedrock is at a depth of 22 inches.

Permeability is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland and wildlife habitat.

The plant community on the Shingle soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre, The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

The plant community on the Thedalund soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Loamy for the Shingle soil and Loamy for the Thedalund soil.

167—Spangler loam, 1 to 6 percent slopes. This nearly level to undulating, moderately deep, well drained soil is on uplands. It formed in material weathered from fine-grained sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Butche, Cushman, and Norka soils and the more sloping Spangler soils were included in mapping.

Typically, the surface layer of the Spangler soil is light brownish gray loam 6 inches thick. The subsoil is brown clay loam 18 inches thick. The substratum is pale brown loam and clay loam 12 inches thick. Noncalcareous sandstone is at a depth of 36 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 25 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded

to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

168—Spangler loam, 6 to 10 percent slopes. This rolling, moderately deep, well drained soil is on uplands. It formed in material weathered from fine-grained sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Butche, Cushman, and Norka soils and a Spangler soil that differs in slope were included in mapping.

Typically, the surface layer of the Spangler soil is light brownish gray loam 6 inches thick. The subsoil is brown clay loam 18 inches thick. The substratum is pale brown loam and clay loam 12 inches thick. Noncalcareous sandstone is at a depth of 36 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 25 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

169—Spangler-Butche complex, 1 to 6 percent slopes. These nearly level to undulating soils are on uplands. They formed in material weathered from fine-grained sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Spangler soil makes up about 45 percent of the map unit, and the Butche soil 25 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Spangler soil is on hillsides, and the Butche soil is on knolls, ridges, or crests of hills. In contrast to the Butche soil, the Spangler soil is more than 20 inches deep over bedrock. The Cushman soil and a soil similar to the Butche soil but deeper to bedrock make up 30 percent of this unit.

The moderately deep, well drained Spangler soil formed in noncalcareous material from sandstone.

Typically, the surface layer is light brownish gray loam 6 inches thick. The subsoil is brown clay loam 18 inches thick. The substratum is pale brown loam and clay loam 12 inches thick. Noncalcareous sandstone is at a depth of 36 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard moderate.

The Butche soil is shallow and somewhat excessively drained.

Typically, the surface layer is light brownish gray fine sandy loam 4 inches thick. The underlying material is light brownish gray and light gray noncalcareous fine sandy loam 8 inches thick. Sandstone is at a depth of 12 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is moderate, and the erosion hazard high. The hazard of soil blowing is moderate.

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 25 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community on the Spangler soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Butche soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy for the Spangler soil and Shallow Loamy for the Butche soil.

170—Spangler-Butche complex, 6 to 10 percent slopes. These rolling soils are on uplands. They formed in material weathered from fine-grained sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Spangler soil makes up about 45 percent of the map unit, and the Butche soil 25 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Spangler soil is on hillsides, and the Butche soil is on knolls, ridges, or crests of hills. In contrast to the Butche soil, the Spangler soil is more than 20 inches deep over bedrock. The Cushman soil and a soil similar to the Butche soil but deeper over bedrock make up 30 percent of this unit.

The moderately deep, well drained Spangler soil formed in noncalcareous material from sandstone.

Typically, the surface layer is light brownish gray loam 6 inches thick. The subsoil is brown clay loam 18 inches thick. The substratum is pale brown loam and clay loam 12 inches thick. Noncalcareous sandstone is at a depth of 36 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The shallow, somewhat excessively drained Butche soil formed in material weathered from hard fine-grained sandstone.

Typically, the surface layer is light brownish gray fine sandy loam 4 inches thick. The underlying material is light brownish gray and light gray, noncalcareous fine sandy loam 8 inches thick. Sandstone is at a depth of 12 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is moderate, and the erosion hazard high. The hazard of soil blowing is moderate.

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 25 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community on the Spangler soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Butche soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years to 900 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy for the Spangler soil and Shallow Loamy for the Butche soil.

171—Spangler-Norka complex, 1 to 6 percent slopes. These nearly level to undulating soils are on uplands. They formed in material weathered from sandstone and shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Spangler soil makes up about 40 percent of the map unit, the Norka soil 30 percent, and the Butche soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. In contrast to the Norka soil, the Spangler soil is less than 40 inches deep over bedrock, and in contrast to the Butche soil it is more than 20 inches deep over bedrock. Cushman, Kim, and

Thedalund soils, Rock outcrop, and a soil similar to the Butche soil but deeper to bedrock make up 10 percent of this unit.

The moderately deep, well drained Spangler soil formed in noncalcareous material from sandstone.

Typically, the surface layer is light brownish gray loam 6 inches thick. The subsoil is brown clay loam 18 inches thick. The substratum is pale brown loam and clay loam 12 inches thick. Noncalcareous sandstone is at a depth of 36 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is moderate, and the erosion hazard moderate.

The very deep, well drained Norka soil formed on gentle to moderately sloping benches and structural terraces adjacent to mountain ranges.

Typically, the surface layer is grayish brown loam 5 inches thick. The subsoil is brown silty clay loam 9 inches thick. The substratum is light brownish gray, calcareous silt loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

The shallow, somewhat excessively drained Butche soil formed in material weathered from hard fine-grained sandstone.

Typically, the surface layer is light brownish gray fine sandy loam 4 inches thick. The underlying material is light brownish gray and light gray, noncalcareous fine sandy loam 8 inches thick. Sandstone is at a depth of 12 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is moderate, and the erosion hazard high. The hazard of soil blowing is moderate.

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 30 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community on Spangler and Norka soils is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Butche soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy for Spangler and Norka soils and Shallow Loamy for the Butche soil.

172—Spangler-Norka complex, 6 to 10 percent slopes. These rolling soils are on uplands. They formed in material weathered from sandstone and shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Spangler soil makes up about 40 percent of the map unit, the Norka soil 30 percent, and the Butche soil 20 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. In contrast to the Norka soil, the Spangler soil is less than 40 inches deep over bedrock, and in contrast to the Butche soil it is more than 20 inches deep over bedrock. Cushman, Kim, and Thedalund soils, Rock outcrop, and a soil similar to the Butche soil but deeper to bedrock make up 10 percent of this unit.

The moderately deep, well drained Spangler soil formed in noncalcareous material from sandstone.

Typically, the surface layer is light brownish gray loam 6 inches thick. The subsoil is brown clay loam 18 inches thick. The substratum is pale brown loam and clay loam 12 inches thick. Noncalcareous sandstone is at a depth of 36 inches.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is severe, and the erosion hazard high.

The very deep, well drained Norka soil formed on gentle to moderately sloping benches and structural terraces adjacent to mountain ranges.

Typically, the surface layer is grayish brown loam 5 inches thick. The subsoil is brown silty clay loam 9 inches thick. The substratum is light brownish gray, calcareous silt loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

The shallow, somewhat excessively drained Butche soil formed in material weathered from hard fine-grained sandstone.

Typically, the surface layer is light brownish gray fine sandy loam 4 inches thick. The underlying material is light brownish gray and light gray, noncalcareous fine sandy loam 8 inches thick. Sandstone is at a depth of 12 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is severe, and the erosion hazard high. Soil blowing is moderate.

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

About 30 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community on Spangler and Norka soils is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Butche soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy for Spangler and Norka soils and Shallow Loamy for the Butche soil.

173—Spearfish-Rock outcrop complex, 10 to 60 percent slopes. This complex of moderately steep and steep soil and Rock outcrop is on uplands at an elevation of 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Spearfish soil makes up about 50 percent of the map unit, and Rock outcrop 40 percent. The areas of soil and miscellaneous area occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. Nevee and Tilford soils and a very shallow soil similar to the Spearfish soil make up 10 percent of this unit.

The Spearfish soil is shallow and well drained. It formed in material weathered from the red siltstone, shale, and sandstone.

Typically, the surface layer is reddish brown silt loam 6 inches thick. The underlying material is yellowish red, calcareous silt loam 12 inches thick. Siltstone is at a depth of 18 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 6 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

Rock outcrop is barren siltstone, sandstone, and shale.

This unit is rangeland and wildlife habitat.

The plant community on the Spearfish soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Loamy for the Spearfish soil.

174—Stetter silty clay loam, 0 to 3 percent slopes. This nearly level, very deep, well drained soil is on flood plains. It formed in alluvium from shale. Slopes range from 0 to 3 percent. The elevation is 3,200 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Frazerton, Lohmiller, Haverson, Heldt, and Twotop soils and a Stetter soil that receives additional moisture were included in mapping.

Typically, the surface layer of the Stetter soil is grayish brown silty clay loam 4 inches thick. The underlying material is light brownish gray silty clay loam stratified with silt loam and clay loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly green needlegrass, big bluestem, Canada wildrye, perennial forbs, and cottonwood trees. If the ecological condition deteriorates, snowberry, silver sagebrush, and wild rose

are dominant. The potential plant community produces about 3,300 pounds of annual air-dry herbage per acre. The yield varies between 4,000 pounds in favorable years and 2,000 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIs-1 dryland and IIe-1 irrigated. The range site is Lowland.

175—Sugardee loam, 1 to 6 percent slopes. This nearly level to gently sloping, very deep, well drained soil is on terraces and alluvial fans. It formed in outwash material of mixed origin. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nihill and Suglo soils and the more sloping Sugardee soils were included in mapping. In areas along the Belle Fourche River, a yellower Sugardee soil was also included.

Typically, the surface layer of the Sugardee soil is reddish brown loam 5 inches thick. The subsoil is reddish brown clay loam 16 inches thick. The substratum is reddish yellow gravelly loam in the upper 7 inches. Below that, to a depth of 60 inches or more, it is reddish yellow, calcareous very gravelly loam.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 30 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue and stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

176—Sugardee loam, 6 to 10 percent slopes. This sloping, very deep, well drained soil is on terraces and alluvial fans. It formed in outwash material of mixed origin. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nihill and Suglo soils and a Sugardee soil that differs in slope were included in mapping. In areas along the Belle Fourche River, a yellower Sugardee soil was included in mapping.

Typically, the surface layer of the Sugardee soil is reddish brown loam 5 inches thick. The subsoil is reddish brown clay loam 16 inches thick. The substratum is reddish yellow gravelly loam in the upper 7 inches. Below that, to a depth of 60 inches or more, it is reddish yellow very gravelly loam.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 30 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue and stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

177—Suglo loam, 2 to 6 percent slopes. This nearly level to gently sloping, very deep, well drained soil is on terraces and fans. It formed in gravelly alluvium of mixed origin. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nihill and Sugardee soils were included in mapping.

Typically, the surface layer of the Suglo soil is dark brown and brown loam 11 inches thick. The subsoil is

light brown gravelly loam 5 inches thick. The substratum is pink and light reddish brown, calcareous gravelly loam to 60 inches or more.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard slight.

This map unit is rangeland and wildlife habitat.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

178—Suglo loam, 6 to 10 percent slopes. This sloping, very deep, well drained soil is on terraces and fans. It formed in gravelly alluvium of mixed origin. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nihill and Sugardee soils were included in mapping.

Typically, the surface layer of the Suglo soil is dark brown and brown loam 11 inches thick. The subsoil is light brown gravelly loam 5 inches thick. The substratum is pink and light reddish brown, calcareous gravelly loam to 60 inches or more.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard moderate.

This map unit is rangeland and wildlife habitat.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

179—Suglo-Nihill complex, 3 to 10 percent slopes. These gently sloping and sloping soils are on terraces and fans. They formed in gravelly alluvium of mixed origin. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Suglo soil makes up about 50 percent of this map unit, and the Nihill soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Suglo soil is less gravelly than the Nihill soil. Spearfish and Sugardee soils and a soil that is similar to the Nihill soil but is red make up 20 percent of this unit. In the Bear Lodge Mountains, this map unit is colder than is typical and has a cover of ponderosa pine.

The Suglo soil is very deep and well drained. Typically, the surface layer is dark brown and brown loam 11 inches thick. The subsoil is light brown gravelly loam 5 inches thick. The substratum is pink and light reddish brown, calcareous gravelly loam to 60 inches or more.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard moderate.

The Nihill soil is very deep and excessively drained. It is on terraces and sides of terraces. Typically, the surface layer is grayish brown gravelly loam 4 inches thick. The underlying layer is pale brown, calcareous very gravelly loam to 60 inches or more.

Permeability is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This unit is rangeland and wildlife habitat.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVs-9 dryland. The range site is Loamy.

180—Tassel-Shingle complex, 10 to 30 percent slopes. These shallow, moderately steep and steep soils formed in material from sandstone and shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Tassel soil makes up about 50 percent of the map unit, and the Shingle soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map

them separately at the scale of mapping used. Tassel and Shingle soils are on ridges and crests of hills and in eroded areas. Terry, Thedalund, and Samsil soils and Rock outcrop make up 20 percent of this unit.

The shallow, well drained Tassel soil formed in residuum of sandstone on uplands.

Typically, the surface layer is brown fine sandy loam 3 inches thick. The underlying material is light brownish gray and light gray, calcareous fine sandy loam 12 inches thick. Calcareous sandstone is at a depth of 15 inches.

Permeability is moderately rapid. The available water capacity is very low. The effective rooting depth is less than 20 inches. Surface runoff is rapid, and the erosion hazard high. The hazard of soil blowing is high.

The shallow, well drained Shingle soil formed in material weathered from soft interbedded sandstone and shale.

Typically, the surface layer is light brownish gray loam 3 inches thick. The underlying material is light gray, calcareous loam 13 inches thick. Soft shale is at a depth of 16 inches.

Permeability is moderate. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland and wildlife habitat.

The plant community on the Tassel soil is mainly prairie sandreed, needleandthread, and bluebunch wheatgrass. If the ecological condition deteriorates, threadleaf sedge and fringed sagewort are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

The plant community on the Shingle soil is mainly little bluestem, bluebunch wheatgrass, needleandthread, and skunkbush sumac. If the ecological condition deteriorates, blue grama and threadleaf sedge are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIIe-14 dryland. The range site is Shallow Sandy for the Tassel soil and Shallow Loamy for the Shingle soil.

181—Terry loamy fine sand, 2 to 6 percent slopes. This nearly level to undulating, moderately deep, well drained soil formed in sediments weathered from underlying soft sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Otero, Tassel, and Vona soils and a Terry soil that differs in slope were included in mapping.

Typically, the surface layer of the Terry soil is grayish brown loamy fine sand 5 inches thick. The subsoil is brown fine sandy loam 11 inches thick. The substratum is light gray, calcareous loamy fine sand 16 inches thick. Sandstone is at a depth of 32 inches.

Permeability is moderately rapid. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is slow, and the erosion hazard slight. The hazard of soil blowing is high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-5 dryland. The range site is Sandy.

182—Terry loamy fine sand, 6 to 10 percent slopes. This rolling, moderately deep, well drained soil formed in sediments weathered from underlying soft sandstone. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Otero, Tassel, and Vona soils and a Terry soil that differs in slope were included in mapping.

Typically, the surface layer of the Terry soil is grayish brown loamy fine sand 5 inches thick. The subsoil is brown fine sandy loam 11 inches thick. The substratum is light gray, calcareous loamy fine sand 16 inches thick. Sandstone is at a depth of 32 inches.

Permeability is moderately rapid. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is slow, and the erosion hazard high. The hazard of soil blowing is high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or

stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-5 dryland. The range site is Sandy.

183—Terry-Samsil complex, 6 to 10 percent slopes. These rolling soils are on uplands. They formed in calcareous material weathered from interbedded sandstone and shale. The elevation is 4,000 to 4,500 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Terry soil makes up about 50 percent of the map unit, and the Samsil soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Terry soil is on ridges and isolated knolls where the sandstone bedrock has not eroded away. The Samsil soil occurs in lower areas where more erosion has taken place. The Terry soil is a moderately deep sandy soil, and the Samsil soil is a shallow clayey soil. Tassel, Otero, and Razor soils make up about 20 percent of this unit.

The moderately deep, well drained Terry soil formed in parent sediments weathered from underlying soft sandstone bedrock.

Typically, the surface layer is grayish brown loamy fine sand 5 inches thick. The subsoil is brown fine sandy loam 11 inches thick. The substratum is light gray, calcareous loamy fine sand 16 inches thick. Sandstone is at a depth of 32 inches.

Permeability is moderately rapid. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is slow, but the hazard of water erosion is high. The hazard of soil blowing is high.

The shallow, well drained Samsil soil formed in material weathered from clay shale.

Typically, the surface layer is grayish brown clay 3 inches thick. The underlying material is grayish brown, calcareous clay and light brownish gray, calcareous shaly clay 17 inches thick. Soft shale is at a depth of 20 inches.

Permeability is slow. The available water capacity is very low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland. It provides grazing and wildlife habitat.

The plant community on the Terry soil is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

The plant community on the Samsil soil is mainly western wheatgrass, green needlegrass, little bluestem, and bluebunch wheatgrass. If the ecological condition deteriorates, big sagebrush and unpalatable forbs are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIe-14 dryland. The range site is Sandy for the Terry soil and Shallow Clayey for the Samsil soil.

184—Thedalund loam, 6 to 10 percent slopes. This rolling, moderately deep, well drained soil is on uplands. It formed in material weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 115 days. Small areas of Alice, Kim, and Shingle soils and a Thedalund soil that differs in slope were included in mapping.

Typically, the surface layer of the Thedalund soil is light brownish gray loam 4 inches thick. The underlying material is light gray and white, calcareous loam 18 inches thick. Bedrock is at a depth of 22 inches.

Permeability is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small area of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

185—Tilford silt loam, 0 to 1 percent slopes. This nearly level, very deep, well drained soil is on uplands, stream terraces, and fans. It formed in material weathered from reddish siltstone and shale. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nevee, Vale, and Suglo soils and more sloping Tilford soils were included in mapping.

Typically, the surface layer of the Tilford soil is brown and reddish gray silt loam 9 inches thick. The subsoil is reddish brown and light reddish brown silt loam 22 inches thick. The substratum is reddish yellow, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slight, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Approximately 60 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIc-2 dryland and IIe-2 irrigated. The range site is Loamy.

186—Tilford silt loam, 1 to 6 percent slopes. This nearly level to undulating, very deep, well drained soil is on uplands, stream terraces, and fans. It formed in material weathered from reddish siltstone and shale. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nevee, Vale, and Suglo soils, more sloping Tilford soils, and a Tilford soil with bedrock at 20 to 40 inches were included in mapping.

Typically, the surface layer of the Tilford soil is brown and reddish gray silt loam 9 inches thick. The subsoil is reddish brown and light reddish brown silt loam 22 inches thick. The substratum is reddish yellow, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Approximately 50 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years to 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland and irrigated. The range site is Loamy.

187—Tilford silt loam, 6 to 10 percent slopes. This rolling, very deep, well drained soil is on rolling uplands, stream terraces, and fans. It formed in material weathered from reddish siltstone and shale. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nevee, Vale, and Suglo soils, a Tilford soil that differs in slope, and a

Tilford soil with bedrock at 20 to 40 inches were included in mapping.

Typically, the surface layer of the Tilford soil is brown and reddish gray silt loam 9 inches thick. The subsoil is reddish brown and light reddish brown silt loam 22 inches thick. The substratum is reddish yellow, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Approximately 40 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland and irrigated. The range site is Loamy.

188—Topeman-Demar complex, 0 to 3 percent slopes. These nearly level to gently sloping soils are on pediments and valley fill having pronounced microrelief. Both formed in alluvium derived from acid shale. The elevation is 3,200 to 4,600 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Topeman soil makes up 50 percent of the map unit, and the Demar soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Demar soil is on hummocks, and the Topeman soil is in depressions. Grummit, Maggin, Querc, and Rhoame soils make up 20 percent of this unit.

The deep, well drained Topeman soil is on pediments. It formed in clayey alluvium derived from acid shale.

Typically, the surface layer is light brownish gray silty clay loam and gray silty clay 5 inches thick. The underlying material is light olive brown and grayish brown clay and shaly clay 43 inches thick. Acid shale is at a depth of 48 inches.

Permeability is very slow. The available water capacity is moderate. The effective rooting depth is 40 to 60 inches. Runoff is slow, and the erosion hazard moderate.

The deep, moderately well drained Demar soil is on terraces.

Typically, the surface layer is grayish brown loam 6 inches thick. The subsoil is grayish brown silty clay 13 inches thick. The substratum is grayish brown shaly clay 29 inches thick. Acid shale is at a depth of 48 inches.

Permeability is very slow. The available water capacity is moderate. The effective rooting depth is 40 to 50 inches. Surface runoff is slow, and the erosion hazard slight.

This unit is pastureland, hayland, rangeland, and wildlife habitat.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community on the Topeman soil is mainly rhizomatous wheatgrass and needlegrass. If the ecological condition deteriorates, big sagebrush, bluegrass, and less desirable forbs are dominant. The potential plant community produces about 1,400 pounds of annual air-dry herbage per acre. The yield varies between 1,800 pounds in favorable years and 900 pounds in unfavorable years.

The plant community on the Demar soil is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIs-1 dryland. The range site is Dense Clay for the Topeman soil and Loamy for the Demar soil.

189—Twotop clay, 0 to 2 percent slopes. This nearly level, very deep, well drained soil is on flood plains or alluvial fans. It formed in uniform clay deposits from weathered calcareous gypsiferous shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Razor, Limon, Petrie, Rhoame, and Winler soils and the more sloping Twotop soils were included in mapping.

Typically, the surface layer of the Twotop soil is grayish brown clay 4 inches thick. The subsoil is grayish brown and light brownish gray clay 14 inches thick. The

substratum is light brownish gray, calcareous clay to 60 inches or more.

Permeability is very slow. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is rangeland and wildlife habitat.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVs-8 dryland. The range site is Clayey.

190—Twotop clay, 2 to 6 percent slopes. This nearly level to gently sloping, very deep, well drained soil is on flood plains and alluvial fans. It formed in uniform clay deposits from weathered calcareous gypsiferous shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 48 degrees F. The frost-free season is about 120 days. Small areas of Razor, Limon, Petrie, Rhoame, and Winler soils and a Twotop soil that differs in slope were included in mapping.

Typically, the surface layer of the Twotop soil is grayish brown clay 4 inches thick. The subsoil is grayish brown and light brownish gray clay 14 inches thick. The substratum is light brownish gray, calcareous clay to 60 inches or more.

Permeability is very slow. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is very slow, and the erosion hazard moderate.

The map unit is rangeland and wildlife habitat.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey.

191—Ulm loam, 0 to 1 percent slopes. This nearly level, very deep, well drained soil is on alluvial fans and valley side slopes throughout the northern and western parts of the county. It formed in thick deposits of sediments from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Bidman, Renohill, and Wyarno soils and an Ulm soil that differs in texture and slope were included in mapping.

Typically, the surface layer of the Ulm soil is light brownish gray loam 7 inches thick. The subsoil is brown clay loam 7 inches thick. The substratum is light gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 10 percent of this unit is cropland. Small grain, hay, and forage grasses are the principal crops. Small grain is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIc-2 dryland. The range site is Loamy.

192—Ulm loam, 1 to 6 percent slopes. This nearly level to gently sloping, very deep, well drained soil is on alluvial fans and valley side slopes. It formed in thick deposits of sediments from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Bidman, Renohill, and Wyarno soils and an Ulm soil that differs in texture and slope were included in mapping.

Typically, the surface layer of the Ulm soil is light brownish gray loam 7 inches thick. The subsoil is brown clay loam 7 inches thick. The substratum is light gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more.

Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 10 percent of this unit is cropland. Small grains, hay, and forage grasses are the principal crops. Small grain is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

193—Ulm loam, 6 to 10 percent slopes. This sloping, very deep, well drained soil is on alluvial fans and valley side slopes. It formed in thick deposits of sediments from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Bidman, Renohill, and Wyarno soils and an Ulm soil that differs in texture and slope were included in mapping.

Typically, the surface layer of the Ulm soil is light brownish gray loam 7 inches thick. The subsoil is brown clay loam 7 inches thick. The substratum is light gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Approximately 10 percent of this unit is cropland. Small grain, hay, and forage grasses are the principal crops. Small grain is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed or terraced across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-2 dryland. The range site is Loamy.

194—Ulm clay loam, 0 to 2 percent slopes. This nearly level, very deep, well drained soil is on alluvial fans and valley side slopes. It formed in thick deposits of sediments from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Bidman, Renohill, and Wyarno soil and an Ulm soil that differs in texture and slope were included in mapping.

Typically, the surface layer of the Ulm soil is light brownish gray clay loam 7 inches thick. The subsoil is brown clay loam 7 inches thick. The substratum is light gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Some of this unit is cropland. Small grain, hay, and forage grasses are the principal crops. Small grain is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush become dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIs-1 dryland. The range site is Clayey.

195—Ulm clay loam, 2 to 6 percent slopes. This nearly level to gently sloping, very deep, well drained soil is on alluvial fans and valley side slopes. It formed in thick deposits of sediments from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Bidman, Renohill, and Wyarno soil and an Ulm soil differing in texture and slope were included in mapping.

Typically, the surface layer of the Ulm soil is light brownish gray clay loam 7 inches thick. The subsoil is brown clay loam 7 inches thick. The substratum is light gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Some of this unit is cropland. Small grain, hay, and forage grasses are the principal crops. Small grain is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly needlegrass and rhizomatous wheatgrass. If the ecological condition deteriorates, blue grama and big sagebrush become dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-1 dryland. The range site is Clayey.

196—Ulm clay loam, 6 to 10 percent slopes. This sloping, very deep, well drained soil is on alluvial fans and valley side slopes. It formed in thick deposits of sediments from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Bidman, Renohill, and Wyarno soils and an Ulm soil that differs in texture and slope were included in mapping.

Typically, the surface layer of the Ulm soil is light brownish gray clay loam 7 inches thick. The subsoil is brown clay loam 7 inches thick. The substratum is light gray, calcareous clay loam to 60 inches or more.

Permeability is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard severe.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Some of this unit is cropland. Small grain, hay, and forage grasses are the principal crops. Small grain is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey.

197—Vale silt loam, 0 to 1 percent slopes. This nearly level, very deep, well drained soil is on uplands, stream terraces, and fans. It formed in alluvium from reddish siltstone and shale. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nevee, Norka, and Tilford soils and more sloping Vale soils were included in mapping.

Typically, the surface layer of the Vale soil is brown silt loam 7 inches thick. The subsoil is brown and reddish brown silty clay loam 14 inches thick. The substratum is reddish brown and light reddish brown, calcareous silt loam to 60 inches or more.

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

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Approximately 60 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual

cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIc-2 dryland and IIe-2 irrigated. The range site is Loamy.

198—Vale silt loam, 1 to 6 percent slopes. This nearly level to undulating, very deep, well drained soil is on uplands, stream terraces, and fans. It formed in alluvium from reddish siltstone and shale. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nevee, Norka, and Tilford soils and more sloping Vale soils were included in mapping.

Typically, the surface layer of the Vale soil is brown silt loam 7 inches thick. The subsoil is brown and reddish brown silty clay loam 14 inches thick. The substratum is reddish brown and light reddish brown, calcareous silt loam to 60 inches or more.

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

This unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Approximately 50 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland and irrigated. The range site is Loamy.

199—Vale silt loam, 6 to 10 percent slopes. This sloping and rolling, very deep, well drained soil is on uplands, stream terraces, and fans. It formed in alluvium from reddish siltstone and shale. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Nevee, Norka, and Tilford soils and a Vale soil that differs in slope were included in mapping.

Typically, the surface layer of the Vale soil is brown silt loam 7 inches thick. The subsoil is brown and reddish brown silty clay loam 14 inches thick. The substratum is reddish brown and light reddish brown, calcareous silt loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the erosion hazard high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Approximately 40 percent of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland and irrigated. The range site is Loamy.

200—Valent loamy sand, 6 to 10 percent slopes. This rolling, very deep, excessively drained soil is on uplands. It formed in dunesand. The elevation is 4,000 to

5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Terry and Vona soils were included in mapping.

Typically, the surface layer of the Valent soil is grayish brown loamy sand 8 inches thick. The underlying material is light brownish gray fine sand to 60 inches or more.

Permeability is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight. The hazard of soil blowing is high.

This map unit is rangeland and wildlife habitat.

The plant community is mainly sand bluestem, prairie sandreed, and needleandthread. If the ecological condition deteriorates, unpalatable forbs are dominant. The potential plant community produces about 2,600 pounds of annual air-dry herbage per acre. The yield varies between 3,400 pounds in favorable years and 1,800 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is VIe-15 dryland. The range site is Sands.

201—Vanocker-Citadel complex, 20 to 60 percent slopes. These steep and very steep soils are in the mountains. They formed in material weathered from calcareous sandstone, limestone, and soft shale. The elevation is 4,000 to 6,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days.

The Vanocker soil makes up about 40 percent of the map unit, the Citadel soil 20 percent, and the McCaffery soil 15 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Vanocker soils differ from Citadel and McCaffery soils in being skeletal. Larkson, Cordeston, Lakoa, Lynx, Maitland, and Paunsaugunt soils and Rock outcrop make up 25 percent of this unit.

The very deep, well drained Vanocker soil formed in material weathered from sedimentary rock.

Typically, the surface layer is dark grayish brown loam 2 inches thick. It is covered with 1 inch of organic mulch. The subsoil is brown very channery clay loam 14 inches thick. The substratum is pale brown very channery clay loam to 60 inches or more.

Permeability is moderate. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

The very deep, well drained Citadel soil formed in material weathered from sandstone, limestone, and soft shale.

Typically, the surface layer is dark brown silt loam 3 inches thick. It is covered with 1 inch of organic mulch. The subsurface layer is brown and pinkish gray silt loam 11 inches thick. The subsoil is reddish brown and light reddish brown clay loam 32 inches thick. The substratum is reddish yellow, calcareous silt loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

The very deep, excessively drained McCaffery soil formed in sandy material from fine-grained sandstone.

Typically, the surface layer is very pale brown and brown fine sand 4 inches thick. It is covered with 1 inch of organic mulch. The subsurface is very pale brown and pale brown fine sand 16 inches thick. The subsoil is very pale brown fine sand to 60 inches or more.

Permeability is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is slight, and the erosion hazard slight. The hazard of soil blowing is high.

This unit is woodland and is used for grazing, production of wood fiber, and wildlife habitat. The site index for ponderosa pine is about 71. Certain types of logging equipment are restricted to slopes of less than 40 percent. Areas where slopes are more than 40 percent are subject to landslides in times of snowmelt and periods of high rainfall. Landslides can occur on undisturbed slopes or in road cuts. Good woodland and grazing management are needed to offset or minimize the limitations of these soils.

The understory is bluegrass, Columbia needlegrass, snowberry, Oregon-grape, quaking aspen, ceanothus, chokecherry, and danthonia. Production of the understory ranges from 400 pounds dry weight per acre per year in dense stands of pine to 1,000 pounds dry weight per acre per year in open stands.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIs-9 dryland.

202—Vona loamy fine sand, 2 to 6 percent slopes. This nearly level to undulating, very deep, somewhat excessively drained soil is on uplands. It formed in wind-reworked material. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Terry and Otero soils and a Vona soil that differs in slope were included in mapping.

Typically, the surface layer of the Vona soil is light brownish gray loamy fine sand 5 inches thick. The subsoil is brown and pale brown fine sandy loam 9 inches thick. The substratum is light yellowish brown, calcareous loamy sand to 60 inches or more.

Permeability is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight. The hazard of soil blowing is high.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-5 dryland. The range site is Sandy.

203—Vona loamy fine sand, 6 to 10 percent slopes. This rolling, very deep, well drained soil is on uplands. It formed in wind-reworked material. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Terry and Otero soils and a Vona soil that differs in slope were included in mapping.

Typically, the surface layer of the Vona soil is light brownish gray loamy fine sand 5 inches thick. The subsoil is brown and pale brown fine sandy loam 9 inches thick. The substratum is light yellowish brown, calcareous loamy sand to 60 inches or more.

Permeability is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard moderate. The hazard of soil blowing is high.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly prairie sandreed, needleandthread, and sand bluestem. If the ecological condition deteriorates, blue grama and unpalatable forbs are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-5 dryland. The range site is Sandy.

204—Wages loam, 1 to 6 percent slopes. This nearly level to undulating, very deep, well drained loamy soil is in alluvium. It formed in material weathered from sandstone and shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Satanta, Kim, and Zigweid soils were included in mapping.

Typically, the surface layer of the Wages soil is grayish brown loam 4 inches thick. The subsoil is brown and light brownish gray clay loam 11 inches thick. The substratum is grayish brown, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Approximately 60 percent of this soil is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-2 dryland and irrigated. The range site is Loamy.

205—Wages loam, 6 to 10 percent slopes. This sloping and rolling, very deep, well drained loamy soil is in alluvium on the upland. It formed in material weathered from sandstone and shale. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Satanta, Kim, and Zigweid soils were included in mapping.

Typically, the surface layer of the Wages soil is grayish brown loam 4 inches thick. The subsoil is brown and

light brownish gray clay loam 11 inches thick. The substratum is grayish brown, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard is high.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat. It can be used for irrigated crops if water is available.

Approximately 60 percent of this soil is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope or terraced to reduce runoff and the hazard of erosion.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-2 dryland and irrigated. The range site is Loamy.

206—Winler-Razor clay loams, 2 to 10 percent slopes. These nearly level to sloping soils are on uplands. They formed in clayey deposits weathered from shale. The elevation is 3,200 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days.

The Winler soil makes up about 50 percent of the map unit, and the Razor soil 30 percent. These soils occur in such an intricate pattern that it was impractical to map them separately at the scale of mapping used. The Winler soil is finer textured than the Razor soil. Heldt, Louviers, Renohill, Samsil, and Twotop soils make up 20 percent of this unit.

The Winler soil is moderately deep and well drained.

Typically, the surface layer is light brownish gray clay loam 3 inches thick. The subsoil is grayish brown clay 7 inches thick. The substratum is light brownish gray calcareous clay 19 inches thick. Shale is at a depth of 29 inches.

Permeability is very slow. The available water capacity is very low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

The Razor soil is moderately deep and well drained.

Typically, the surface layer is grayish brown clay loam 4 inches thick. The subsoil is dark grayish brown clay loam 6 inches thick. The substratum is brown, calcareous clay loam 20 inches thick. Shale is at a depth of 30 inches.

Permeability is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard high.

This unit is rangeland and wildlife habitat.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey.

207—Work clay loam, 2 to 6 percent slopes. This nearly level to undulating, very deep, well drained soil is on uplands. It formed in sediments from shale. The elevation is 4,500 to 6,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days. Small areas of Larkson, Gaynor, Nunn, and Samsil soils and a Work soil that differs in slope were included in mapping.

Typically, the surface layer of the Work soil is very dark grayish brown clay loam 10 inches thick. The subsoil is brown clay 9 inches thick. The substratum is light brownish gray and grayish brown, calcareous clay loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, big sagebrush and blue grama are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IIIe-1 dryland. The range site is Clayey.

208—Work clay loam, 6 to 10 percent slopes. This rolling, very deep, well drained soil is on uplands. It formed in sediments weathered from shale. The elevation is 4,500 to 6,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days. Small areas of Larkson, Gaynor, Nunn, and Samsil soils and a Work soil that differs in slope were included in mapping.

Typically, the surface layer of the Work soil is very dark grayish brown clay loam 10 inches thick. The subsoil is brown clay 13 inches thick. The substratum is light brownish gray and grayish brown, calcareous clay loam to 60 inches or more.

Permeability is moderately slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and the erosion hazard high.

This map unit is pastureland, hayland, rangeland, and wildlife habitat.

Bromegrass, alfalfa, and intermediate, pubescent, and crested wheatgrasses are suitable for pasture and hay seeding.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, big sagebrush and blue grama are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey.

209—Work clay loam, 10 to 30 percent slopes. This moderately steep and steep, very deep, well drained soil formed in material weathered from sandstone and shale. The elevation is 4,000 to 6,000 feet. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F. The frost-free season is about 90 days. Small areas of Gaynor, Limon, Samsil, and Larkson soils and a wet soil similar to the Work soil are included in mapping.

Typically, the surface layer is very dark grayish brown clay loam 10 inches thick. The subsoil is brown clay 13 inches thick. The substratum is light brownish gray and grayish brown, calcareous clay loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is moderately high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland and wildlife habitat.

Native vegetation is dominantly scrub oak, rhizomatous wheatgrass, needlegrass, and perennial forbs. Ponderosa pine occurs in some areas. The climatic and soil conditions of this unit are such that in much of the area scrub oak increases to the point that livestock grazing is nearly impossible. Special treatments are required to return this unit to grazing land.

This unit provides habitat for wild turkey, sharp-tailed grouse, white-tailed deer, mule deer, coyote, bobcat, and other small animals. Oak and hawthorn provide some food and cover for wildlife.

The capability unit is VIe-1 dryland. The range site is Clayey.

210—Wyarno clay loam, 0 to 2 percent slopes. This nearly level, very deep, moderately well drained soil is on alluvial fans and valley filling side slopes. It formed in calcareous alluvial sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Renohill, Ulm, and Bidman soils and the more sloping Wyarno soils were included in mapping.

Typically, the surface layer of the Wyarno soil is grayish brown clay loam 5 inches thick. The subsoil is pale brown clay loam 5 inches thick. The substratum is pale brown clay loam and light brownish gray, calcareous clay to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard slight.

This map unit is rangeland and wildlife habitat.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIs-1 dryland. The range site is Clayey.

211—Wyarno clay loam, 2 to 6 percent slopes. This nearly level to gently sloping, very deep, moderately well drained soil is on alluvial fans and valley filling side slopes. It formed in calcareous alluvial sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Renohill, Ulm, and Bidman soils and a Wyarno soil that differs in slope were included in mapping.

Typically, the surface layer of the Wyarno soil is grayish brown clay loam 5 inches thick. The subsoil is pale brown clay loam 5 inches thick. The substratum is pale brown clay loam and light brownish gray, calcareous clay to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is rangeland and wildlife habitat.

The plant community is mainly needlegrass, rhizomatous wheatgrass, and perennial forbs. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 1,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-1 dryland. The range site is Clayey.

212—Wyarno clay loam, 6 to 10 percent slopes. This sloping, very deep, moderately well drained soil is on alluvial fans and valley filling side slopes. It formed in calcareous alluvial sediments weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Renohill, Ulm, and Bidman soils and a Wyarno soil that differs in slope were included in mapping.

Typically, the surface layer of the Wyarno soil is grayish brown clay loam 5 inches thick. The subsoil is pale brown clay loam 5 inches thick. The substratum is pale brown clay loam and light brownish gray, calcareous clay to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard high.

This map unit is rangeland and wildlife habitat.

The plant community is mainly needlegrass and rhizomatous wheatgrass. If the ecological condition deteriorates, blue grama and big sagebrush are dominant. The potential plant community produces about 2,000 pounds of annual air-dry herbage per acre. The yield varies between 2,900 pounds in favorable years and 1,400 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IVe-1 dryland. The range site is Clayey.

213—Zigweid loam, 2 to 6 percent slopes. This nearly level to gently sloping, very deep, well drained soil is on terraces of rivers and streams, on alluvial fans, and on foot slopes. It formed in calcareous alluvium weathered from sedimentary rock. The elevation is 3,500 to 5,000 feet. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F. The frost-free season is about 120 days. Small areas of Cushman and Kim soils and a Zigweid soil that differs in slope were included in mapping.

Typically, the surface layer of the Zigweid soil is grayish brown loam 6 inches thick. The subsoil is grayish brown clay loam 8 inches thick. The substratum is pale brown and light brownish gray, calcareous loam to 60 inches or more.

Permeability is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is moderate, and the erosion hazard moderate.

This map unit is cropland, pastureland, hayland, rangeland, and wildlife habitat.

Only a small part of this unit is cropland. Small grain, the principal crop, is grown in a crop-fallow system because precipitation is not sufficient for annual cropping. Fall grain seeded early, crop residue or stubble-mulch tillage, and waterways shaped and seeded to perennial grasses can help to control erosion. Long slopes may need to be farmed across the slope to reduce runoff and the hazard of erosion.

Intermediate, pubescent, and crested wheatgrasses and bromegrass are suitable for pasture and hay seeding.

The plant community is mainly rhizomatous wheatgrass, needlegrass, needleandthread, and perennial forbs. If the ecological condition deteriorates, blue grama and fringed sagewort are dominant. The potential plant community produces about 2,200 pounds of annual air-dry herbage per acre. The yield varies between 3,000 pounds in favorable years and 1,500 pounds in unfavorable years.

This unit provides habitat for sage grouse, antelope, mule deer, coyote, fox, jack rabbits, and other small animals. Sagebrush and forbs provide food and cover for wildlife.

The capability unit is IIIe-2 dryland. The range site is Loamy.

use and management of the soils

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

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

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

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

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

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

crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

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

Most of the cropland in Crook County is dryfarmed. Winter wheat is the most common crop. Oats, barley, alfalfa hay, and grass hay are also grown. Summer fallow is needed in alternate years to insure a grain crop. Some areas of the county are irrigated. In those areas hay is the principal crop.

Water erosion is the major conservation problem in the county. Terraces, contour stripcropping, grassed waterways, and stubble mulch can reduce the erosion hazard.

Wind erosion, or soil blowing, is a problem on some soils. Wind stripcropping, stubble mulch, and windbreaks are needed.

An adequate fertility level can be maintained without adding fertilizer on the soils that are dryfarmed.

Compaction from tillage can be a problem on some soils. Avoiding tillage when soils are wet helps in preserving soil tilth.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 2. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

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

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops

grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

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

Crops other than those shown in table 2 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

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

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

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

Class I soils have slight limitations that restrict their use.

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

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

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

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

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

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

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

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

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIIe-2 or IVe-5.

The capability classification of each map unit is given in the section "Detailed soil map units."

rangeland

Jim Doughty, range conservationist, Soil Conservation Service, prepared this section.

About 70 percent of Crook County is rangeland. More than half the agricultural income is derived from livestock, primarily cattle. Cow-calf enterprises are dominant. Some of the larger units are cow-calf-yearling. The average size of ranches is about 3,100 acres.

On some ranches, the forage produced is supplemented by crop stubble and small grain. In winter, the native forage is supplemented by hay and protein concentrate. Creep feeding of calves and yearlings to increase their market weight is practiced on a few ranches.

The deep or moderately deep clayey soils derived from shale produce vegetation dominated by green needlegrass and western wheatgrass. Soils derived from sandstone or sandy alluvium produce vegetation dominated by prairie sandreed and needleandthread. A unique condition occurs in the county where shaly soils are derived from the Mowry Shale. These soils have a relatively high clay content, but the vegetation responds as if it were growing on sand. Prairie sandreed and little bluestem are dominant. Production is much higher on all of these soils than on the shallower soils formed from the same kinds of parent material.

Where climate and topography are about the same, differences in the kind and amount of vegetation that

rangeland can produce are related closely to differences in the kind of soil. Effective management is based on the relationship among soils, vegetation, and water.

The map unit description for each kind of soil shows the name of the range site, the total annual production of vegetation in favorable, normal, and unfavorable years, and the characteristic vegetation. Soils that naturally produce ponderosa pine are not considered as rangeland and are not assigned to a range site. They are considered as grazeable woodland, which is explained in the section "Woodland management and productivity."

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Because of topographic features in Crook County, rainfall ranges from about 15 to more than 19 inches in the range areas. The productivity values given in the map unit descriptions are for the areas that receive about 19 inches of precipitation. For many of the units in drier parts of the county, the vegetative production may be as much as 10 to 15 percent less.

In addition to knowledge of the kinds of soil and the potential natural plant community, range management requires an evaluation of the present condition of the range vegetation in relation to its potential. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the maximum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

The major concern on most rangeland is management of grazing so that the kinds and amounts of plants that make up the potential natural plant community are reestablished. Forage production has been reduced about one half because the natural vegetation in many parts of the survey area has been greatly depleted by continued excessive use. On loamy and clayey range sites, big sagebrush has increased several times the amount in the potential plant community on loamy and clayey range sites.

Planned grazing management and deferred grazing will improve the range condition. Sound range management based on soil survey information and other rangeland inventory information is the basis for maintaining or improving forage production.

woodland management and productivity

George Dern, biologist, Soil Conservation Service, helped prepare this section.

The principal woodland type in Crook County is ponderosa pine. It grows at elevations of 4,000 to 6,000 feet. Quaking aspen, bur oak, and hawthorn are intermixed with ponderosa pine in most areas at elevations above 4,500 feet and where precipitation is 16 inches or more.

Some soils such as Larkson and McCaffery receive sufficient moisture to produce dense stands of bur oak. These dense stands compete with ponderosa pine for sunlight and moisture. Soils such as Work, Larkson, and Citadel may support a pure stand of bur oak. Although bur oak, quaking aspen, and hawthorn do not provide commercial quality stands, they do provide food and cover for wildlife and valuable watershed protection.

Grummit and Butche soils support limited growth of ponderosa pine, but they should be primarily managed for livestock grazing. Occasional woodcrops may be taken by selective harvest.

Much of the woodland in Crook County is frequently used for calving pastures. In such areas, all harvesting should be done early in spring, before the pine needles drop.

Most productive for woodcrops are Citadel, Larkson, McCaffery, Lakoa, and Maitland soils.

woodland understory vegetation

Understory vegetation consists of grasses, forbs, shrubs, and other plants. Some woodland, if well managed, can produce enough understory vegetation to support grazing of livestock or wildlife, or both, without damage to the trees.

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

windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 3 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 3 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

In addition to the trees listed in table 3 other trees do well. Blue spruce, for example, is growing in a few windbreaks.

All dryland windbreaks need annual cultivation and protection from livestock if they are to be effective. In general, sandy and sandy loam soils such as Alice, Glenberg, Tassel, and Ascalon soils produce the best windbreaks with the least effort. The moderately good windbreaks on loamy soils such as Tilford, Nevee, and Thedalund require more maintenance. Establishing and maintaining windbreaks on the clayey Gaynor, Boneek, and Nunn soils may be difficult. Dense clay soils such as Twotop and Winler may not be suitable for windbreaks.

recreation

Crook County has a variety of recreation available—camping, hiking, picnicking, swimming, fishing, water skiing, bicycling, motorcycling, backpacking, snowmobiling, skiing, and hunting.

There are several recreation areas in the county: Devil's Tower National Monument, Keyhole State Park, Cook Lake, Reuter Springs Campgrounds, Bear Lodge Campgrounds, and the Sand Creek public fishing and camping area. City parks and some farm ponds are also open to the public.

Approximately 200,000 acres of Forest Service land in the county provides developed trails that can be traveled by foot, horseback, motorcycle, or snowmobile. Maps of these trails can be acquired through the Forest Service.

Cross-country skiing and downhill skiing are potential winter sports. Snowmobile races are held several times during winter.

Boating, fishing, and water skiing are the summer sports. Boat docks and marina services are available. Keyhole Reservoir is the only body of water large enough to accommodate boats for water skiing.

There are hunting seasons for antelope, deer, elk, turkey, cottontail, sage grouse, and sharp-tailed grouse.

The soils of the survey area are rated in table 4 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 4, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 4 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 7 and interpretations for dwellings without basements and for local roads and streets in table 6.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads

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

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

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

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

wildlife habitat

In Crook County the soils support habitat for many kinds of wildlife. Areas of rangeland, dryfarmed cropland, and woodland provide food and cover for white-tailed deer, mule deer, elk, antelope, bobcat, coyote, fox, wild turkey, sage grouse, ruffed grouse, and sharp-tailed grouse. There are hunting seasons for most of the wildlife.

Few streams in the county support fish. The Belle Fourche River, Sand Creek, and Beaver Creek provide some fishing. Many stock ponds are stocked with warm- or cold-water fish.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 5, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, biscuitroot, wheatgrass, and grama.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine and juniper.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountainmahogany, bitterbrush, snowberry, and big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, and shrubs. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include eagle, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodpeckers, squirrels, coyote, raccoon, deer, and elk.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, sage grouse, meadowlark, and lark bunting.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 6 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or

maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 7 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 7 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 7 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2

feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 7 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 8 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 8, only the probability of finding material in suitable quantity is

evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 9 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design

and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 10 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2, 6*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

physical and chemical properties

Table 11 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very low*, less than 1 percent, and *very high*, greater than 9 percent, are sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.
2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Loamy soils that are less than 18 percent clay and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.
7. Silty clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can easily be grown.
8. Stony or gravelly soils and other soils not subject to wind erosion.

soil and water features

Table 12 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 12 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. Only saturated zones within a depth of about 6 feet are indicated. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 12 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 12.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavations.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed

that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*5*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 13, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Alfisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boralf (*Bor*, meaning cool, plus *alf*, from Alfisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Eutroboralf (*Eutro*, meaning high base saturation, plus *boralf*, the suborder of the Alfisols that have a cool temperature regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Eutroboralfs.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed Typic Eutroboralfs.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*4*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*5*). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Absted series

The Absted series consists of very deep, well drained soils on alluvial fans and valley filling side slopes. These soils formed in strongly alkaline alluvial deposits derived principally from sedimentary rock. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Absted soils are similar to Bidman, Briggsdale, and Demar soils. They are near Bone, Ulm, and Wyarno soils. Bidman, Briggsdale, Ulm, and Wyarno soils do not have a high reaction within the profile. Demar soils are acid. Ulm and Wyarno soils do not have an abrupt

boundary between the A and B horizons. Bone soils have a solum 5 inches thick or less.

Typical pedon of Absted very fine sandy loam in an area of Absted-Bone complex, 0 to 3 percent slopes, about 8 miles southwest of Moorcroft, SW1/4 sec. 31, T. 49 N., R. 68 W.

A1—0 to 3 inches; pale brown (10YR 6/3) very fine sandy loam, dark grayish brown (10YR 4/2) moist; very weak subangular blocky structure; soft, very friable, nonsticky; neutral; clear smooth boundary.
A2—3 to 7 inches; pale brown (10YR 6/3) very fine sandy loam, grayish brown (10YR 5/2) moist; weak coarse subangular blocky structure; slightly hard, friable, nonsticky; neutral; abrupt smooth boundary.
B2t—7 to 12 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse columnar structure parting to strong coarse angular blocky; hard, firm, sticky; thick continuous clay films on all faces of peds; mildly alkaline; clear smooth boundary.
B3cacs—12 to 16 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; hard, firm, sticky; calcareous; strongly alkaline; clear smooth boundary.
Ccacs—16 to 60 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure to massive; slightly hard, friable, sticky; calcareous; strongly alkaline.

The solum is 10 to 30 inches thick. Depth to calcareous material is 4 to 12 inches. The cation exchange capacity in the lower B and C horizons is 70 to 90 milliequivalents.

The A1 horizon is light grayish brown or pale brown. The A2 horizon is light brownish gray or pale brown and is about 1 to 4 inches thick. The A1 and A2 horizons are sandy loam, fine sandy loam, or very fine sandy loam. The B2t horizon is 35 to 50 percent clay and is strongly alkaline in the lower part. The C horizon is strongly calcareous and may contain segregated lime.

Alice series

The Alice series consists of very deep, well drained soils formed in alluvium weathered mainly from sandstone. These soils are on alluvial fans, terraces, and valley fill. The slope range is 0 to 15 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Alice soils are similar to Suglo and Tilford soils. They are near Colombo, Kim, Satanta, Thedalund, Tassel, Vona, and Wages soils. Colombo, Kim, Thedalund, and Tassel soils do not have a cambic horizon. Satanta and Wages soils have an argillic horizon. Tassel soils have bedrock at a depth of less than 20 inches. Suglo soils have gravel throughout the profile. Tilford soils have hue of 7.5YR or redder. Vona soils do not have a mollic epipedon.

Typical pedon of Alice fine sandy loam, 6 to 10 percent slopes, about 25 miles northeast of Hulett, SE1/4NE1/4 sec. 14, T. 56 N., R. 63 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine crumb structure; slightly hard, very friable, slightly sticky; mildly alkaline; clear smooth boundary.
A1—7 to 10 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak prismatic structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky; mildly alkaline; clear smooth boundary.
B2—10 to 28 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure; slightly hard, friable, slightly sticky; few patchy clay films on vertical faces; mildly alkaline; clear smooth boundary.
C1ca—28 to 40 inches; very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; massive; slightly hard, friable, nonsticky; calcareous; moderately alkaline; clear smooth boundary.
C2—40 to 60 inches; very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; massive; slightly hard, friable, nonsticky; strongly calcareous; moderately alkaline.

The solum is 18 to 30 inches thick. Reaction ranges from mildly to moderately alkaline.

The A horizon is dark grayish brown or grayish brown fine sandy loam or sandy loam. The B2 horizon is fine sandy loam, loam, or very fine sandy loam.

Ascalon series

The Ascalon series consists of very deep, well drained soils on uplands. These soils formed in material weathered from sandy shale and sandstone. The slope range is 2 to 20 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Ascalon soils are similar to Fort Collins, Sugardee, Satanta, and Wages soils. They are near Fort Collins, Terry, and Tassel soils. Sugardee soils have gravel at 20 to 40 inches. Fort Collins, Satanta, and Wages soils are less than 35 percent fine sand and coarser material. Tassel soils are underlain by bedrock at a depth of less than 20 inches. Terry soils do not have a mollic epipedon.

Typical pedon of Ascalon sandy loam, 2 to 6 percent slopes, about 2 miles west of Oshoto, N1/4 corner sec. 13, T. 53 N., R. 68 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky; neutral; abrupt smooth boundary.
B2t—7 to 12 inches; grayish brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to moderate coarse subangular blocky; slightly hard, friable, sticky; thin continuous clay films; mildly alkaline; clear smooth boundary.
B31—12 to 16 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky; neutral; clear smooth boundary.
B32ca—16 to 20 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky; visible calcium carbonates occur as concretions and in thin seams and streaks; strongly calcareous; moderately alkaline; clear smooth boundary.
Cca—20 to 60 inches; light gray (10YR 7/2) sandy clay loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, sticky; calcareous; moderately alkaline.

The solum is 15 to 40 inches thick. Depth to carbonates is 8 to 30 inches. The mollic epipedon is 7 to 20 inches thick.

The A horizon is sandy loam or fine sandy loam. The C horizon is sandy loam or sandy clay loam that is calcareous or strongly calcareous.

Bankard series

The Bankard series consists of very deep, excessively drained sandy soils on flood plains. These soils formed in sandy alluvium along the Belle Fourche River. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Bankard soils are similar to Barnum, Haverson, Glenberg, Otero, and Valent soils. They are near Glenberg, Haverson, and Lohmiller soils, and Riverwash. Barnum, Haverson, Glenberg, and Lohmiller soils are finer textured then Bankard soils. Otero and Valent soils do not have an irregular decrease of organic matter. Riverwash is gravelly throughout.

Typical pedon of Bankard loamy fine sand in an area of Bankard loamy fine sand, 0 to 3 percent slopes, 3 miles northwest of Mona, SW1/4NE1/4 sec. 15, T. 56 N., R. 63 W.

A1—0 to 4 inches; pale brown (10YR 6/3) loamy fine sand, dark brown (10YR 4/3) moist; weak granular structure; soft, very friable, nonsticky; mildly alkaline; abrupt wavy boundary.
C1—4 to 26 inches; pale brown (10YR 6/3) loamy fine sand, brown (10YR 4/3) moist; very weak fine subangular blocky structure; slightly hard, very friable, nonsticky; slightly calcareous; moderately alkaline; abrupt wavy boundary.
C2—26 to 34 inches; very pale brown (10YR 7/3) loamy fine sand, grayish brown (10YR 5/2) moist; very weak subangular blocky structure; slightly hard, friable, nonsticky; slightly calcareous; moderately alkaline; abrupt wavy boundary.
C3—34 to 44 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; single grain; loose, nonsticky; moderately calcareous; moderately alkaline; abrupt wavy boundary.
C4—44 to 48 inches; very pale brown (10YR 7/4) fine sand, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, nonsticky; moderately calcareous; moderately alkaline; abrupt wavy boundary.
C5—48 to 60 inches; very pale brown (10YR 7/3) very fine sand, brown (10YR 5/3) moist; single grain; loose, nonsticky; moderately calcareous; moderately alkaline.

The soil may be noncalcareous in the upper few inches. The A horizon is loamy sand or loamy fine sand. The C horizon is moderately to strongly alkaline fine sand to loamy fine sand.

Barnum series

The Barnum series consists of very deep, well drained soils formed in alluvium weathered mainly from red-bed shale and sandstone. These soils are on flood plains and terraces. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Barnum soils are similar to Bankard, Haverson, Glenberg, and Nevee soils. They are near Haverson, Nevee, Spearfish, Tilford, and Vale soils. Bankard, Haverson, and Glenberg soils have hue no redder than 7.5YR. Nevee soils are not stratified, and organic matter content decreases uniformly with depth. Tilford and Vale soils have a mollic epipedon. Vale soils have an argillic horizon. Spearfish soils have bedrock within a depth of 20 inches.

Typical pedon of Barnum silt loam in an area of Barnum silt loam, 0 to 3 percent slopes, about one-half mile south of Beulah, SE1/4NE1/4 sec. 31, T. 52 N., R. 60 W.

Ap—0 to 8 inches; light reddish brown (5YR 6/4) silt loam, reddish brown (5YR 4/4) moist; very weak fine subangular blocky structure; slightly hard, friable, slightly sticky; calcareous; moderately alkaline; clear smooth boundary.
C—8 to 60 inches; reddish yellow (5YR 6/6) silt loam, yellowish red (5YR 4/6) moist; very weak

subangular blocky structure; slightly hard, friable, slightly sticky; calcareous; moderately alkaline.

The A horizon is light reddish brown or dark reddish brown. The C horizon is yellowish red to red.

Bidman series

The Bidman series consists of very deep, well drained soils formed in material weathered from sedimentary rock. These soils are on alluvial fans and valley filling side slopes. The slope range is 0 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Bidman soils are similar to Absted, Briggsdale, and Demar soils. They are near Bone, Briggsdale, and Ulm soils. Absted soils are more than 35 percent exchangeable sodium. Bone soils have a thin solum and have a high content of exchangeable sodium. Briggsdale soils have bedrock at 20 to 40 inches. Demar soils are acid. Ulm soils differ in not having an abrupt boundary between the A and B horizons.

Typical pedon of Bidman loam in an area of Bidman loam, 0 to 1 percent slopes, about 25 miles north of Hulett, NE1/4SW1/4 sec. 1, T. 57 N., R. 66 W.

A2—0 to 6 inches; light gray (10YR 7/2) loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure parting to fine granular; soft, very friable, nonsticky; neutral; abrupt smooth boundary.

B2t—6 to 15 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; strong medium columnar structure parting to strong medium angular blocky; hard, firm, sticky; moderately thick continuous clay films on faces of peds; strongly calcareous; mildly alkaline; clear smooth boundary.

B3ca—15 to 19 inches; light brownish gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; moderate coarse angular blocky structure; hard, firm, sticky; common fine distinct segregations of calcium carbonate as seams and threads; strongly calcareous; moderately alkaline; clear smooth boundary.

C1ca—19 to 46 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate coarse angular blocky structure; hard, firm, sticky; many medium distinct segregations of calcium carbonate; strongly calcareous; strongly alkaline; clear smooth boundary.

C2ca—46 to 60 inches; light brownish gray (2.5Y 6/2) clay loam; strongly calcareous; strongly alkaline.

Thickness of the solum ranges from 15 to 30 inches. Depth to carbonates ranges from 8 to 15 inches.

The C horizon is moderately to strongly alkaline.

Bone series

The Bone series consists of very deep, moderately well drained soils on alluvial fans and valley filling side slopes. These soils formed in moderately alkaline deposits derived mainly from sedimentary rock. The slope range is 0 to 10 percent. The average annual precipitation is 16 inches. The average annual air temperature is about 46 degrees F.

Bone soils are similar to Gaynor, Twotop, Limon, and Topeman soils and are near Absted, Bidman, Briggsdale, Ulm, and Wyarno soils. Gaynor, Twotop, Limon, Ulm, and Wyarno soils do not have a salic horizon. In contrast with Bone soils, Bidman and Briggsdale soils have thicker A and B2t horizons. Topeman soils are acid throughout. Absted soils have a solum 16 inches or more thick.

Typical pedon of Bone loam in an area of Absted-Bone complex, 0 to 3 percent slopes, about 25 miles northwest of Hulett, SW1/4NW1/4 sec. 13, T. 57 N., R. 65 W.

A2—0 to 2 inches; white (2.5Y 8/1) loam, dark grayish brown (2.5Y 4/2) moist; massive; vesicular; hard, firm, slightly sticky; slightly acid; abrupt smooth boundary.

B2t—2 to 5 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; very weak fine subangular blocky structure; hard, firm, sticky; thin patchy clay films on some peds; neutral; clear smooth boundary.

C1cacs—5 to 12 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky; few seams and nests of gypsum and salts; calcareous; strongly alkaline; clear smooth boundary.

C2ca—12 to 60 inches; grayish brown (2.5Y 5/2) clay loam; massive; hard, firm, sticky; few seams and nests of gypsum and salts decreasing with depth; strongly calcareous; moderately alkaline.

The depth to carbonates and thickness of the solum range from 2 to 5 inches.

Soluble salts content of the C horizon is 1 to 2 percent.

Boneek series

The Boneek series consists of deep, well drained soils formed in silty sediments. On uplands these soils are underlain by sandstone, siltstone, or loess. On high terraces they are underlain by silty alluvium. The slope range is 0 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Boneek soils, which are similar to Kadoka, Norka, Nunn, Vale, and Emigrant soils, are near Butche, Kadoka, and Nunn soils. Kadoka, Norka, and Vale soils

are fine-silty. Nunn soils contain more fine sand than Boneek soils and are coarser textured. Bedrock is at a depth of 20 to 40 inches in Emigrant soils and is within 20 inches in Butche soils.

Typical pedon of Boneek loam in an area of Boneek loam, 2 to 6 percent slopes, 13 miles northwest of Sundance, NE1/4NE1/4 sec. 2, T. 52 N., R. 65 W.

A1—0 to 9 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable, slightly sticky; neutral; clear smooth boundary.
B2t—9 to 21 inches; brown (7.5YR 5/4) silty clay loam, brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium angular blocky; hard, firm, sticky; thin continuous clay films on all ped faces; neutral; clear smooth boundary.
B3—21 to 25 inches; very pale brown (10YR 7/4) silt loam, brown (10YR 5/3) moist; moderate medium prismatic structure parting to moderate coarse angular blocky; hard, firm, slightly sticky; mildly alkaline; clear smooth boundary.
C1ca—25 to 58 inches; very pale brown (10YR 7/4) silt loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; hard, firm, slightly sticky; common medium soft masses of calcium carbonate; strongly calcareous; moderately alkaline; clear wavy boundary.
C2r—58 inches; pale brown sandstone.

The solum is 20 to 25 inches thick. Depth to carbonates ranges from 11 to 25 inches. Depth to bedrock is 40 to 60 inches or more. The mollic epipedon is 7 to 15 inches thick.

The B2t horizon is silty clay loam or silty clay that is 35 to 45 percent clay. It has moderate to strong prismatic and blocky structure.

The B3 and Cca horizons are pale brown to very pale brown silt loam or silty clay loam.

Briggsdale series

The Briggsdale series consists of moderately deep, well drained soils on uplands. These soils formed in residuum of sedimentary rock. The slope range is 0 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Briggsdale soils are similar to Absted, Bidman, and Demar soils. They are near Bidman, Bone, Renohill, and Wyarno soils. Absted soils are more than 15 percent exchangeable sodium. Bidman soils are more than 40 inches deep over bedrock. Demar soils are acid in the B and C horizons. Bone soils have a thin solum and are more than 15 percent exchangeable sodium. Renohill and Wyarno soils do not have an abrupt textural boundary between the A and B horizons.

Typical pedon of Briggsdale loam in an area of Briggsdale loam, 1 to 6 percent slopes, about 30 miles north of Hulett, SE1/4NE1/4 sec. 31, T. 58 N., R. 65 W.

A1—0 to 4 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; very weak fine granular structure; soft, very friable, slightly sticky; neutral; abrupt smooth boundary.
A2—4 to 6 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; very weak thin platy structure; soft, very friable, slightly sticky; neutral; abrupt smooth boundary.
B21t—6 to 13 inches; brown (10YR 5/3) clay, dark grayish brown (10YR 4/2) moist; moderate medium columnar structure that parts to strong medium and coarse angular blocky; hard, firm, sticky; moderate, continuous clay films on all faces of peds; neutral; clear smooth boundary.
B22t—13 to 20 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; strong coarse angular blocky structure; hard, firm, sticky; thin clay films on all faces of peds; neutral; clear smooth boundary.
B3ca—20 to 25 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate coarse subangular blocky structure; hard, firm, sticky; common secondary calcium carbonate concretions, strongly calcareous; moderately alkaline; gradual wavy boundary.
C1ca—25 to 36 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; weak coarse subangular blocky structure; hard, firm, sticky; visible secondary carbonates as concretions or in finely divided form, calcareous; moderately alkaline; clear smooth boundary.
C2r—36 inches; clay shale.

Thickness of the solum ranges from 16 to 40 inches. Depth to calcareous material ranges from 10 to 20 inches. Depth to a paralithic contact ranges from 20 to 40 inches.

The A horizon is loam or fine sandy loam. The B2t horizon is neutral or mildly alkaline. The C horizon is moderately to strongly alkaline loam to clay.

Butche series

The Butche series consists of shallow, somewhat excessively drained soils on uplands. These soils formed in material weathered from hard fine-grained sandstone. The slope is 1 to 60 percent. The average annual precipitation is about 16 inches. The annual average air temperature is about 46 degrees F.

Butche soils are similar to Grummit, Laporte, Paunsaugunt, Samsil, Spearfish, Shingle, and Tassel soils. They are near Boneek, Kadoka, Larkson, McCaffery, Norka, Thedalund, Lakoa, and Spangler soils. Grummit soils are clay or clay loam. Laporte,

Paunsaugunt, Tassel, Shingle, Samsil, and Spearfish soils are calcareous. Boneek, Kadoka, Larkson, McCaffery, Norka, Thedalund, Lakoa, and Spangler soils are all more than 20 inches deep over bedrock.

Typical pedon of Butche fine sandy loam in an area of Butche-Spangler complex, 3 to 10 percent slopes, about 5 miles east of Mona, SE1/4SE1/4 sec. 6, T. 56 N., R. 62 W.

A1—0 to 4 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak granular structure; soft, very friable, nonsticky; neutral; clear smooth boundary.
AC—4 to 8 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate coarse subangular blocky structure; slightly hard, very friable, nonsticky; mildly alkaline; clear smooth boundary.
C—8 to 12 inches; light gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak blocky structure to massive; slightly hard, very friable, nonsticky; mildly alkaline; abrupt wavy boundary.
R—12 inches; light gray (10YR 7/2) hard sandstone; neutral.

Depth to bedrock ranges from 7 to 20 inches. Texture ranges from fine sandy loam to loam. Reaction is slightly acid to mildly alkaline.

Cadoma series

The Cadoma series consists of moderately deep, well drained soils on uplands. These soils formed in fine textured material derived from shale that contains a considerable amount of sodium or salts. The slope range is 2 to 15 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Cadoma soils are similar to Gaynor, Orella, Petrie, and Razor soils. They are near Gaynor, Orella, Petrie, Samsil, and Shingle soils. Orella soils are 10 to 20 inches deep over bedrock. Petrie soils are more than 40 inches deep over bedrock. Gaynor and Razor soils are less than 15 percent exchangeable sodium. Shingle and Samsil soils are shallow over bedrock and do not have a high content of exchangeable sodium.

Typical pedon of Cadoma clay in an area of Cadoma clay, 2 to 10 percent slopes, 8 miles east of Moorcroft, NE1/4NW1/4 sec. 5, T. 49 N., R. 66 W.

A1—0 to 4 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; hard, firm, sticky; strongly calcareous; strongly alkaline; clear smooth boundary.
B2—4 to 12 inches; light brownish gray (10YR 6/2) clay, dark yellowish brown (10YR 4/4) moist; moderate coarse subangular blocky structure; hard, firm, very sticky; strongly calcareous; very strongly alkaline; clear smooth boundary.
C1ca—12 to 30 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; moderate coarse subangular blocky structure; hard, firm, very sticky; some visible secondary carbonates, strongly calcareous; strongly alkaline; clear smooth boundary.
C2r—30 inches; alkaline shale.

Depth to carbonates is 0 to 4 inches. Depth to bedrock is 20 to 40 inches. The control section is clay or clay loam. The content of exchangeable sodium ranges from 15 to 25 percent. Reaction is strongly or very strongly alkaline.

Citadel series

The Citadel series consists of very deep, well drained soils in the mountains. These soils formed in residuum of calcareous sandstone, limestone, and soft shale. The slope range is 3 to 40 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

Citadel soils are similar to Lail, Larkson, Lakoa, Maitland, and Stovho soils. They are near Cordeston, Grizzly, Larkson, McCaffery, Paunsaugunt, Peso, Vanocker, and Virkula soils and Rock outcrop. Lail and Stovho soils are colder than Citadel soils. Larkson soils do not have red material in the profile. Lakoa, Maitland, and Cordeston soils are less than 35 percent clay. Grizzly and Vanocker soils are channery. McCaffery soils are less than 28 percent clay. Paunsaugunt soils are less than 20 inches deep over bedrock. Peso soils do not have an argillic horizon. Virkula soils formed in material weathered from igneous rock.

Typical pedon of Citadel loam in an area of Citadel-McCaffery complex, 10 to 30 percent slopes, about 12 miles northwest of Sundance, SW1/4SW1/4 sec. 13, T. 52 N., R. 64 W.

O2—1 inch to 0; mulch of decomposed pine needles and grass.
A1—0 to 3 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak fine crumb structure; slightly hard, very friable, slightly sticky; slightly acid; neutral; clear wavy boundary.
A21—3 to 7 inches; brown (7.5YR 5/2) silt loam, dark brown (7.5YR 3/2) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky; slightly acid; clear wavy boundary.
A22—7 to 14 inches; pinkish gray (7.5YR 6/2) silt loam, brown (7.5YR 4/2) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky; slightly acid; clear wavy boundary.
B&A—14 to 19 inches; reddish brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure;

slightly hard, friable, slightly sticky; slightly acid; clear wavy boundary.
B21t—19 to 30 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; strong medium angular blocky structure; slightly hard, friable, sticky; thick continuous clay films on all faces of peds; slightly acid; clear wavy boundary.
B22t—30 to 40 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; strong coarse angular blocky structure; hard, firm, sticky; thick continuous clay films on all faces of peds; slightly acid; clear wavy boundary.
B3ca—40 to 46 inches; light reddish brown (5YR 6/4) clay loam, reddish brown (5YR 4/4) moist; weak coarse subangular blocky structure; hard, firm, sticky; thin patchy clay films on some peds; slightly calcareous; mildly alkaline; clear wavy boundary.
Cca—46 to 60 inches; reddish yellow (5YR 6/6) silt loam, yellowish red (5YR 4/6) moist; massive; slightly hard, friable, slightly sticky; strongly calcareous, medium soft masses of segregated lime; mildly alkaline.

Thickness of the solum is 18 to 46 inches. Depth to carbonates ranges from 13 to 40 inches. Depth to bedrock is 60 inches or more. The content of coarse fragments is up to 15 percent in the solum and up to 25 percent in the C horizon. The solum is strongly acid to neutral.

The A2 horizon is light brown or gray silt loam or very fine sandy loam. The C horizon is silt loam to clay loam.

Colombo series

The Colombo series consists of very deep, well drained soils on flood plains. These soils formed in alluvium. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Colombo soils are similar to Frazerton, Onita, Lynx, and Cordeston soils. They are near Alice, Lynx, Cordeston, Onita, and Haverson soils. Frazerton soils are more than 35 percent clay. Lynx soils are noncalcareous throughout. Cordeston and Onita soils have a mollic epipedon more than 20 inches thick. Haverson soils do not have a mollic epipedon. Alice soils have a cambic horizon.

Typical pedon of Colombo loam in an area of Colombo loam, 0 to 3 percent slopes, 2 miles south of Beulah, SW1/4SW1/4 sec. 8, T. 52 N., R. 60 W.

A11—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, dry or moist; strong very fine granular structure; slightly hard, very friable, slightly sticky; calcareous; moderately alkaline; abrupt smooth boundary.
A12—6 to 10 inches; dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky; strongly calcareous; moderately alkaline; clear smooth boundary.
A13—10 to 16 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky; strongly calcareous; moderately alkaline; clear smooth boundary.
C1—16 to 24 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky; strongly calcareous; moderately alkaline; clear smooth boundary.
C2—24 to 60 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky; slightly calcareous; moderately alkaline.

The control section is loam or clay loam. The mollic epipedon is 10 to 16 inches thick.

The A horizon is very dark grayish brown, dark grayish brown, grayish brown, or dark brown. The C horizon is loam or clay loam and is moderately to strongly alkaline.

Cordeston series

The Cordeston series consists of very deep, well drained soils formed on valley filling alluvial fans. The slope range is 1 to 10 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

Cordeston soils are near Citadel, Colombo, Lakoa, Larkson, Maitland, Stovho, and Vanocker soils. They are similar to Colombo, Frazerton, and Lynx soils but are colder. Citadel, Lakoa, Larkson, Maitland, and Stovho soils have an argillic horizon. Vanocker soils are channery.

Typical pedon of Cordeston loam in an area of Cordeston loam, 1 to 6 percent slopes, 1 mile southeast of Moskee, NW1/4NE1/4 sec. 9, T. 49 N., R. 61 W.

A11—0 to 3 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse granular structure; slightly hard, friable, slightly sticky; neutral; clear smooth boundary.
A12—3 to 8 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak fine and medium granular structure; slightly hard, friable, slightly sticky; neutral; clear smooth boundary.
B21—8 to 15 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak medium and coarse angular blocky structure; slightly hard, friable, slightly sticky; neutral; clear smooth boundary.
B22—15 to 26 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak coarse angular

blocky structure; slightly hard, friable, slightly sticky; neutral; gradual wavy boundary.
B3—26 to 40 inches; dark brown (7.5YR 4/2) with streaks of brown (7.5YR 5/4) loam, dark brown (7.5YR 3/2) moist; weak medium and coarse angular blocky structure; slightly hard, friable, slightly sticky; neutral; clear smooth boundary.
C1—40 to 48 inches; brown (7.5YR 5/4) very fine sandy loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky; mildly alkaline; clear smooth boundary.
C2—48 to 60 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/2) moist; massive; slightly hard, friable, slightly sticky; mildly alkaline.

Thickness of the mollic epipedon is typically about 40 inches but ranges from 36 to 50 inches.

The A horizon is dark gray or dark grayish brown loam or fine sandy loam. The C horizon is brown or grayish brown loam, silt loam, or very fine sandy loam.

Cushman series

The Cushman series consists of moderately deep, well drained soils on upland plains. These soils formed in calcareous material weathered from sandstone and shale. The slope range is 1 to 30 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Cushman soils are similar to Fort Collins, Spangler, and Zigweid soils. They are near Fort Collins, Kadoka, Kim, Zigweid, Renohill, Shingle, Terry, Ulm, and Thedalund soils. Fort Collins, Kim, Ulm, and Zigweid soils have no bedrock within 40 inches. Spangler soils are noncalcareous throughout. Kim and Thedalund soils do not have an argillic horizon. Terry soils are coarser textured than Cushman soils. Shingle soils are less than 20 inches thick over to bedrock. Kadoka soils have a mollic epipedon.

Typical pedon of Cushman loam in an area of Cushman loam, 6 to 10 percent slopes, 3 miles east of Mateo Village, SW1/4 sec. 5, T. 52 N., R. 65 W.

A1—0 to 3 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky; neutral; clear smooth boundary.
B2t—3 to 7 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; moderate coarse prismatic structure parting to medium angular blocky; hard, firm, sticky; thin continuous clay films; neutral; clear smooth boundary.
B3ca—7 to 11 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; moderate coarse subangular blocky structure; hard, firm, slightly sticky; calcareous, common medium masses of calcium carbonate; moderately alkaline; clear smooth boundary.
C1ca—11 to 30 inches; light brownish gray (10YR 6/2) clay loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky; strongly calcareous, medium-sized soft masses of calcium carbonate; moderately alkaline; gradual wavy boundary.
C2r—30 inches; soft, light gray, calcareous sandstone.

The solum is 10 to 15 inches thick. Depth to carbonates is 6 to 10 inches. Depth to bedrock is 20 to 40 inches. Bedrock is sandstone, shale, or loamstone.

The A horizon is grayish brown to light brownish gray fine sandy loam to loam. The B horizon is brown to light brownish gray loam or clay loam that is less than 35 percent clay. The C horizon is moderately to strongly alkaline loam or clay loam.

Demar series

The Demar series consists of deep, moderately well drained soils on alluvial terraces. These soils formed in clayey alluvium derived from acid shale. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Demar soils are similar to Absted, Bidman, and Briggsdale soils. They are near Grummit, Maggin, Topeman, and Querc soils. Absted, Bidman, and Briggsdale soils are alkaline. Absted soils have a natric horizon. Grummit, Maggin, and Topeman soils do not have an argillic horizon. Querc soils do not have an albic horizon.

Typical pedon of Demar loam in an area of Topeman-Demar complex, 0 to 3 percent slopes, 3 miles east of Colony, SE1/4NW1/4 sec. 13, T. 56 N., R. 61 W.

A2—0 to 6 inches; grayish brown (10YR 5/2) loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; slightly hard, friable, nonsticky; 10 percent soft shale fragments; neutral; abrupt wavy boundary.
B2t—6 to 14 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate coarse prismatic structure parting to moderate coarse angular blocky; very hard, very firm, very sticky; many moderately thick clay films on faces of peds; 5 percent soft shale chips; medium acid; clear wavy boundary.
B3cs—14 to 19 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate medium and fine angular blocky structure; very hard, very firm, very sticky; common fine distinct nests of gypsum; 10 percent soft shale fragments; very strongly acid; clear wavy boundary.
C1cs—19 to 48 inches; grayish brown (10YR 5/2) shaly clay, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; very hard, very firm, very sticky; few fine distinct nests of gypsum;

30 percent soft shale chips; very strongly acid; gradual wavy boundary.
C2r—48 inches; dark gray, strongly acid, carbonaceous shale.

The solum ranges from 16 to 36 inches thick. The depth to bedrock ranges from 40 to 50 inches. Reaction is neutral to strongly acid in the upper 12 inches and very strongly to extremely acid below this depth. The control section is 10 to 35 percent soft shale chips.

The A2 horizon is grayish brown or pale brown loam or clay loam. The B2t horizon is dark grayish brown, grayish brown, or brown. The C horizon is grayish brown or light brownish gray. It is 30 to 50 percent soft shale fragments.

Emigrant series

The Emigrant series consists of moderately deep, well drained soils on uplands. These soils formed in calcareous clayey and loamy residuum or transported material over sandstone or shale. The slope range is 1 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Emigrant soils are similar to Boneek, Nunn, Renohill, Querc, Ulm, and Work soils. They are near Louviers, Nunn, Razor, Renohill, and Samsil soils. Boneek, Nunn, Ulm, and Work soils do not have bedrock within 40 inches. Renohill soils have an ochric epipedon. Razor soils have a cambic horizon. Samsil and Louviers soils have bedrock within 20 inches. Querc soils do not have a continuous horizon of calcium carbonate accumulation.

Typical pedon of Emigrant loam in an area of Emigrant loam, 1 to 6 percent slopes, 5 miles south of Colony, NW1/4SW1/4 sec. 36, T. 56 N., R. 61 W.

A1—0 to 5 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky; neutral; clear smooth boundary.
B1—5 to 8 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate fine subangular blocky; hard, firm, sticky; thin patchy glossy coatings on all faces of peds; neutral; clear smooth boundary.
B2t—8 to 20 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky; continuous clay films on all faces of peds; mildly alkaline; clear smooth boundary.
B3ca—20 to 26 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; very hard, firm, sticky; thin patchy clay films on all faces of peds; calcareous, few fine threads and soft rounded masses of secondary lime; moderately alkaline; gradual wavy boundary.
C1ca—26 to 32 inches; light gray (2.5Y 7/2) clay, grayish brown (2.5Y 5/2) moist; weak coarse subangular blocky structure; hard, firm, sticky; strongly calcareous, common soft masses of secondary lime; moderately alkaline; gradual wavy boundary.
C2r—32 inches; amorphous, yellowish, slightly calcareous shale.

Depth to bedrock is 20 to 40 inches. Depth to carbonates is 10 to 20 inches.

The A horizon is loam or clay loam. The B2t horizon is dark brown or grayish brown clay loam or clay that is 35 to 45 percent clay. The C horizon is light gray or yellowish brown loam, clay loam, or clay.

Fort Collins series

The Fort Collins series consists of very deep, well drained soils on alluvial fans, foot slopes, and terraces. These soils formed in calcareous loamy sediment. The slope range is 0 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Fort Collins soils are similar to Ascalon, Cushman, and Spangler soils. They are near the Ascalon, Cushman, Kim, Zigweid, Shingle, and Vona soils. Cushman and Spangler soils have bedrock at 20 to 40 inches. Ascalon and Vona soils are more than 35 percent fine sand or coarser in the argillic and C horizons. Shingle soils have bedrock within 20 inches. Kim soils have no argillic horizon. Zigweid soils have a cambic horizon.

Typical pedon of Fort Collins loam in an area of Fort Collins loam, 6 to 10 percent slopes, 3 miles east of Moorcroft, SW1/4NW1/4 sec. 34, T. 50 N., R. 67 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; very weak subangular blocky structure parting to granular; soft, very friable, slightly sticky; neutral; clear smooth boundary.
B2t—8 to 14 inches; brown (7.5YR 5/2) clay loam, (10YR 4/2) moist; moderate fine prismatic structure parting to strong fine angular blocky; slightly hard, friable, sticky; thin continuous clay films on all faces of peds; mildly alkaline; clear smooth boundary.
B3ca—14 to 22 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; moderate medium prismatic structure parting to moderate medium angular blocky; slightly hard, friable; sticky; thin continuous clay films on vertical faces; calcareous; moderately alkaline; clear smooth boundary.
Cca—22 to 60 inches; light gray (10YR 7/2) loam, light brownish gray (10YR 6/2) moist; weak coarse subangular blocky structure; slightly hard, friable, sticky; strongly calcareous; moderately alkaline.

Thickness of the solum is 15 to 30 inches. Depth to calcareous material ranges from 8 to 20 inches.

The A horizon is light brownish gray or grayish brown. The B2t horizon is brown or yellowish brown clay loam or loam that is 18 to 35 percent clay. The C horizon is light gray or pale brown.

Frazerton series

The Frazerton series consists of very deep, well drained soils on narrow flood plains. These soils formed in stratified alluvium. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Frazerton soils are similar to Colombo and Lynx soils. They are near Haverson, Lohmiller, Stetter, and Twotop soils. Colombo, Lynx, and Haverson soils are less than 35 percent clay. Haverson, Lohmiller, Stetter, and Twotop soils do not have a mollic epipedon.

Typical pedon of Frazerton silty clay loam in an area of Frazerton silty clay loam, 0 to 3 percent slopes, 10 miles northwest of Hulett, one-fourth mile south of the 1/16 corner marker, NE1/4SW1/4 sec. 10, T. 55 N., R. 66 W.

A1—0 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam; very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure parting to moderate medium granular; hard, firm, sticky; mildly alkaline; clear smooth boundary.

C1—14 to 27 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; moderate coarse subangular blocky structure; hard, firm, sticky; mildly alkaline; clear smooth boundary.

C2—27 to 60 inches; grayish brown (10YR 5/2) silty clay loam stratified with silty clay and loam; dark grayish brown (10YR 4/2) moist; massive; hard, firm, sticky; mildly alkaline.

Carbonates are at a depth of 40 to 60 inches. Thickness of the mollic epipedon ranges from 8 to 15 inches. Texture of the control section is dominantly silty clay loam but ranges to clay.

The A horizon is dark grayish brown or dark gray.

The C horizon is neutral or mildly alkaline.

Gaynor series

The Gaynor series consists of moderately deep, well drained soils formed in residuum or in sediments locally transported from sedimentary rock of the uplands. The slope range is 2 to 30 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Gaynor soils are similar to Bone, Cadoma, Limon, Petrie, Samsil, and Winler soils. They are near Cadoma, Heldt, Limon, Nunn, Petrie, Razor, Renohill, Samsil, and Twotop soils. Heldt, Limon, and Nunn soils do not have bedrock above 40 inches. Winler soils are more than 60 percent clay. Petrie and Cadoma soils are more than 15 percent exchangeable sodium. Samsil soils have bedrock at less than 20 inches. Razor soils have a cambic horizon. Renohill soils have an argillic horizon. Twotop soils are more than 60 percent clay.

Typical pedon of Gaynor clay loam in an area of Gaynor clay loam, 2 to 10 percent slopes, 3 miles north of Mateo village, 100 feet southeast of southwest corner, NW1/4NW1/4 sec. 33, T. 53 N., R. 65 W.

A11—0 to 2 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; thin crust overlying a moderate very fine granular structure; slightly hard, friable, sticky; calcareous, moderately alkaline; abrupt smooth boundary.

A12—2 to 5 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate fine subangular blocky structure; very hard, very firm, very sticky; calcareous; moderately alkaline; clear smooth boundary.

AC—5 to 9 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure; very hard, very firm, very sticky; slickensides on all faces; few small shale fragments; calcareous; moderately alkaline; clear smooth boundary.

C1—9 to 18 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium and coarse angular blocky; very hard, very firm, very sticky; slickensides on most ped faces; few partially weathered shale fragments; strongly calcareous; moderately alkaline; clear smooth boundary.

C2—18 to 32 inches; grayish brown (2.5Y 5/2) clay mottled with pale yellow and dark olive; massive; hard, firm, sticky; 5 to 15 percent shale fragments; strongly calcareous; moderately alkaline; diffuse wavy boundary.

C3r—32 inches; gray calcareous shale.

Depth to the underlying bedrock is 20 to 40 inches. The control section is clay or clay loam that is 35 to 50 percent clay.

The A horizon is grayish brown or light brownish gray.

Glenberg series

The Glenberg series consists of very deep, well drained soils formed in thick, very strongly stratified alluvial sediment derived from mixed sources. These soils are on flood plains and low terraces. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Glenberg soils are similar to Bankard, Barnum, and Otero soils. They are near Bankard, Haverson, and Lohmiller soils and Riverwash. Bankard soils are coarser

and less stratified. Barnum soils have hues redder than 7.5YR. Haverson and Lohmiller soils are finer textured. Otero soils do not have an irregular decrease in organic matter content. Riverwash contains a large amount of gravel.

Typical pedon of Glenberg fine sandy loam in an area of Glenberg fine sandy loam, 0 to 3 percent slopes, 3 miles west of Colony, SE1/4SW1/4 sec. 26, T. 57 N., R. 62 W.

A1—0 to 5 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky; mildly alkaline; abrupt smooth boundary.
C—5 to 60 inches; light brownish gray (10YR 6/2) sandy loam stratified with thin lenses of loam and loamy sand, dark grayish brown (10YR 4/2) moist; massive; slightly hard, very friable, nonsticky; calcareous; mildly alkaline.

Rock fragments range from 0 to 15 percent.

Grizzly series

The Grizzly series consists of very deep, well drained soils on mountain uplands. These soils formed in igneous material. The slope range is 6 to 60 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

Grizzly soils are not similar to any other soils in Crook County. They are near Citadel, Stovho, Vanocker, and Virkula soils. Citadel and Vanocker soils formed in silty material over limestone. Stovho soils are cryic. The solum of Virkula soils is less than 35 percent rock fragments.

Typical pedon of Grizzly very channery loam in an area of Grizzly-Virkula complex, 15 to 60 percent slopes, near Warren Peak near center of sec. 20, T. 52 N., R. 63 W.

O—1 inch to 0; forest litter and decomposed forest litter and grass.
A1—0 to 3 inches; grayish brown (10YR 5/2) very channery loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; soft, very friable, nonsticky; 35 percent channery fragments; neutral; clear smooth boundary.
A21—3 to 14 inches; brown (10YR 4/3) very channery loam, dark brown (10YR 3/3) moist; moderate fine granular structure; soft, very friable, nonsticky; 25 percent channery fragments and 15 percent flagstones; slightly acid; clear wavy boundary.
A22—14 to 17 inches; light yellowish brown (10YR 6/4) very channery loam, brown (10YR 4/3) moist; weak coarse subangular blocky structure; slightly hard, friable, nonsticky; 25 percent channery fragments and 15 percent flagstones; slightly acid; clear wavy boundary.
B&A—17 to 22 inches; light brown (7.5YR 6/4) very channery clay loam, dark brown (7.5YR 4/4) moist (B2t), and 40 percent light yellowish brown (10YR 6/4) very channery loam, brown (10YR 4/3) moist (A2); weak medium subangular blocky structure; slightly hard, friable, sticky; 35 percent channery fragments and 20 percent flagstones; medium acid; clear wavy boundary.
B21t—22 to 29 inches; light brown (7.5YR 6/4) very channery clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm, sticky; common thin clay films on faces of peds; 40 percent channery fragments and 25 percent flagstones; medium acid; clear smooth boundary.
B22t—29 to 42 inches; light brown (7.5YR 6/4) very channery clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm, sticky; few thin clay films on faces of peds; 40 percent channery fragments and 25 percent flagstones; medium acid; clear smooth boundary.
B3—42 to 52 inches; light brown (7.5YR 6/4) very channery clay loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; hard, firm, sticky; 40 percent channery fragments and 25 percent flagstones; medium acid; clear smooth boundary.
C—52 to 66 inches; light brown (7.5YR 6/4) very channery clay loam, dark brown (7.5YR 4/4) moist; massive; 40 percent channery fragments and 25 percent flagstones; slightly acid.

Content of coarse fragments or rock ranges from 35 to 75 percent in the solum and 50 to 80 percent in the underlying material. Solum thickness ranges from 25 to 60 inches.

The solum ranges from medium acid to neutral.

Grummit series

The Grummit series consists of shallow, well drained soils on uplands. These soils formed in clayey residuum of acid shale. The slope range is 3 to 60 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Grummit soils are similar to Butche, Maggin, Samsil, and Louviers soils. They are near Demar, Louviers, Maggin, Querc, Shingle, and Samsil soils. Butche soils are loamy. Maggin soils are 20 to 40 inches to bedrock. Samsil soils are calcareous. Louviers soils are neutral. Demar and Querc soils have an argillic horizon. Shingle soils are loamy and calcareous.

Typical pedon of Grummit shaly clay loam in an area of Grummit-Maggin complex, 3 to 10 percent slopes, east quarter corner sec. 15, T. 56 N., R. 61 W.

A1—0 to 4 inches; light brownish gray (10YR 6/2) shaly clay loam, very dark grayish brown (10YR 3/2)

moist; strong very fine granular structure; soft, very friable, slightly sticky; many very fine shale fragments; strongly acid; abrupt smooth boundary.
C1—4 to 11 inches; light brownish gray (10YR 6/2) shaly clay, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky; 40 percent flaky fragments of shale; very strongly acid; clear smooth boundary.
C2r—11 inches; gray (2.5Y 5/0) brittle platy shale, common medium distinct yellowish brown (10YR 5/8) stains; very hard; very strongly acid.

The soil is strongly acid to extremely acid. Depth to shale is 7 to 20 inches. The control section is 20 to 50 percent flaky shale fragments. Shale fragments are readily crushed.

Gypnevee series

The Gypnevee series consists of deep, well drained soils on uplands. These soils formed in residuum of gyprock. The slope range is 3 to 20 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Gypnevee soils are similar to Nevee and Higgins soils and are near Nevee, Higgins, Rekop, and Tilford soils. Nevee and Tilford soils do not have a large quantity of gypsum. Rekop soils have bedrock at 10 to 20 inches. Higgins soils have a high water table.

Typical pedon of Gypnevee silt loam in an area of Rekop-Gypnevee-Rock outcrop complex, 3 to 30 percent slopes, NW1/4NW1/4, sec. 4, T. 50 N., R. 62 W.

A1—0 to 5 inches; reddish brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; soft, very friable, slightly sticky; strongly calcareous; moderately alkaline; clear smooth boundary.
AC—5 to 16 inches; light reddish brown (5YR 6/4) silt loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky; strongly calcareous; moderately alkaline; clear smooth boundary.
C1—16 to 20 inches; pink (5YR 7/4) silt loam, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky; strongly calcareous; 50 percent gypsum and calcium carbonates mainly disseminated throughout the mass; mildly alkaline; clear smooth boundary.
C2—20 to 46 inches; reddish yellow (5YR 7/6) silt loam, yellowish red (5YR 5/6) moist; massive; soft, very friable, slightly sticky; strongly calcareous; 60 percent gypsum and calcium carbonate in fine soft rounded masses, threads, and seams; moderately alkaline; gradual irregular boundary.
C3r—46 inches; soft massive gyprock.

Depth to bedrock is 40 to 60 inches. The control section is silt loam, loam, or very fine sandy loam. Content of gypsum plus calcium carbonate is 40 to 60 percent.

The A horizon is reddish brown to gray to pink. The C horizon is pink to pale red or light reddish brown.

Haverson series

The Haverson series consists of very deep, well drained soils on flood plains and low terraces along the major streams. These soils formed in stratified calcareous alluvium. The slope range is 0 to 6 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Haverson soils are similar to Bankard, Barnum, Kim, Lohmiller, and Stetter soils. They are near Bankard, Barnum, Colombo, Frazerton, Glenberg, Lohmiller, Lynx, and Stetter soils. Barnum soils have hues of 5YR or redder. Bankard and Glenberg soils are less than 18 percent clay in the control section. Lohmiller soils are more than 35 percent clay. Kim soils do not have an irregular decrease of organic matter. Colombo, Frazerton, and Lynx soils have a mollic epipedon. Stetter soils are more than 35 percent clay.

Typical pedon of Haverson loam in an area of Haverson loam, 0 to 1 percent slopes, 6 miles south of Colony, NW1/4SE1/4 sec. 2, T. 55 N., R. 61 W.

A1—0 to 4 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; granular structure; soft, very friable, slightly sticky; calcareous; moderately alkaline; clear smooth boundary.
C—4 to 60 inches; pale brown (10YR 6/3) loam, stratified with thin lenses of clay loam and fine sandy loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky; calcareous; moderately alkaline.

Content of coarse fragments is generally less than 5 percent but ranges from 0 to 15 percent.

Heldt series

The Heldt series consists of very deep, well drained soils on alluvial fans and valley filling side slopes. These soils formed in fine textured alluvial sediments derived mainly from sedimentary rock. The slope range is 0 to 6 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Heldt soils are similar to Razor, Stetter, and Twotop soils. They are near Gaynor, Limon, Lohmiller, Razor, Stetter, Samsil, and Winler soils. Razor soils have bedrock at 20 to 40 inches. Twotop and Winler soils are more than 60 percent clay. Limon, Lohmiller, Gaynor, and Stetter soils do not have a cambic horizon. Samsil soils have bedrock at less than 20 inches.

Typical pedon of Heldt clay loam in an area of Heldt clay loam, 0 to 2 percent slopes, 10 miles north of

Moorcroft, west quarter corner sec. 13, T. 51 N., R. 67 W.

A11—0 to 2 inches; light brownish gray (2.5Y 6/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; thick platy structure parting to fine granular; slightly hard, friable, sticky; calcareous; moderately alkaline; clear smooth boundary.
A12—2 to 7 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (10YR 4/2) moist; strong fine angular blocky structure; very hard, very firm, very sticky; calcareous; moderately alkaline; clear smooth boundary.
B2—7 to 22 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to strong coarse angular blocky; very hard, very firm, very sticky; few fine threads of gypsum in the lower part; calcareous; moderately alkaline; clear smooth boundary.
Cca—22 to 60 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse angular blocky structure; very hard, very firm, very sticky; few calcium sulfate crystals and visible calcium carbonate as concretions and thin seams and streaks; moderately alkaline.

The solum is 20 to 50 inches thick. The soil may be leached a few inches in some pedons. Cracks 1/4 to 1 inch wide and 12 inches long occur in the upper 20 inches.

The A horizon is light brownish gray or grayish brown. The B2 horizon is 35 to 50 percent clay. The C horizon is light brownish gray to light gray.

Higgins series

The Higgins series consists of very deep, poorly drained soils on broad fans and valley filling areas. These soils formed in alluvium. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Higgins soils are similar to Nevee and Gypnevee soils. They are near Nevee, Tilford, and Vale soils. Nevee, Tilford, and Vale soils do not have a large quantity of gypsum or a high water table. Gypnevee soils do not have a high water table, and they have bedrock at 40 to 60 inches.

Typical pedon of Higgins silt loam in an area of Higgins silt loam, 0 to 3 percent slopes, southeast corner, sec. 5, T. 51 N., R. 62 W.

A11—0 to 2 inches; light brownish gray (10YR 6/2) silt loam; very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky; calcareous; moderately alkaline; abrupt smooth boundary.
A12cs—2 to 10 inches; light brownish gray (10YR 6/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate medium and fine granular; soft, very friable, slightly sticky; common fine nests of gypsum crystals; calcareous; moderately alkaline; clear smooth boundary.
B2cs—10 to 23 inches; pinkish gray (7.5YR 7/2) silt loam, brown (7.5YR 5/2) moist; weak medium and fine subangular blocky structure; soft, very friable, slightly sticky; few nests and threads of gypsum crystals; calcareous; mildly alkaline; gradual wavy boundary.
B3cs—23 to 33 inches; reddish yellow (5YR 6/6) silt loam, yellowish red (5YR 4/6) moist; weak medium and fine subangular blocky structure; soft, very friable, slightly sticky; many fine and coarse nests of gypsum crystals; calcareous; mildly alkaline; gradual wavy boundary.
Ccs—33 to 60 inches; reddish yellow (5YR 6/8) silt loam, yellowish red (5YR 4/8) moist; massive; soft, very friable, slightly sticky; many fine and coarse nests of gypsum crystals; calcareous; mildly alkaline.

The control section is silt loam or fine sandy loam. The subsoil is 40 to 50 percent carbonates and gypsum; more than half this percentage is gypsum. The seasonal water table is at 0 to 6 inches for long intervals.

Kadoka series

The Kadoka series consists of moderately deep, well drained soils. These soils formed in silty residuum or in sediments locally transported from siltstone and sandstone. They occur in uplands on terrace positions. The slope range is 1 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Kadoka soils are similar to Boneek, Norka, and Vale soils. They are near Butche, Cushman, and Norka soils. Boneek soils are more than 35 percent clay in the subsoil. Norka and Vale soils do not have bedrock at a depth of 20 to 40 inches. Vale soils have hue of 7.5YR or redder. Butche soils have bedrock within a depth of 20 inches. Cushman soils do not have a mollic epipedon.

Typical pedon of Kadoka loam in an area of Kadoka loam, 1 to 6 percent slopes, about 10 miles north of Aladdin, SW1/4NE1/4 sec. 11, T. 55 N., R. 62 W.

A1—0 to 7 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to granular; slightly hard, very friable, slightly sticky; neutral; clear smooth boundary.
B2t—7 to 13 inches; brown (10YR 5/3) silty clay loam; brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate medium and fine angular blocky; slightly hard, friable, sticky; thin continuous clay films on all faces of peds; mildly alkaline; clear smooth boundary.

B3ca—13 to 17 inches; pale brown (10YR 6/3) silt loam, grayish brown (10YR 5/2) moist; moderate medium subangular blocky structure; hard, firm, sticky; calcareous; moderately alkaline; clear smooth boundary.
C1ca—17 to 31 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; weak medium subangular blocky structure; slightly hard, friable, sticky; strongly calcareous; moderately alkaline; clear smooth boundary.
C2r—31 inches; soft pinkish sandstone with hard pieces of ironstone.

The solum is 17 to 28 inches thick. Depth to carbonates is 12 to 20 inches. Depth to bedrock is 20 to 40 inches. The mollic epipedon is 7 to 15 inches thick.

The A horizon is grayish brown or dark grayish brown. The B2t horizon is silt loam or silty clay loam. The C horizon is moderately to strongly alkaline.

Kim series

The Kim series consists of very deep, well drained soils on alluvial fans. These soils formed in sediments from a variety of rocks. The slope range is 0 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Kim soils are similar to Haverson, Nevee, and Thedalund soils. They are near Alice, Cushman, Fort Collins, Zigweid, Shingle, Satanta, Wages, and Thedalund soils. Thedalund soils are less than 40 inches thick over bedrock. Cushman, Fort Collins, Satanta, and Wages soils have an argillic horizon. Alice and Zigweid soils have cambic horizons. Shingle soils are less than 20 inches thick over bedrock. The organic matter content in Haverson soils does not decrease uniformly with depth.

Typical pedon of Kim loam in an area of Kim loam, 6 to 10 percent slopes, 4 miles north of Beulah, NW1/4SE1/4 sec. 24, T. 53 N., R. 61 W.

A1—0 to 4 inches; brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure; slightly hard, friable, nonsticky; calcareous; moderately alkaline; clear smooth boundary.
AC—4 to 10 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; very weak subangular blocky structure; slightly hard, friable, nonsticky; strongly calcareous; moderately alkaline; clear smooth boundary.
C1—10 to 14 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; very weak coarse subangular blocky structure; slightly hard, friable, nonsticky; strongly calcareous; moderately alkaline; clear smooth boundary.
C2—14 to 60 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, nonsticky; strongly calcareous; moderately alkaline.

The control section is typically loam or light clay loam that is 18 to 35 percent clay.

The A horizon is brown or grayish brown loam or clay loam. The C horizon is loam or clay loam.

Lail series

The Lail series consists of very deep, well drained soils on uplands in the mountains. These soils formed in material weathered from sedimentary rock. The slope range is 3 to 20 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

Lail soils are similar to Citadel soils. They are near Citadel, Larkson, McCaffery, and Stovho soils. Larkson and Citadel soils have a frigid temperature regime. Stovho and Larkson soils are not so red as Lail soils.

Typical pedon of Lail loam in an area of Lail-Stovho loams, 3 to 20 percent slopes, 100 yards west of the South Dakota border about 20 miles southeast of Sundance, SE1/4NE1/4 sec. 4, T. 49 N., R. 60 W.

O—2 inches to 0; forest litter and decomposed forest litter.
A2—0 to 4 inches; pale brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; weak fine granular structure; slightly hard, friable, slightly sticky; neutral; clear smooth boundary.
A&B—4 to 8 inches; light brown (7.5YR 6/4) clay loam, dark brown (7.5YR 4/4) moist; weak fine prismatic structure parting to medium subangular blocky; slightly hard, friable, sticky; medium acid; clear wavy boundary.
B2t—8 to 28 inches; reddish brown (2.5YR 4/4) clay, dark reddish brown (2.5YR 3/4) moist; strong medium and coarse subangular blocky structure; extremely hard, extremely firm, very sticky; thick continuous clay films on all ped faces; slightly acid; clear smooth boundary.
B3ca—28 to 42 inches; reddish brown (2.5YR 5/4) clay, reddish brown (2.5YR 4/4) moist; moderate medium and coarse subangular blocky structure; extremely hard, extremely firm, very sticky; many moderately thick clay films lining the pores; calcareous; mildly alkaline; clear smooth boundary.
Cca—42 to 60 inches; light reddish brown (5YR 6/3) clay loam, reddish brown (5YR 5/3) moist; massive; slightly hard, friable, slightly sticky; strongly calcareous; moderately alkaline.

The solum is 24 to 60 inches thick. Depth to carbonates ranges from 20 to 60 inches. Content of coarse fragments is typically less than 5 percent and ranges from 0 to 15 percent.

The A2 horizon is pale brown to dark brown. The A&B horizon is light brown to dark brown. The B horizon is reddish brown or dark reddish brown clay or clay loam.

Lakoa series

The Lakoa series consists of deep, well drained soils in the mountains. These soils formed in sediments from interbedded sandstone and shale. The slope range is 3 to 40 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

Lakoa soils are similar to Citadel, Larkson, and Maitland soils. They are near Butche, Cordeston, Larkson, Onita, Maitland, and Vanocker soils. Maitland and Onita soils have a mollic epipedon. Larkson and Citadel soils are more than 35 percent clay in the B2t horizon. Cordeston soils have a cambic horizon. Butche soils are less than 20 inches deep over bedrock. Vanocker soils are channery.

Typical pedon of Lakoa loam in an area of Lakoa-Satanta loams, 6 to 10 percent slopes, about 10 miles north of Aladdin, SW1/4NW1/4 sec. 36, T. 55 N., R. 62 W.

O—1 inch to 0; forest litter and partly decomposed forest litter; abrupt smooth boundary.

A1—0 to 2 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure parting to weak fine granular; soft, very friable, slightly sticky; slightly acid; clear smooth boundary.

A2—2 to 10 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky; slightly acid; abrupt wavy boundary.

B21t—10 to 20 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate coarse subangular blocky structure; slightly hard, friable, sticky; thin continuous clay films on all faces; neutral; clear smooth boundary.

B22t—20 to 30 inches; brown (10YR 5/3) clay loam, yellowish brown (10YR 5/4) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, firm, sticky; moderate continuous clay films on all faces; neutral; clear smooth boundary.

C1ca—30 to 48 inches; pale brown (10YR 6/3) clay loam, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure; hard, firm, sticky; calcareous; mildly alkaline; clear smooth boundary.

C2ca—48 to 60 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; slightly hard, friable, sticky; calcareous, moderate alkaline.

Thickness of the solum is 24 to 34 inches. Depth to carbonates ranges from 30 to 50 inches. Depth to bedrock ranges from 40 to more than 60 inches. The content of coarse fragments ranges from 5 to 20 percent. The solum is slightly acid to mildly alkaline. The A1 and A2 horizons are dark grayish brown, gray, or light brownish gray. The B2t horizon is brown or yellowish brown clay loam or sandy clay loam. The C horizon is loam or clay loam.

Laporte series

The Laporte series consists of shallow, well drained soils on uplands in the mountains. These soils formed in residuum of limestone. The slope range is 3 to 30 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Laporte soils are similar to Butche, Spearfish, Shingle, Paunsaugunt, and Tassel soils. They are near Norka, Tilford, and Vale soils. Butche soils formed on noncalcareous sandstone. Spearfish soils formed on red siltstone. Shingle soils formed on calcareous sandstone and shale. Tassel soils are on calcareous sandstone. Norka, Tilford, and Vale soils are all more than 20 inches deep over bedrock. Paunsaugunt soils have colder temperatures than Laporte soils.

Typical pedon of Laporte loam in an area of Rock outcrop-Laporte complex, 3 to 30 percent slopes; 14 miles south of Sundance on U.S. Highway 585, one-fourth mile south of center sec. 3, T. 49 N., R. 62 W.

A11—0 to 1 inch; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate granular structure; slightly hard, friable, slightly sticky; slightly calcareous; mildly alkaline; abrupt smooth boundary.

A12—1 to 8 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky; 15 percent gravel and small stones; calcareous; mildly alkaline; abrupt wavy boundary.

C—8 to 12 inches; light brownish gray (10YR 6/2) channery loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky; 20 percent channery fragments; calcareous, moderately alkaline; abrupt wavy boundary.

R—12 inches; weakly fractured, hard limestone.

Depth to bedrock ranges from 10 to 20 inches. The mollic epipedon is 7 to 15 inches thick. The control section is channery loam or channery clay loam that is 18 to 35 percent clay. This soil is mildly to strongly alkaline.

Larkson series

The Larkson series consists of very deep, well drained soils in the mountains. These soils formed in sediments from interbedded sandstone and shale. The slope range is 3 to 60 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

Larkson soils are similar to Citadel, Lakoa, Nunn, and Maitland soils. They are near Butche, Citadel, Cordeston, Lail, Lakoa, Maitland, Lynx, Peso, Vanocker, and Work soils. Maitland soils have a mollic epipedon. Citadel and Lail soils are redder. Lakoa and Maitland soils are less than 35 percent clay. Nunn and Work soils do not have an albic horizon. Butche soils are shallow. Lynx and Cordeston soils have a mollic epipedon. Peso soils have a cambic horizon. Vanocker soils are channery.

Typical pedon of Larkson loam in an area of Larkson-Lakoa loams, 3 to 10 percent slopes, about 15 miles northwest of Sundance, SE1/4SW1/4 sec. 9, T. 52 N., R. 64 W.

O2—1 inch to 0; mulch of decomposed pine needles and grass.

A1—0 to 3 inches; dark gray (10YR 4/1) loam, very dark gray (10YR 3/1) moist; weak thin platy structure parting to granular; soft, very friable, slightly sticky; neutral; clear smooth boundary.

A21—3 to 7 inches; light brownish gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky; neutral; clear wavy boundary.

A22—7 to 18 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky; neutral; clear wavy boundary.

A&B—18 to 22 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; many patches of brown (10YR 5/3); strong fine subangular blocky structure; slightly hard, friable, slightly sticky; neutral; clear wavy boundary.

B&A—22 to 28 inches; brown (10YR 5/3) clay loam, dark yellowish brown (10YR 4/4) moist; many coats and patches of light brownish gray (10YR 6/2); strong medium prismatic structure parting to strong fine subangular blocky; hard, firm, very sticky; neutral; clear wavy boundary.

B21t—28 to 41 inches; yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure parting to strong angular blocky; very hard, very firm, very sticky; thick continuous clay films on all faces of peds; neutral; clear smooth boundary.

B22t—41 to 52 inches; yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; moderate coarse angular blocky structure; very hard, very firm, very sticky; thin continuous clay films on all faces of peds; neutral; diffuse boundary.

Cca—52 to 72 inches; very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; massive; hard, firm, sticky; slightly calcareous; moderately alkaline.

The thickness of the solum is 30 to 60 inches. Depth to carbonates ranges from 40 to 60 inches. Depth to bedrock is 60 inches or more. The content of coarse fragments 3 to 10 inches in size ranges from 5 to 30 percent. The solum is slightly acid to mildly alkaline.

The A1 horizon is dark grayish brown or dark gray. The A2 horizon is light brownish gray, light gray, or pale brown. The B2t horizon is brown or yellowish brown clay or clay loam.

Limon series

The Limon series consists of very deep, well drained soils on alluvial fans and terraces. These soils formed in alluvial deposits. The slope range is 0 to 30 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Limon soils are similar to Bone, Gaynor, Petrie, Twotop, and Winler soils. They are near Gaynor, Heldt, Nunn, Petrie, Rhoame, Renohill, Samsil, Satanta, Twotop, Wages, and Work soils. Gaynor and Renohill soils have bedrock between 20 and 40 inches. Bone soils have a salic horizon. Nunn, Renohill, Satanta, Wages, and Work soils have an argillic horizon. Twotop soils are more than 60 percent clay. Petrie soils are more than 15 percent exchangeable sodium. Rhoame soils are noncalcareous. Samsil soils have bedrock at a depth of 20 inches or less.

Typical pedon of Limon clay loam in an area of Limon clay loam, 2 to 6 percent slopes, about 15 miles south of Sundance, NE1/4SW1/4 sec. 18, T. 49 N., R. 63 W.

Ap—0 to 7 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; cloddy; hard, firm, sticky; slightly calcareous; moderately alkaline; abrupt smooth boundary.

AC—7 to 20 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate fine angular blocky structure; hard, firm, sticky; slightly calcareous; moderately alkaline; clear smooth boundary.

C—20 to 60 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky; few visible secondary calcium carbonates; moderately alkaline.

The control section is clay, clay loam, or silty clay that is 35 to 60 percent clay.

The A horizon is grayish brown or light brownish gray.

Lohmiller series

The Lohmiller series consists of very deep, well drained soils on flood plains. These soils formed in light

colored clayey alluvium from clay shale. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Lohmiller soils are similar to and are near Haverson, Heldt, Stetter, Twotop, Bankard, and Glenberg soils. Stetter soils are noncalcareous throughout. Haverson soils have a control section that is less than 35 percent clay. Heldt and Twotop soils are not stratified, and they have a cambic horizon. Bankard and Glenberg soils are coarser textured than the Lohmiller soils.

Typical pedon of Lohmiller silty clay loam in an area of Lohmiller silty clay loam, 0 to 3 percent slopes, 8 miles northeast of Hulett, NW1/4NE1/4 sec. 11, T. 54 N., R. 64 W.

A1—0 to 5 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; slightly hard, friable, sticky; mildly alkaline; clear smooth boundary.

C—5 to 60 inches; grayish brown (10YR 5/2) clay loam, stratified with loam and clay, dark grayish brown (10YR 4/2) moist; weak coarse angular blocky structure; hard, firm, sticky; calcareous; moderately alkaline.

The soil is mildly alkaline to strongly alkaline.

Louviers series

The Louviers series consists of shallow, well drained soils on uplands. These soils formed in residuum of noncalcareous shale. The slope range is 3 to 30 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Louviers soils are similar to Grummit, Samsil, and Shingle soils. They are near Grummit, Twotop, Winler, Emigrant, and Rhoame soils. Samsil and Shingle soils are calcareous throughout. Grummit soils are acid throughout. Winler soils, which are calcareous, are 20 to 40 inches deep over bedrock. Twotop soils are calcareous and are more than 40 inches deep over bedrock. Emigrant soils have an argillic horizon. Rhoame soils are 60 inches or more deep over bedrock.

Typical pedon of Louviers clay in an area of Louviers clay, 3 to 30 percent slopes, 12 miles north of Moorcroft, 100 yards east of west quarter corner sec. 13, T. 51 N., R. 67 W.

A1—0 to 3 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; granular and weak fine angular blocky structure; hard, firm, very sticky; neutral; clear smooth boundary.

C1—3 to 20 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak coarse angular blocky structure; hard, firm, very sticky; neutral; clear smooth boundary.

C2r—20 inches; dark gray clay shale.

Depth to bedrock is 10 to 20 inches. The control section is clay or clay loam.

Lynx series

The Lynx series consists of very deep, well drained soils on flood plains and low fans. These soils formed in alluvium. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees.

Lynx soils are similar to Colombo, Cordeston, Frazerton, and Onita soils. They are near Colombo, Cordeston, Haverson, Larkson, Onita, and Vanocker soils. Colombo and Larkson soils have a thinner A horizon. Frazerton soils are more than 35 percent clay. Cordeston soils have cooler temperatures. Onita soils have an argillic horizon. Haverson soils do not have a mollic epipedon. Vanocker soils are channery.

Typical pedon of Lynx silt loam in an area of Lynx silt loam, 0 to 3 percent slopes, SW1/4NE1/4 sec. 12, T. 50 N., R. 63 W.

A11—0 to 7 inches; dark gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky; neutral; clear smooth boundary.

A12—7 to 27 inches; very dark gray (10YR 3/1) silt loam, black (10YR 2/1) moist; weak medium and fine subangular blocky structure; soft, very friable, slightly sticky; mildly alkaline; clear smooth boundary.

C1—27 to 39 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky; mildly alkaline; clear smooth boundary.

C2—39 to 60 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky; mildly alkaline.

The mollic epipedon is 20 to 40 inches thick. The control section is loam, silt loam, or light clay loam that is 18 to 35 percent clay.

Maggin series

The Maggin series consists of moderately deep, well drained soils on uplands. These soils formed in residuum of acid shale. The slope range is 2 to 30 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Maggin soils are similar to Grummit soils. They are near Demar, Grummit, Querc, Shingle, and Topeman soils. Grummit soils are less than 20 inches deep over bedrock. Querc and Demar soils have an argillic horizon.

Shingle soils are loamy and calcareous. Topeman soils are acid.

Typical pedon of Maggin shaly clay loam in an area of Maggin shaly clay loam, 2 to 6 percent slopes, 6 miles southeast of Colony, SW1/4NW1/4 sec. 33, T. 56 N., R. 60 W.

A1—0 to 3 inches; dark grayish brown (10YR 4/2) shaly clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to moderate fine granular; soft, very friable, sticky; 25 percent easily crushed shale fragments; medium acid; clear smooth boundary.

C1—3 to 36 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, sticky; 60 percent easily crushed shale fragments; strongly acid; gradual wavy boundary.

C2r—36 inches; dark gray, strongly acid, fissile, carbonaceous shale.

Depth to bedrock is 20 to 40 inches. The control section is 60 to 70 percent clay. Shale fragments that are easily crushed are 35 to 70 percent of the soil mass.

Maitland series

The Maitland series consists of very deep, well drained soils in the mountains. These soils formed in residuum or material transported from sedimentary rock. The slope range is 6 to 40 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

Maitland soils are similar to Citadel, Larkson, and Lakoa soils. They are near Larkson, Cordeston, Onita, Lakoa, and Vanocker soils. Lakoa and Larkson soils do not have a mollic epipedon. The control section of Larkson and Citadel soils is more than 35 percent clay. Cordeston and Onita soils do not have an albic horizon. Vanocker soils are channery.

Typical pedon of Maitland loam in an area of Maitland loam, 6 to 10 percent slopes, north quarter corner sec. 28, T. 55 N., R. 62 W.

O1—4 to 3 inches; litter of pine needles, grass, and oak leaves.

O2—3 inches to 0; decomposed pine needles and grass.

A1—0 to 5 inches; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak thin platy structure parting to moderate medium granular; soft, very friable, slightly sticky; less than 10 percent coarse fragments; neutral; clear smooth boundary.

A2—5 to 9 inches; light gray (10YR 7/2) loam, dark grayish brown (10YR 4/2) moist; moderate medium and fine blocky structure; soft, very friable, nonsticky; slightly acid; gradual wavy boundary.

B21t—9 to 27 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; strong medium angular blocky structure; hard, firm, sticky; thick continuous clay films on all faces; few moderately distinct yellowish brown (10YR 5/4) rust stains; slightly acid; clear smooth boundary.

B22t—27 to 36 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate coarse angular blocky structure; hard, firm, sticky; thick continuous clay films on all faces; many coarse prominent yellowish brown (10YR 5/6) rust stains; slightly acid; clear smooth boundary.

C—36 to 60 inches; grayish brown (10YR 5/2) loam; very weak coarse subangular blocky structure; soft, very friable, nonsticky; many coarse prominent yellowish brown (10YR 5/4) rust stains; slightly acid.

Thickness of the solum ranges from 25 to 53 inches. Reaction ranges from neutral to strongly acid.

The A2 horizon is pale brown to light gray. The B2t horizon is brown to dark brown. The C horizon is 0 to 10 percent coarse fragments.

McCaffery series

The McCaffery series consists of very deep, well drained soils in the mountains. These soils formed in sandy material from fine grained sandstone. The slope range is 3 to 60 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

McCaffery soils are near Butche, Citadel, Lail, and Paunsaugunt soils. They are coarser textured than those soils. They also differ in having lamella.

Typical pedon of McCaffery fine sand in an area of McCaffery-Larkson complex, 3 to 10 percent slopes, about 4 miles east of Alva, NE1/4SE1/4 sec. 1, T. 54 N., R. 63 W.

O1—1 inch to 0; organic mulch of partly decomposed forest litter.

A11—0 to 1 inch; very pale brown (10YR 7/3) fine sand, dark brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, nonsticky; slightly acid; clear smooth boundary.

A12—1 to 4 inches; brown (10YR 5/3) fine sand, dark brown (10YR 4/3) moist; weak coarse granular structure; soft, very friable, nonsticky; slightly acid; clear smooth boundary.

A21—4 to 6 inches; very pale brown (10YR 7/3) fine sand, brown (10YR 5/3) moist; weak very coarse granular structure; soft, very friable, nonsticky; slightly acid; gradual wavy boundary.

A22—6 to 20 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; weak medium and coarse angular blocky structure; soft, very friable, nonsticky; slightly acid; gradual irregular boundary.

B2t—20 to 68 inches; very pale brown (10YR 8/4) fine sand, light yellowish brown (10YR 6/4) moist; bands and lamella of brown (10YR 5/3) loamy fine sand,

dark brown (10YR 4/3) moist; structureless; soft, very friable, nonsticky; 7 bands of lamellae ranging from 2 mm to 25 mm in thickness, with clay bridges between sand grains; neutral; gradual wavy boundary.

Cr—68 inches; light olive brown, soft, noncalcareous fine grained sandstone.

The content of coarse fragments is 0 to 10 percent.

The A1 horizon is brown, pale brown, or very pale brown. It is slightly acid to neutral.

The A2 horizon is slightly acid to neutral.

The Bt horizon is brown or yellowish brown loamy fine sand or sandy loam. The total thickness of the lamellae is 10 to 15 centimeters.

Nevee series

The Nevee series consists of deep, well drained soils on uplands, terraces, and fans. These soils formed in silty alluvium from reddish colored silty shale, siltstone, or sandstone. The slope range is 1 to 30 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Nevee soils are similar to Barnum, Higgins, Kim, Tilford, and Vale soils. They are near Barnum, Higgins, Spearfish, Tilford, and Vale soils. Barnum soils are fine-loamy and are more stratified. Tilford and Vale soils have a mollic epipedon. Vale soils have an argillic horizon. Kim soils are fine-loamy and are not so red. Higgins soils have a high water table. Spearfish soils have bedrock within a depth of 20 inches.

Typical pedon of Nevee silt loam in an area of Nevee silt loam, 6 to 10 percent slopes, 15 miles northeast of Sundance, one-fourth mile west, 100 feet north of south quarter sec. 2, T. 52 N., R. 62 W.

A1—0 to 5 inches; reddish brown (5YR 5/3) silt loam, dark reddish brown (5YR 3/3) moist; strong fine granular structure; soft, very friable, nonsticky; noncalcareous; mildly alkaline; clear smooth boundary.

AC—5 to 21 inches; light reddish brown (5YR 6/4) silt loam; reddish brown (5YR 4/4) moist; weak coarse prismatic structure parting to very weak medium subangular blocky; slightly hard, friable, nonsticky; calcareous; moderately alkaline; gradual smooth boundary.

C1—21 to 48 inches; light red (2.5YR 6/6) silt loam, red (2.5YR 5/6) moist; massive; slightly hard, friable, nonsticky; strongly calcareous; moderately alkaline; clear wavy boundary.

C2r—48 inches; red siltstone.

The control section is silt loam, loam, or very fine sandy loam; it averages 10 to 18 percent clay. Bedrock is at 40 to 60 inches.

Nihill series

The Nihill series consists of very deep, excessively drained soils on terraces. These soils formed in gravelly alluvium of mixed origin. The slope range is 3 to 40 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Nihill soils are similar to Suglo soils. They are near Suglo and Sugardee soils. Suglo soils have a cambic horizon. Sugardee soils have an argillic horizon.

Typical pedon of Nihill gravelly loam in an area of Suglo-Nihill complex, 3 to 10 percent slopes, 5 miles northeast of Sundance, SW1/4SW1/4 sec. 19, T. 52 N., R. 62 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak granular structure to massive; slightly hard, friable, slightly sticky; 20 percent gravel; mildly alkaline; clear smooth boundary.

C1—4 to 10 inches; pale brown (10YR 6/3) very gravelly loam, brown (10YR 4/3) moist; very weak subangular blocky structure; slightly hard, friable, nonsticky; 40 percent gravel; moderately calcareous; moderately alkaline; clear wavy boundary.

C2—10 to 100 inches; pale brown (10YR 6/3) extremely gravelly loam; brown (10YR 4/3) moist; massive; 65 percent gravel; strongly calcareous with white lime coatings on the undersides of the gravel; moderately alkaline.

Calcium carbonate content ranges from 3 to 10 percent. The solum is 35 to 70 percent gravel.

Norka series

The Norka series consists of very deep, well drained, gently sloping to moderately sloping soils on uplands. These soils formed in silty residuum of siltstone and sandstone. They are on structural terraces adjacent to mountain ranges. The slope range is 1 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Norka soils are similar to Boneek, Kadoka, Satanta, Sugardee, Wages, and Vale soils. They are near Butche, Kadoka, Laporte, Spangler, and Tilford soils. Boneek soils are more than 35 percent clay. Satanta soils are more than 15 inches to the base of the B2t horizon. Sugardee and Tilford soils are redder. Kadoka soils have bedrock at a depth of 20 to 40 inches. Wages soils are fine-loamy. Vale soils have hue of 5YR or redder. Butche and Laporte soils have bedrock at 10 to 20 inches. Spangler soil are noncalcareous throughout the profile.

Typical pedon of Norka loam in an area of Norka loam, 1 to 6 percent slopes, 3 miles northeast of Aladdin, SE1/4NE1/4 sec. 27, T. 54 N., R. 61 W.

A1—0 to 3 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure parting to flakes and flat crumbs; soft, very friable, nonsticky; neutral; abrupt smooth boundary.
B1—3 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to medium and coarse subangular blocky; slightly hard, very friable, slightly sticky; neutral; clear smooth boundary.
B21t—5 to 9 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; dark brown (10YR 4/3) crushed; fine and medium prismatic structure parting to moderate fine angular blocky; hard, firm, sticky; thin continuous clay films on all faces of peds; neutral; clear smooth boundary.
B22t—9 to 14 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist, dark brown (10YR 4/3) crushed; strong moderate and fine prismatic structure parting to strong medium and fine angular blocky; hard, firm, sticky; thin continuous clay films on all faces of peds; neutral; clear smooth boundary.
B3ca—14 to 39 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; slightly hard, friable, sticky; thin patchy clay films on faces of peds; calcareous, carbonates completely disseminated in the upper part and only faintly segregated in the lower part; moderately alkaline; diffuse wavy boundary.
Cca—39 to 60 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, sticky; calcareous, carbonates faintly segregated as threads; strongly alkaline.

The thickness of the solum is 15 to 40 inches. The depth to carbonates is 5 to 15 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon is grayish brown or dark grayish brown. The C horizon is silt loam or silty clay loam.

Nunn series

The Nunn series consists of very deep, well drained soils on terraces, fans, and uplands. These soils formed in sediments from sedimentary rock. The slope range is 0 to 25 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Nunn soils are similar to Boneek, Larkson, Ulm, Emigrant, and Work soils. They are near Boneek, Larkson, Gaynor, Limon, Onita, Satanta, Wages, and Emigrant soils. Emigrant soils have bedrock at a depth of 20 to 40 inches. Work soils are frigid. Boneek soils have less fine sand than Nunn soils and are finer textured. Satanta and Wages soils are less than 35 percent clay in the argillic horizon. Larkson soils have an A2 horizon. Ulm, Gaynor, and Limon soils do not have a mollic epipedon. Onita soils have a thicker mollic epipedon.

Typical pedon of Nunn clay loam in an area of Nunn clay loam, 2 to 6 percent slopes, 6 miles north of Aladdin, 200 yards north of east quarter corner sec. 5, T. 54 N., R. 61 W.

A11—0 to 4 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak platy and granular structure; hard, firm, sticky; neutral; clear smooth boundary.
A12—4 to 6 inches; grayish brown (10YR 5/2) clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; hard, firm, sticky; neutral; clear smooth boundary.
B21t—6 to 10 inches; grayish brown (10YR 5/2) clay, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to moderate medium and fine angular blocky; hard, firm, very sticky; thick continuous clay films on all faces of peds; mildly alkaline; clear wavy boundary.
B22t—10 to 21 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; strong coarse prismatic structure parting to strong coarse angular blocky; very hard, very firm, very sticky; thick continuous clay films on all faces of peds; mildly alkaline; clear wavy boundary.
B3ca—21 to 30 inches; light brownish gray (2.5Y 6/2) clay, olive brown (2.5Y 4/4) moist, crushing to dark grayish brown (2.5Y 4/2); moderate coarse subangular blocky structure; hard, firm, sticky; strongly calcareous; moderately alkaline; clear wavy boundary.
C—30 to 60 inches; light brownish gray (10YR 6/2) clay loam, yellowish brown (10YR 5/4) moist; massive; hard, firm, sticky, plastic; strongly calcareous; moderately alkaline.

The mollic epipedon is 7 to 19 inches thick. Depth to carbonates is 10 to 30 inches. The solum is 16 to 40 inches thick.

The A horizon is grayish brown or dark grayish brown. The B2t horizon is brown, grayish brown, or light brownish gray clay or clay loam that is 35 to 50 percent clay. The C horizon is clay or clay loam. It is mildly to strongly alkaline.

Onita series

The Onita series consists of very deep, well drained soils on alluvial fans and valley filling side slopes. These soils formed in alluvium. The slope range is 1 to 10 percent. The average annual precipitation is about 46 degrees F.

Onita soils are similar to Colombo and Lynx soils. They are near those soils and Cordeston, Lakoa, Maitland, Nunn, and Satanta soils. Cordeston, Colombo, and Lynx soils do not have an argillic horizon. Satanta and Nunn

soils have a mollic epipedon less than 20 inches thick. Lakoa and Maitland soils have an albic horizon.

Typical pedon of Onita loam in an area of Onita loam, 1 to 6 percent slopes, about 6 miles west of Sundance, NE1/4SW1/4 sec. 12, T. 51 N., R. 64 W.

A11—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate coarse and fine subangular blocky structure; slightly hard, friable, slightly sticky; neutral; clear smooth boundary.

A12—6 to 22 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate coarse and fine subangular blocky structure; slightly hard, friable, sticky; neutral; clear smooth boundary.

B2t—22 to 32 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate fine angular blocky; hard, firm, sticky; thin continuous clay films on faces of peds; neutral; clear smooth boundary.

C1ca—32 to 40 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate medium angular blocky structure; hard, firm, sticky; calcareous, secondary carbonates occur as specks, threads, and seams; moderately alkaline; clear smooth boundary.

C2—40 to 60 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak medium angular blocky structure; hard, firm, sticky; calcareous; moderately alkaline.

The solum is 25 to 48 inches thick. Depth to calcareous material is 30 to 48 inches. The mollic epipedon is 20 to 40 inches thick.

The B2t horizon is silty clay loam or clay loam. The C horizon is loam, silt loam, silty clay loam, or clay loam.

Orella series

The Orella series consists of shallow, well drained soils on uplands. These soils formed in residuum of shale that contained a considerable amount of sodium or salts. The slope range is 3 to 30 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Orella soils are similar to Cadoma, Petrie, Samsil, and Shingle soils and are near those soils. Samsil and Shingle soils do not have a high reaction or salts. Cadoma soils have bedrock at 20 to 40 inches. Petrie soils have bedrock below 60 inches.

Typical pedon of Orella silty clay loam in an area of Orella silty clay loam, 3 to 30 percent slopes, 6 miles east of Moorcroft, NE1/4SE1/4 sec. 30, T. 50 N., R. 66 W.

A1—0 to 2 inches; light gray (2.5Y 7/2) silty clay loam, grayish brown (2.5Y 5/2) moist; weak fine subangular blocky structure; hard, firm, sticky; strongly alkaline; clear smooth boundary.

AC—2 to 8 inches; light gray (2.5Y 7/2) clay loam; grayish brown (2.5Y 5/2) moist; weak coarse subangular blocky structure; hard, firm, very sticky; strongly calcareous; very strongly alkaline; clear smooth boundary.

C1—8 to 12 inches; grayish brown (2.5Y 6/2) clay; grayish brown (2.5Y 5/2) moist; moderate fine subangular blocky structure; hard, firm, very sticky; few fine soft rounded masses of lime, strongly calcareous; very strongly alkaline; clear smooth boundary.

C2r—12 inches; light brownish gray alkaline fractured shale.

Depth to shale is 10 to 20 inches. The control section is clay, clay loam, or silty clay loam that is 38 to 60 percent or more clay. Reaction ranges from strongly to very strongly alkaline. Exchangeable sodium is 8 to 30 percent.

Otero series

The Otero series consists of very deep, somewhat excessively drained soils on alluvial fans and side slopes. These soils formed in alluvial sediments. The slope range is 2 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Otero soils are similar to Bankard, Glenberg, Terry, and Vona soils. They are near Terry and Vona soils. Glenberg and Bankard soils have an irregular decrease of organic matter with increasing depth. Terry and Vona soils have an argillic horizon.

Typical pedon of Otero sandy loam in an area of Otero sandy loam, 2 to 6 percent slopes, 3 miles northeast of Rocky Point, SE1/4 sec. 7, T. 57 N., R. 68 W.

Ap—0 to 8 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; very weak medium subangular blocky structure; slightly hard, friable, nonsticky; slightly calcareous; moderately alkaline; abrupt smooth boundary.

AC—8 to 24 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 4/3) moist; very weak medium subangular blocky structure; slightly hard, friable, nonsticky; moderately calcareous; moderately alkaline; clear smooth boundary.

C—24 to 60 inches; pale brown (10YR 6/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky; slightly calcareous; moderately alkaline.

The A horizon is pale brown to light brownish gray. The C horizon is very pale brown or pale brown. The calcium carbonate equivalent is 1 to 4 percent.

Paunsaugunt series

The Paunsaugunt series consists of shallow, well drained soils in the mountains. These soils formed in material weathered from limestone. The slope range is 6 to 60 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

The Paunsaugunt soils are similar to Butche, Laporte, Peso, Shingle, Spearfish, and Tassel soils and are near Citadel, McCaffery, Peso, and Vanocker soils. Butche soils formed on noncalcareous sandstone. Spearfish soils formed on red siltstone. Shingle soils formed on calcareous sandstone and shale. Tassel soils formed on calcareous sandstone. Citadel, McCaffery, Peso, and Vanocker soils are all more than 20 inches deep over bedrock. Laporte soils have a warmer soil temperature.

Typical pedon of Paunsaugunt loam in an area of Peso-Paunsaugunt complex, 6 to 10 percent slopes, 14 miles southeast of Sundance, near center of sec. 22, T. 50 N., R. 60 W.

A11—0 to 1 inch; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate granular structure; slightly hard, friable, nonsticky; slightly calcareous; mildly alkaline; abrupt smooth boundary.

A12—1 to 8 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky; slightly calcareous; mildly alkaline; clear wavy boundary.

C—8 to 12 inches; light brownish gray (10YR 6/2) very channery loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; hard, firm, slightly sticky; 35 percent channery fragments; calcareous; mildly alkaline; abrupt wavy boundary.

R—12 inches; weakly fractured, very hard limestone.

Depth to bedrock ranges from 10 to 20 inches. The mollic epipedon is 7 to 15 inches thick. This soil is mildly to strongly alkaline.

Peso series

The Peso series consists of moderately deep, well drained soils in the mountains. These soils formed in material weathered from limestone. The slope range is 6 to 55 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

Peso soils are similar to Vanocker and Paunsaugunt soils. They are near Citadel, Larkson, and Paunsaugunt soils. Vanocker soils do not have a mollic epipedon. Paunsaugunt soils are less than 20 inches deep over bedrock. Citadel and Larkson soils are redder than Peso soils and have an argillic horizon.

Typical pedon of Peso very channery silt loam in an area of Peso-Paunsaugunt complex, 6 to 10 percent slopes, 1 mile west of Moskee, SW1/4NW1/4 sec. 5, T. 50 N., R. 61 W.

O—1 inch to 0; mulch of pine needles and decomposed pine needles and grass.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) very channery silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable, sticky; 40 percent channery fragments; strongly calcareous; moderately alkaline; diffuse wavy boundary.

B2—6 to 16 inches; grayish brown (10YR 5/2) very channery silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, sticky; 50 percent channery fragments; strongly calcareous; moderately alkaline; clear wavy boundary.

Cca—16 to 30 inches; very pale brown (10YR 7/3) very channery silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable, sticky; 30 percent channery fragments and 15 percent flagstones; strongly calcareous; moderately alkaline; abrupt wavy boundary.

R—30 inches; hard fractured limestone.

Depth to bedrock ranges from 20 to 40 inches. The control section is very channery clay loam or very channery silt loam and is 35 to 60 percent coarse fragments.

The A horizon is dark grayish brown, dark gray, or very dark gray. The B horizon is light brownish gray or grayish brown very channery silt loam or very channery clay loam. The C horizon is light brownish gray, very pale brown, or grayish brown very channery loam or very channery silt loam.

Petrie series

The Petrie series consists of very deep, well drained soils on alluvial fans, valley filling side slopes, and bottoms of small drainageways. These soils formed in thick, calcareous, very alkaline sediments derived from sedimentary bedrock. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Petrie soils are similar to and are near Cadoma, Gaynor, Limon, Orella, and Twotop soils. Cadoma soils have bedrock at 20 to 40 inches. Orella soils have bedrock within a depth of 20 inches. Gaynor and Limon soils are less than 15 percent exchangeable sodium in the control section. Twotop soils are more than 60 percent clay.

Typical pedon of Petrie clay loam in an area of Petrie clay loam, 0 to 3 percent slopes, 5 miles east of Colony, one-fourth mile west of center of sec. 21, T. 56 N., R. 60 W.

A11—0 to 1 inch; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; vesicular; soft, very friable, nonsticky; very unstable; moderately calcareous; strongly alkaline; abrupt smooth boundary.
A12—1 to 2 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; strong fine granular structure; hard, very firm, sticky; moderately calcareous; very strongly alkaline; abrupt smooth boundary.
AC—2 to 6 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse and medium subangular blocky structure; very hard, very firm, very sticky; moderately calcareous; very strongly alkaline; gradual smooth boundary.
C1—6 to 14 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; very hard, very firm, very sticky; moderately calcareous; very strongly alkaline; gradual wavy boundary.
C2cs—14 to 60 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, very firm, very sticky; slight segregation of calcium carbonate and sulfate in the form of threads and flecks, strongly calcareous; very strongly alkaline.

Conductivity ranges from 2 to about 8 millimhos. The control section is 15 to 30 percent exchangeable sodium. It is typically clay, but it can be clay loam that is 35 to 50 percent clay.

The A horizon is light gray or light brownish gray. The C horizon is light brownish gray or grayish brown clay or heavy clay loam.

Querc series

The Querc series consists of moderately deep, well drained soils on uplands. These soils formed in residuum of acid fissile shale. The slope range is 0 to 20 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Querc soils are similar to Emigrant, Renohill, Ulm, Spangler, and Wyarno soils. They are near Demar, Grummit, Maggin, and Topeman soils. Grummit, Maggin, and Topeman soils do not have an argillic horizon. Emigrant, Renohill, Ulm, and Wyarno soils have continuous horizons of calcium carbonate accumulation. Demar soils have an albic horizon. Spangler soils are less than 35 percent clay in the argillic horizon.

Typical pedon of Querc silt loam in an area of Grummit-Querc complex, 3 to 10 percent slopes, near center sec. 9, T. 55 N., R. 60 W.

A11—0 to 2 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky; slightly acid; abrupt smooth boundary.
A12—2 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate fine granular; slightly hard, friable, slightly sticky; slightly acid; clear smooth boundary.
B2t—5 to 14 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to strong medium and fine subangular blocky; hard, firm, sticky; thin patchy clay films on all faces of peds; 15 percent shale fragments; slightly acid; clear smooth boundary.
C1—14 to 35 inches; light brownish gray (2.5Y 6/2) shaly silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; hard, firm, sticky; 30 percent shale fragments; slightly acid; clear wavy boundary.
C2r—35 inches; soft, weathered, acid, platy, dark gray fissile shale with sulfur between the plates.

Depth to the base of the B2t horizon is 10 to 22 inches. Depth to shale is 20 to 40 inches. Shale fragments that are easily crushed make up 15 to 35 percent of the C horizon.

Razor series

The Razor series consists of moderately deep, well drained soils on upland plains. These soils formed in clay loam residuum or transported material over clay shale. The slope range is 2 to 20 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Razor soils are similar to Cadoma, Heldt, Zigweid, and Winler soils. They are near Emigrant, Gaynor, Heldt, Rhoame, Samsil, Twotop, Ulm, Wyarno, and Winler soils. Cadoma soils have 15 to 25 percent sodium saturation. Emigrant, Ulm, and Wyarno soils have an argillic horizon. Heldt soils have no bedrock within 40 inches. Winler soils have more clay than Razor soils. Zigweid soils are less than 35 percent clay. Samsil soils are less than 20 inches deep over bedrock. Gaynor soils do not have a cambic horizon. Twotop and Rhoame soils are more than 60 inches deep over bedrock.

Typical pedon of Razor clay loam in an area of Razor clay loam, 2 to 10 percent slopes, 7 miles northeast of Aladdin, NE1/4NE1/4 sec. 13, T. 54 N., R. 61 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak thin platy structure parting to moderate coarse angular blocky; hard, firm, sticky; mildly alkaline; clear smooth boundary.
B2—4 to 10 inches; dark grayish brown (10YR 4/2) clay loam, dark brown (10YR 3/3) moist; moderate coarse angular blocky structure; very hard, very firm, very sticky; mildly alkaline; clear smooth boundary.
B3ca—10 to 20 inches; brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; weak coarse angular blocky structure; very hard, very firm, very

sticky; moderately calcareous; moderately alkaline; clear smooth boundary.
C1ca—20 to 30 inches; brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; massive; very hard, very firm, very sticky; moderately calcareous; moderately alkaline; clear smooth boundary.
C2r—30 inches; dark grayish brown platy shale, slightly calcareous.

Depth to bedrock is 20 to 40 inches. The solum is 11 to 20 inches thick.

The A horizon is grayish brown or dark grayish brown. The B horizon is brown or grayish brown clay or clay loam that is 35 to 50 percent clay. The C horizon is clay or clay loam.

Rekop series

The Rekop series consists of shallow, somewhat excessively drained soils on uplands. These soils formed in thin, highly calcareous sediments weathered from reddish brown, gypsiferous siltstone, gyprock, and alabaster. The slope range is 3 to 30 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Rekop soils are similar to Gypnevee and Laporte soils. They are near Gypnevee, Nevee, and Tilford soils. Laporte soils have limestone bedrock. Gypnevee soils have bedrock at 20 to 40 inches. Nevee soils do not have bedrock, and they contain less gypsum and carbonates than Rekop soils. Tilford soils have a mollic epipedon and do not have bedrock.

Typical pedon of Rekop loam in an area of Rekop-Gypnevee-Rock outcrop complex, 3 to 30 percent slopes, 5 miles east of Sundance, NW1/4NW1/4 sec. 23, T. 51 N., R. 62 W.

A1—0 to 6 inches; reddish brown (5YR 5/3) loam, reddish brown (5YR 4/4) moist; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky; strongly calcareous; moderately alkaline; clear smooth boundary.
C1cs—6 to 16 inches; pinkish gray (5YR 7/2) loam, gray (5YR 5/1) moist; massive; soft, very friable, nonsticky; strongly calcareous, fine irregularly shaped soft masses of calcium carbonate and calcium sulfate; moderately alkaline; clear smooth boundary.
C2r—16 inches; hard white gyprock.

Depth to bedrock ranges from 10 to 20 inches. The control section is loam or silt loam that averages between 18 and 35 percent clay. Calcium carbonate and calcium sulfate content ranges from about 40 to 60 percent; calcium sulfate content is more than 35 percent.

Renohill series

The Renohill series consists of moderately deep, well drained soils on uplands. These soils formed in residuum or material locally transported from sedimentary rock. The slope range is 1 to 30 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Renohill soils are similar to Emigrant, Querc, Ulm, and Wyarno soils. They are near Cushman, Gaynor, Limon, Samsil, Ulm, Winler, and Wyarno soils. Emigrant soils have a mollic epipedon. Ulm and Wyarno soils do not have bedrock within a depth of 40 inches. Querc soils do not have continuous horizons of calcium carbonate accumulation. Cushman soils are less than 35 percent clay. Gaynor and Limon soils do not have an argillic horizon. Winler soils are more than 60 percent clay. Samsil soils are less than 20 inches deep over bedrock.

Typical pedon of Renohill loam in an area of Renohill loam, 1 to 6 percent slopes, 25 miles northwest of Hulett, 200 yards northwest of SW1/4 corner sec. 16, T. 57 N., R. 67 W.

A1—0 to 3 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak thick platy structure parting to granular; soft, very friable, slightly sticky; mildly alkaline; clear smooth boundary.
B1—3 to 5 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse and medium subangular blocky structure; hard, firm, sticky; mildly alkaline; clear smooth boundary.
B2t—5 to 13 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate fine angular blocky; hard, firm, very sticky; thin continuous clay films; slightly calcareous; moderately alkaline; clear smooth boundary.
B3ca—13 to 21 inches; gray (10YR 5/1) clay, weak coarse prismatic structure parting to moderate fine angular blocky; hard, firm, very sticky; many medium segregations of calcium carbonate; moderately alkaline; clear smooth boundary.
C1ca—21 to 36 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm, very sticky; many medium segregations of calcium carbonate; moderately alkaline; clear smooth boundary.
C2r—36 inches; calcareous clay shale.

Thickness of the solum ranges from 15 to 30 inches. Depth to bedrock ranges from 20 to 40 inches. Depth to calcareous material ranges from 5 to 20 inches.

The A horizon is light brownish gray or grayish brown loam or clay loam.

The B2t horizon is light olive brown or grayish brown clay or heavy clay loam.

Rhoame series

The Rhoame series consists of very deep, well drained soils on alluvial and colluvial fans. These soils formed in clayey sediments derived from noncalcareous shale. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Rhoame soils are similar to Topeman soils. They are near Limon, Louviers, Razor, and Topeman soils. Limon and Razor soils are calcareous. Louviers soils have bedrock within a depth of 20 inches. Topeman soils are more acid.

Typical pedon of Rhoame clay loam in an area of Rhoame clay loam, 0 to 3 percent slopes, 20 miles north of Hulett, NW1/4SE1/4 sec. 12, T. 57 N., R. 65 W.

A1—0 to 6 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; weak thin platy structure parting to moderate fine granular; hard, firm, sticky; neutral; clear smooth boundary.
AC—6 to 11 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; hard, firm, sticky; neutral; clear smooth boundary.
C—11 to 60 inches; light brownish gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; massive; hard, firm, sticky; common fine distinct soft masses of gypsum; 5 percent shale chips; neutral.

Content of small shale chips or channery fragments ranges from 0 to 15 percent. The soil is medium acid to mildly alkaline throughout. The matrix of the control section is 35 to 50 percent clay.

The A horizon is pale brown or light brownish gray.

The C horizon is light brownish gray or brown clay loam, channery clay loam, or clay.

Samsil series

The Samsil series consists of shallow, well drained soils on uplands. These soils formed in material weathered from shale. The slope range is 2 to 30 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Samsil soils are similar to Butche, Gaynor, Grummit, Louviers, Orella, Shingle, and Winler soils. They are near Cadoma, Emigrant, Gaynor, Grummit, Heldt, Limon, Louviers, Orella, Renohill, Shingle, Ulm, Winler, Work, and Wyarno soils. Cadoma, Emigrant, Gaynor, Heldt, Limon, Renohill, Ulm, Winler, Work, and Wyarno soils are more than 20 inches deep over bedrock. Grummit soils are acid. Butche and Louviers soils are noncalcareous. Orella soils are more than 15 percent exchangeable sodium. Shingle soils are less than 35 percent clay.

Typical pedon of Samsil clay in an area of Samsil-Gaynor complex, 2 to 10 percent slopes, 20 miles northwest of Hulett, 100 feet east of west quarter corner sec. 36, T. 57 N., R. 67 W.

A1—0 to 3 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak thin platy structure parting to moderate medium granular; hard, firm, sticky; noncalcareous; moderately alkaline; clear smooth boundary.
C1—3 to 15 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; hard, firm, very sticky; moderately calcareous; moderately alkaline; clear smooth boundary.
C2—15 to 20 inches; light brownish gray (2.5Y 6/2) shaly clay, grayish brown (2.5Y 4/2) moist; massive; hard, firm, very sticky; 35 percent shale fragments; moderately calcareous; moderately alkaline; gradual wavy boundary.
C3r—20 inches; brown, black, and white mottled shale containing gypsum crystals.

Depth to bedrock is 10 to 20 inches. The control section is clay or clay loam that is 35 to 50 percent clay.

Satanta series

The Satanta series consists of very deep, well drained soils on alluvial fans and high terraces. These soils formed in material weathered from sandstone. The slope range is 0 to 20 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Satanta soils are similar to Ascalon, Norka, Sugardee, and Wages soils. They are near Alice, Kim, Limon, Nunn, Onita, Shingle, and Thedalund soils. Ascalon soils are more than 35 percent fine sand or coarser. Norka soils are less than 15 inches to the base of the argillic horizon. Sugardee soils have gravel at 20 to 40 inches. Alice, Kim, Limon, Shingle, and Thedalund soils do not have an argillic horizon. Shingle soils have bedrock within a depth of 20 inches. Onita soils have a mollic epipedon more than 20 inches thick. Thedalund soils have bedrock at 20 to 40 inches. Nunn soils are more than 35 percent clay in the argillic horizon. Wages soils have a thinner solum.

Typical pedon of Satanta loam in an area of Satanta loam, 1 to 6 percent slopes, near Mateo village, NE1/4SW1/4 sec. 8, T. 52 N., R. 65 W.

A1—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure that parts to thin platy; slightly hard, friable, sticky; neutral, abrupt smooth boundary.
B1—6 to 10 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse angular blocky structure; hard, firm, sticky; few thin clay films on faces of peds; neutral; clear wavy boundary.

B2t—10 to 18 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure that parts to fine angular blocky; hard, firm, sticky; thick clay films on faces of peds; mildly alkaline; clear wavy boundary.
B3ca—18 to 22 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak coarse angular blocky structure; hard, firm, sticky; strongly calcareous; moderately alkaline; clear smooth boundary.
Cca—22 to 60 inches; light brownish gray (10YR 6/2) loam, brown (10YR 5/3) moist; weak coarse angular blocky structure; hard, firm, slightly sticky; strongly calcareous, lime segregated in medium sized, soft, rounded masses; moderately alkaline.

Thickness of the solum ranges from 20 to 40 inches. Depth to carbonates ranges from 15 to 30 inches. The mollic epipedon is 8 to 20 inches thick.

The B2t horizon is loam, clay loam, or sandy clay loam.

Shingle series

The Shingle series consists of shallow, well drained soils on uplands. These soils formed in material weathered from soft, interbedded sandstone and shale. The slope range is 1 to 60 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Shingle soils are similar to Butche, Laporte, Louviers, Orella, Paunsaugunt, Samsil, Spearfish, Tassel, and Thedalund soils. They are near Cadoma, Cushman, Fort Collins, Grummit, Kim, Louviers, Maggin, Orella, Satanta, Thedalund, Wages, and Zigweid soils. Butche, Louviers, and Maggin soils are noncalcareous. Laporte and Paunsaugunt soils formed over limestone. Orella soils are more than 15 percent exchangeable sodium. Samsil and Grummit soils are more than 35 percent clay. Spearfish soils have a redder hue. Tassel soils are coarser textured. Thedalund, Cadoma, Cushman, Fort Collins, Kim, Satanta, Wages, and Zigweid soils are more than 20 inches deep over bedrock.

Typical pedon of Shingle loam in an area of Shingle-Thedalund loams, 10 to 30 percent slopes, 8 miles northwest of Moorcroft, center sec. 5, T. 50 N., R. 68 W.

A1—0 to 3 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; granular structure; soft, very friable, nonsticky; slightly calcareous; moderately alkaline; clear smooth boundary.
C1—3 to 6 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky; strongly calcareous; moderately alkaline; clear smooth boundary.
C2—6 to 16 inches; light gray (10YR 7/1) loam, light brownish gray (10YR 6/2) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky; strongly calcareous; strongly alkaline; diffuse smooth boundary.
C3r—16 inches; soft calcareous shale.

Depth to bedrock is 10 to 20 inches. The control section is loam to light clay loam that is 18 to 35 percent clay.

Spangler series

The Spangler series consists of moderately deep, well drained soils on uplands. These soils formed in residuum of fine grained sandstone. The slope range is 1 to 20 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Spangler soils are similar to Cushman, Fort Collins, and Querc soils and are near Butche and Norka soils. Cushman, Fort Collins, and Norka soils all are calcareous. Butche soils are shallow over bedrock. Querc soils are more than 35 percent clay.

Typical pedon of Spangler loam in an area of Spangler loam, 6 to 10 percent slopes, about 6 miles northwest of Devil's Tower, SW1/4SE1/4 sec. 31, T. 54 N., R. 66 W.

A1—0 to 6 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; slightly hard, friable, slightly sticky; neutral; clear smooth boundary.
B1—6 to 12 inches; brown (10YR 5/3) clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium and fine angular blocky structure; hard, firm, sticky; neutral; clear smooth boundary.
B2t—12 to 24 inches; brown (10YR 5/3) clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium and fine angular blocky structure; hard, firm, sticky; thin continuous clay films on all faces of peds; neutral; clear smooth boundary.
B3—24 to 30 inches; pale brown (10YR 6/3) loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; hard, firm, sticky; neutral; clear smooth boundary.
C1—30 to 36 inches; pale brown (10YR 6/3) clay loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; neutral; abrupt wavy boundary.
C2r—36 inches; yellowish brown, slightly hard, fine grained, noncalcareous argillaceous sandstone.

Depth to the base of the B2t horizon is 14 to 26 inches. Depth to bedrock is 20 to 40 inches.

The A horizon is light brownish gray to dark grayish brown. The B2t horizon is clay loam or sandy clay loam that is 28 to 35 percent clay. The C horizon is loam or clay loam.

Spearfish series

The Spearfish series consists of shallow, well drained soils on uplands. These soils formed in loamy material weathered from red siltstone, sandstone, or shale. The slope range is 10 to 60 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Spearfish soils are similar to Butche, Laporte, Paunsaugunt, Shingle, Tassel, and Tilford soils. They are near Barnum, Nevee, Tilford, and Vale soils. Butche, Laporte, Paunsaugunt, Shingle, and Tassel soils are not red. Barnum, Nevee, Tilford, and Vale soils are more than 40 inches deep over bedrock.

Typical pedon of Spearfish silt loam in an area of Spearfish-Rock outcrop complex, 10 to 60 percent slopes, 5 miles northwest of Sundance, SE1/4NW1/4 sec. 8, T. 51 N., R. 63 W.

A1—0 to 6 inches; reddish brown (5YR 5/4) silt loam, reddish brown (5YR 4/4) moist; weak thin platy structure parting to granular; slightly hard, friable, slightly sticky; strongly calcareous; moderately alkaline; clear smooth boundary.

C1—6 to 18 inches; yellowish red (5YR 5/6) silt loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky; strongly calcareous; moderately alkaline; clear wavy boundary.

C2r—18 inches; reddish brown, hard calcareous siltstone.

Depth to bedrock is 6 to 20 inches. The control section is typically loam. Some pedons are very fine sandy loam, silt loam, or silty clay loam that is 18 to 32 percent clay. The C horizon is yellowish red or reddish brown.

Stetter series

The Stetter series consists of very deep, well drained soils on flood plains. These soils formed in light colored clayey alluvium derived from clay shale. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Stetter soils are similar to and near Frazerton, Lohmiller, Haverson, Twotop, and Heldt soils. Lohmiller soils are calcareous throughout. Haverson soils have a control section that is less than 35 percent clay. Twotop and Heldt soils have a cambic horizon.

Typical pedon of Stetter silty clay loam in an area of Stetter silty clay loam, 0 to 3 percent slopes, 18 miles north of Hulett, NW1/4NE1/4 sec. 13, T. 57 N., R. 65 W.

A1—0 to 4 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak medium granular structure; hard, firm, slightly sticky; neutral; clear smooth boundary.

C—4 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam stratified with silt loam and clay loam; dark grayish brown (2.5Y 4/2) moist; weak angular blocky structure; hard, firm, sticky; noncalcareous; mildly alkaline.

Reaction is neutral to mildly alkaline. The control section is silty clay loam, clay loam, or clay. Cracks 1/2 to 1 inch wide form when the soil is dry.

Stovho series

The Stovho series consists of deep, well drained soils in the mountains. These soils formed in sediments from limestone. The slope range is 3 to 20 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

Stovho soils are similar to Citadel, Larkson, and Lail soils. They are near Citadel, Cordeston, Grizzly, Lail, and Virkula soils. Citadel, Larkson, Cordeston, Grizzly, and Virkula soils are frigid. Lail soils have a redder hue. Cordeston soils have a thick mollic epipedon.

Typical pedon of Stovho loam in an area of Lail-Stovho loams, 3 to 20 percent slopes, about 20 miles southwest of Sundance, NE1/4SE1/4 sec. 17, T. 50 N., R. 60 W.

O—3 inches to 0; decomposed and partly decomposed forest litter, mainly needles, twigs, and leaves.

A1—0 to 3 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; slightly hard, friable, slightly sticky; slightly acid; gradual wavy boundary.

A21—3 to 7 inches; light gray (10YR 7/2) loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky; slightly acid; gradual wavy boundary.

A22—7 to 9 inches; light gray (10YR 7/2) loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky; slightly acid; gradual wavy boundary.

B2t—9 to 25 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; very hard, very firm, very sticky; thick continuous clay films on all faces of peds; slightly acid; abrupt wavy boundary.

B3ca—25 to 42 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 4/4) moist; weak coarse prismatic structure parting to weak coarse angular blocky; hard, firm, slightly sticky; calcareous; mildly alkaline; gradual wavy boundary.

C1ca—42 to 45 inches; pink (7.5YR 7/4) clay loam, light brown (7.5YR 6/4) moist; massive; hard, firm, slightly sticky; 10 percent fragments of limestone; calcareous; moderately alkaline; gradual irregular boundary.

C2r—45 inches; limestone.

Thickness of the solum is 20 to 60 inches. Depth to carbonates ranges from 25 to 60 inches. Depth to limestone ranges from 40 to 60 inches or more. Content of coarse fragments ranges up to 15 percent in the solum and up to 50 percent in the C horizon.

The B2t horizon is silty clay loam or silty clay. The C horizon is clay loam, silty clay loam, or cobbly clay loam.

Sugardee series

The Sugardee series consists of very deep, well drained soils on terraces and alluvial fans. These soils formed in outwash material of mixed origin washed from adjacent mountains. The slope range is 1 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

The Sugardee soils are similar to Ascalon, Norka, Satanta, Vale, and Wages soils. They are near Nihill, Suglo, and Vale soils. Ascalon, Satanta, and Wages soils are not red. Nihill soils do not have an argillic horizon. Suglo soils have a cambic horizon. Vale soils do not have gravel in the substratum.

Typical pedon of Sugardee loam in an area of Sugardee loam, 1 to 6 percent slopes, 15 miles southeast of Sundance, SW1/4SE1/4 sec. 9, T. 50 N., R. 62 W.

A1—0 to 5 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; weak medium granular structure; slightly hard, friable, slightly sticky; mildly alkaline; clear smooth boundary.

B1—5 to 8 inches; reddish brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate coarse angular blocky structure; slightly hard, friable, sticky; neutral; clear smooth boundary.

B2t—8 to 16 inches; reddish brown (5YR 5/3) clay loam, dark reddish brown (5YR 3/4) moist; weak medium and coarse prismatic structure parting to moderate medium angular blocky; slightly hard, friable, sticky; common moderately thick clay films on faces of peds; mildly alkaline; clear smooth boundary.

B3tca—16 to 20 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky; few thin clay films on faces of peds; strongly calcareous; strongly alkaline; clear wavy boundary.

C1ca—20 to 27 inches; reddish yellow (5YR 6/6) gravelly loam, yellowish red (5YR 5/6) moist; massive; slightly hard, friable, slightly sticky; 20 percent gravel; medium irregular soft masses of lime; strongly calcareous; strongly alkaline; clear wavy boundary.

C2—27 to 60 inches; reddish yellow (5YR 7/6) very gravelly loam, yellowish red (5YR 5/6) moist; massive; slightly hard, friable, slightly sticky; 40 percent gravel; lime coatings on the underside of gravel; strongly calcareous; strongly alkaline.

Thickness of the mollic epipedon ranges from 7 to 14 inches.

The solum is 16 to 32 inches thick. Depth to carbonates ranges from 13 to 26 inches. The solum is up to 10 percent coarse fragments.

The B2t horizon is silty clay loam or clay loam that is 28 to 35 percent clay. The C horizon is 30 to 50 percent gravel and coarse fragments.

Suglo series

The Suglo series consists of very deep, well drained soils on terraces and fans. These soils formed in gravelly alluvium of mixed origin. The slope range is 2 to 20 percent. The average annual air temperature is about 46 degrees F.

Suglo soils are similar to Alice, Nihill, Zigweid, and Tilford soils. They are near Nihill, Sugardee, and Tilford soils. Alice and Zigweid soils do not have red material, in the profile, and they do not have gravel in the substratum. Tilford soils do not have gravel in the substratum. Nihill soils are gravelly throughout. Sugardee soils have an argillic horizon.

Typical pedon of Suglo loam in an area of Suglo-Nihill complex, 3 to 10 percent slopes, 3 miles northeast of Sundance, NE1/4NW1/4 sec. 6, T. 51 N., R. 62 W.

A11—0 to 5 inches; dark brown (7.5YR 4/2) loam, very dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure parting to moderate fine granular; soft, very friable, slightly sticky; slightly calcareous; moderately alkaline; clear smooth boundary.

A12—5 to 11 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 3/2) moist; weak coarse prismatic structure parting to moderate fine subangular blocky; soft, very friable, nonsticky; strongly calcareous; moderately alkaline; clear smooth boundary.

B2ca—11 to 16 inches; light brown (7.5YR 6/4) gravelly loam, dark brown (7.5YR 4/3) moist; moderate fine subangular blocky structure; slightly hard, friable, nonsticky; thin patchy clay films on vertical faces of peds; 25 percent gravel; strongly calcareous; moderately alkaline; gradual wavy boundary.

C1ca—16 to 19 inches; pink (7.5YR 7/4) gravelly loam, light brown (7.5YR 6/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky; 25 percent gravel; strongly calcareous, soft powdery calcium carbonate and coarse fragments coated with calcium carbonate; strongly alkaline; gradual wavy boundary.

C2—19 to 60 inches; light reddish brown (5YR 6/4) gravelly loam, reddish brown (5YR 5/4) moist; massive; hard, very friable, slightly sticky; 30 percent gravel; strongly calcareous, many medium and coarse seams and soft masses of calcium carbonate; strongly alkaline.

Thickness of the mollic epipedon is 7 to 15 inches. Depth to continuous horizons of secondary calcium carbonate is 12 to 24 inches. The solum is gravelly loam or loam. The clay content is 18 to 27 percent. Gravel content in the solum ranges from 15 to 35 percent. Below the solum, it ranges from 30 to 60 percent.

Tassel series

The Tassel series consists of shallow, well drained soils in the uplands. These soils formed in residuum from sandstone. The slope range is 3 to 30 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Tassel soils are similar to Butche, Laporte, Paunsaugunt, Shingle, and Spearfish soils. They are near Alice, Ascalon, Terry, and Vona soils, which are more than 20 inches deep. Butche soils are noncalcareous throughout. Laporte and Paunsaugunt soils formed in residuum from limestone. Shingle and Spearfish soils are finer textured. Spearfish soils are red.

Typical pedon of Tassel fine sandy loam in an area of Tassel-Shingle complex, 10 to 30 percent slopes, about 8 miles northwest of Moorcroft, north quarter corner sec. 5, T. 50 N., R. 68 W.

A1—0 to 3 inches; brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable, nonsticky; mildly alkaline; clear smooth boundary.
AC—3 to 8 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; very weak medium subangular blocky structure; soft, very friable, nonsticky; strongly calcareous; mildly alkaline; abrupt smooth boundary.
C1—8 to 15 inches; light gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky; strongly calcareous; mildly alkaline; clear smooth boundary.
C2r—15 inches; gray, strongly calcareous, soft sandstone.

The depth to sandstone ranges from 10 to 20 inches.

Terry series

The Terry series consists of moderately deep, well drained soils. These soils formed in residuum of soft sandstone. The slope range is 2 to 20 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Terry soils are similar to Otero and Vona soils. They are near Cushman, Otero, Tassel, Vona, and Valent soils. Vona soils do not have bedrock within a depth of 40 inches. Valent and Otero soils do not have an argillic horizon. Tassel soils are less than 20 inches deep over bedrock. Valent soils are coarser textured. Cushman soils are finer textured.

Typical pedon of Terry loamy fine sand in an area of Terry loamy fine sand, 6 to 10 percent slopes, about 3 miles north of Moorcroft, NW1/4NW1/4 sec. 28, T. 50 N., R. 67 W.

A1—0 to 5 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky; mildly alkaline; abrupt smooth boundary.
B2t—5 to 16 inches; brown (10YR 5/3) fine sandy loam; brown (10YR 4/3) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky; thin patchy clay films on faces of peds; mildly alkaline; clear smooth boundary.
C1ca—16 to 32 inches; light gray (10YR 7/2) loamy fine sand, light brownish gray (10YR 6/2) moist; massive; soft, very friable, nonsticky; slightly calcareous; moderately alkaline; clear smooth boundary.
C2r—32 inches; soft, slightly calcareous, fine grained sandstone.

Thickness of the solum ranges from 15 to 30 inches. Depth to carbonates ranges from 6 to 20 inches. Depth to bedrock ranges from 20 to 40 inches.

The A horizon is grayish brown or light brownish gray. The B horizon is light olive brown or brown. The C horizon is sandy loam, loamy fine sand, or loamy sand.

Thedalund series

The Thedalund series consists of moderately deep, well drained soils on uplands. These soils formed in residuum and localized alluvium from sedimentary rock. The slope range is 3 to 30 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Thedalund soils are similar to Kim and Shingle soils and are near Alice, Butche, Cushman, Kim, Satanta, Shingle, Wages, and Zigweid soils. Alice, Kim, Satanta, and Wages soils have bedrock below 40 inches. Shingle and Butche soils have bedrock within 20 inches. Cushman soils have an argillic horizon. Zigweid soils have a cambic horizon.

Typical pedon of Thedalund loam in an area of Thedalund loam, 6 to 10 percent slopes, about 6 miles northeast of Hulett in the SW1/4SE1/4 sec. 3, T. 54 N., R. 64 W.

A1—0 to 4 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; granular structure; slightly hard, very friable, slightly sticky; moderately calcareous; moderately alkaline; clear smooth boundary.
C1—4 to 10 inches; light gray (10YR 7/2) loam, brown (10YR 5/3) moist; very weak medium subangular blocky structure; slightly hard, friable, slightly sticky; strongly calcareous; moderately alkaline; clear smooth boundary.

C2—10 to 22 inches; white (10YR 8/2) loam, light brownish gray (10YR 6/2) moist; very weak subangular blocky structure to massive; slightly hard, friable, slightly sticky; strongly calcareous; moderately alkaline; clear wavy boundary.
C3r—22 inches; soft shale.

Depth to soft shale, sandstone, or siltstone ranges from 20 to 40 inches. Reaction is mildly to moderately alkaline.

The A horizon is light brownish gray or grayish brown.

Tilford series

The Tilford series consists of very deep, well drained soils on rolling uplands, stream terraces, and fans. These soils formed in silty alluvium weathered from reddish siltstone and shale. The slope range is 0 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Tilford soils are similar to Alice, Nevee, Spearfish, Suglo, and Vale soils. They are near Barnum, Gypnevee, Higgins, Laporte, Nevee, Norka, Rekop, Spearfish, Suglo, and Vale soils. Gypnevee and Nevee soils do not have a mollic epipedon and are coarse-silty. Vale soils have an argillic horizon. Laporte, Rekop, and Spearfish soils are 20 inches deep over bedrock. Alice soils are brown and coarse loamy. Barnum soils do not have a mollic epipedon. Suglo soils have gravel at 20 to 40 inches. Norka soils do not have red material in the profile. Higgins soils are poorly drained.

Typical pedon of Tilford silt loam in an area of Tilford silt loam, 1 to 6 percent slopes, 8 miles northeast of Sundance, NW1/4SW1/4 sec. 9, T. 52 N., R. 62 W.

A1—0 to 4 inches; brown (7.5YR 5/2) silt loam, dark brown (7.5YR 3/2) moist; moderate fine crumb and granular structure; soft, very friable, slightly sticky; mildly alkaline; abrupt smooth boundary.
A3—4 to 9 inches; reddish gray (5YR 5/2) silt loam, dark reddish brown (5YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, nonsticky; mildly alkaline; clear smooth boundary.
B21—9 to 13 inches; reddish brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, nonsticky; thin patchy glossy coatings on most vertical faces of peds; moderately calcareous; mildly alkaline; clear smooth boundary.
B22—13 to 21 inches; light reddish brown (5YR 6/3) silt loam, reddish brown (5YR 4/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky; strongly calcareous; moderately alkaline; clear smooth boundary.
B3ca—21 to 31 inches; light reddish brown (5YR 6/3) silt loam, reddish brown (5YR 4/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky; strongly calcareous, carbonates slightly segregated as streaks and flecks; moderately alkaline; gradual wavy boundary.
Cca—31 to 60 inches; reddish yellow (5YR 6/6) loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, friable, nonsticky; strongly calcareous; moderately alkaline.

The thickness of the solum ranges from 20 to 31 inches. Depth to carbonates ranges from 5 to 10 inches. The mollic epipedon ranges from 7 to 16 inches thick.

Topeman series

The Topeman series consists of deep, well drained soils on pediments. These soils formed in clayey alluvium derived from acid shale. The slope range is 0 to 3 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Topeman soils are similar to Bone and Rhoame soils. They are near Demar, Grummit, Maggin, Querc, and Rhoame soils. Rhoame soils are slightly acid to moderately alkaline and friable, and they do not have bedrock at 40 to 60 inches. Grummit and Maggin soils are shallower over bedrock and are more friable. They do not contain salts. Querc and Demar soils have an argillic horizon. Bone soils are strongly alkaline.

Typical pedon of Topeman silty clay loam in an area of Topeman-Demar complex, 0 to 3 percent slopes, 2 miles east of Colony, NE1/4SE1/4 sec. 19, T. 56 N., R. 60 W.

A11—0 to 1 inch; light brownish gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) moist; thin hard dispersed crust; hard, firm, sticky; slightly acid; clear smooth boundary.
A12—1 to 5 inches; gray (10YR 6/1) silty clay, dark gray (10YR 4/1) moist; weak coarse angular blocky structure parting to weak medium granular; hard, firm, sticky; medium acid; clear smooth boundary.
C1—5 to 19 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak medium and coarse angular blocky structure parting to weak medium granular; very hard, very firm, very sticky; 10 percent shale fragments 1/4 to 3/8 inch in size; few fine threads of gypsum; medium acid; gradual wavy boundary.
C2cs—19 to 28 inches; light olive brown (2.5Y 5/4) shaly clay with many (2.5Y 5/6) iron stains, dark grayish brown (2.5Y 4/2) moist; massive; very hard, very firm, very sticky; 25 percent shale fragments 1/4 to 3/8 inch in size; few medium threads of gypsum; medium acid; clear smooth boundary.
C3cs—28 to 48 inches; grayish brown (2.5Y 5/2) shaly clay with light olive brown (2.5Y 5/6) iron stains;

dark grayish brown (2.5Y 4/2) moist; massive; very hard, very firm, very sticky; 25 percent shale fragments 1/4 to 3/8 inch in size; common fine and medium threads of gypsum; medium acid; clear smooth boundary.

C4r—48 inches; brown (10YR 5/3) shale with yellowish brown (10YR 5/6) mottles of iron stains and many fine crystals of gypsum.

Depth to shale is 40 to 60 inches. The control section is shaly clay, silty clay, or clay. It is about 10 to 35 percent 1/4- to 3/8-inch shale fragments that crush easily.

Twotop series

The Twotop series consists of very deep, well drained soils on flood plains or alluvial fans. These soils formed in uniform clay deposits weathered from calcareous gypsiferous shale. The slope range is 0 to 6 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Twotop soils are similar to Bone, Heldt, Limon, Petrie, Stetter, and Winler soils. All the soils except Winler are less than 60 percent clay. Winler soils have bedrock at 20 to 40 inches.

Typical pedon of Twotop clay in an area of Twotop clay, 2 to 6 percent slopes, 5 miles west of Colony, NW1/4SE1/4 sec. 23, T. 57 R. 62 W.

A1—0 to 4 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak thin platy structure parting to weak fine granular; hard, firm, sticky; slightly calcareous; mildly alkaline; abrupt smooth boundary.

B21—4 to 12 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate coarse angular blocky structure; very hard, very firm, very sticky; slightly calcareous; mildly alkaline; clear smooth boundary.

B22—12 to 18 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak coarse angular blocky structure; very hard, very firm, very sticky; strongly calcareous; moderately alkaline; clear smooth boundary.

Cca—18 to 60 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; very hard, very firm, very sticky; lime and gypsum in soft, rounded masses, threads, and seams; moderately alkaline.

The control section averages between 60 and 70 percent clay. When the soil is dry, cracks 1/2 to 1 inch wide and several feet long extend to a depth of 20 inches or more.

The A horizon is light brownish gray to grayish brown.

Ulm series

The Ulm series consists of very deep, well drained soils on alluvial fans and valley side slopes. These soils formed in thick deposits of medium and moderately fine textured, calcareous sediments from sedimentary rock. The slope range is 0 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Ulm soils are similar to Emigrant, Nunn, Querc, Renohill, and Wyarno soils. They are near Absted, Bone, Cushman, Razor, Renohill, Samsil, Bidman, and Wyarno soils. Emigrant, Cushman, and Renohill soils are 20 to 40 inches deep over bedrock. Nunn soils have a mollic epipedon. Absted and Bidman soils have an abrupt boundary between the A and B horizons. The solum of Wyarno soils is less than 15 inches thick. Querc soils do not have continuous horizons of calcium carbonate accumulation. Bone soils have a salic horizon. Samsil soils have bedrock at 10 to 20 inches.

Typical pedon of Ulm loam in an area of Ulm loam, 1 to 6 percent slopes, 18 miles southwest of Sundance, SE1/4SE1/4 sec. 28, T. 56 N., R. 65 W.

A1—0 to 4 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; granular structure; soft, very friable, slightly sticky; neutral; clear smooth boundary.

B1—4 to 7 inches; brown (10YR 5/3) loam, brown (10YR 4/3) moist, weak coarse subangular blocky structure; hard, firm, sticky; neutral; clear smooth boundary.

B2t—7 to 14 inches; brown (10YR 5/3) clay loam, brown (10YR 4/3) moist, moderate medium prismatic structure parting to moderate medium angular blocky; hard, firm, sticky; moderate continuous clay films on all faces of peds; mildly alkaline; clear smooth boundary.

B3ca—14 to 18 inches; light gray (10YR 7/2) clay loam, grayish brown (10YR 5/2) moist; weak coarse subangular blocky structure; hard, firm, sticky; few clay films as patches on some faces of peds; calcareous; moderately alkaline; clear smooth boundary.

C1ca—18 to 22 inches; light gray (10YR 7/2) clay loam, grayish brown (10YR 5/2) moist; massive; hard, firm, sticky; calcareous, visible calcium carbonate occurs as threads; moderately alkaline; clear smooth boundary.

C2ca—22 to 60 inches; light gray (10YR 7/2) clay loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, slightly sticky; calcareous, visible calcium carbonates in small soft rounded masses; moderately alkaline.

Depth to the calcareous material ranges from 12 to 30 inches. Thickness of the solum ranges from 15 to 40 inches.

The A horizon is light brownish gray or grayish brown loam or clay loam. The B2t horizon is brown or grayish brown clay or clay loam that is 35 to 50 percent clay. The C horizon is 6 to 15 percent calcium carbonate equivalent.

Vale series

The Vale series consists of very deep, well drained, nearly level to gently sloping soils on terraces, uplands, and fans. These soils formed in silty alluvium derived from reddish colored silty shale. The slope range is 0 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Vale soils are similar to Boneek, Kadoka, Nevee, Norka, Sugardee, and Tilford soils. They are near Barnum, Higgins, Laporte, Nevee, Spearfish, and Tilford soils. Kadoka soils are 20 to 40 inches deep over bedrock. Norka and Kadoka soils have grayer hues. Boneek soils are more than 35 percent clay. Barnum and Nevee soils do not have an argillic horizon. Tilford soils have a mollic epipedon and a cambic horizon. Spearfish and Laporte soils are less than 20 inches deep over bedrock. Higgins soils are poorly drained. Sugardee soils have a gravel substratum.

Typical pedon of Vale silt loam in an area of Vale silt loam, 0 to 1 percent slopes, 14 miles east of Sundance, SE1/4NE1/4 sec. 19, T. 51 N., R. 61 W.

A1—0 to 7 inches; brown (10YR 4/3) silt loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure parting to granular; slightly hard, friable, slightly sticky; neutral; abrupt smooth boundary.

B21t—7 to 11 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 4/2) moist; moderate coarse angular blocky structure; slightly hard, friable, sticky; thin continuous clay films on vertical faces of peds; neutral; clear smooth boundary.

B22t—11 to 21 inches; reddish brown (5YR 5/3) silty clay loam, reddish brown (5YR 4/3) moist; strong medium prismatic structure parting to strong medium subangular blocky; hard, firm, sticky; thin continuous clay films on all faces of peds; mildly alkaline; clear smooth boundary.

B3ca—21 to 28 inches; reddish brown (5YR 6/3) silt loam, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky; calcareous; moderately alkaline; clear smooth boundary.

Cca—28 to 60 inches; light reddish brown (5YR 6/3) silt loam, reddish brown (5YR 5/3) moist; weak coarse angular blocky structure; slightly hard, friable, slightly sticky, calcareous; moderately alkaline.

Solum thickness ranges from 20 to 38 inches. Depth to carbonates ranges from 12 to 26 inches. The mollic epipedon is 7 to 20 inches thick.

The A horizon is brown or dark brown. The B2t horizon is silty clay loam or silt loam that is 25 to 35 percent clay.

Valent series

The Valent series consists of very deep, excessively drained soils on uplands. These soils formed in dune sand. The slope range is 6 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Valent soils are similar to Bankard and Vona soils. They are near Terry and Vona soils. Bankard soils do not have organic matter that decreases uniformly with depth. Terry and Vona soils have a sandy loam texture.

Typical pedon of Valent loamy sand in an area of Valent loamy sand, 6 to 10 percent slopes, 8 miles east of Moorcroft, NE1/4SE1/4, sec. 27, T. 50 N., R. 66 W.

A1—0 to 8 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; single grained; loose; neutral; clear smooth boundary.

C—8 to 60 inches; light brownish gray (10YR 6/2) fine sand, grayish brown (10YR 5/2) moist; massive; soft, very friable, nonsticky; neutral.

Depth to calcareous material is more than 40 inches. The control section is fine sand or loamy sand. It is 0 to 15 percent clay and 75 to 100 percent sand. The C horizon is grayish brown or light brownish gray.

Vanocker series

The Vanocker series consists of very deep, well drained soils in the mountains. These soils formed in material weathered from sedimentary rock. The slope range is 20 to 75 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

Vanocker soils are similar to Peso and Virkula soils. They are near Citadel, Grizzly, Larkson, Cordeston, Lakoa, Lynx, Maitland, Paunsaugunt, and Virkula soils. Peso soils have a mollic epipedon. Virkula soils formed in material from igneous rock, and they are noncalcareous. Grizzly soils are more than 35 percent clay. Citadel, Larkson, Cordeston, Lakoa, Lynx, and Maitland soils do not have coarse fragments in the solum. Paunsaugunt soils are shallow over bedrock.

Typical pedon of Vanocker loam in an area of Vanocker-Citadel complex, 20 to 60 percent slopes, 20 miles southeast of Sundance, SE1/4NE1/4 sec. 17, T. 50 N., R. 61 W.

O—1 inch to 0; forest litter and decomposing forest litter.

A1—0 to 2 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky; 10 percent channery fragments; neutral; clear wavy boundary.

B21—2 to 7 inches; brown (7.5YR 5/4) channery clay loam, dark brown (7.5YR 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky; 30 percent channery fragments; neutral; gradual wavy boundary.
B22—7 to 16 inches; light brown (7.5YR 6/4) very channery clay loam, brown (7.5YR 5/4) moist; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; hard, firm, sticky; 40 percent channery fragments and 15 percent flagstones; mildly alkaline; gradual wavy boundary.
Cca—16 to 62 inches; pale brown (10YR 6/3) very channery clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky; 50 percent channery fragments and 20 percent flagstones; calcareous, common fine segregations of lime; moderately alkaline.

Thickness of the solum and depth to carbonates range from 10 to 25 inches. Depth to bedrock ranges from 40 to more than 60 inches. The control section is channery loam, channery clay loam, very channery loam, or very channery clay loam. The content of coarse fragments increases with increasing depth. It ranges from 10 percent at the surface to 80 percent in the C horizon.

The A horizon is grayish brown or dark grayish brown.

Virkula series

The Virkula series consists of very deep, well drained soils in the mountains. These soils formed in igneous material. The slope range is 6 to 35 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

Virkula soils are similar to Vanocker soils. They are near Citadel, Grizzly, Stovho, and Vanocker soils. Citadel and Vanocker soils formed in silty material over limestone. The solum of Grizzly and Vanocker soils is more than 35 percent coarse fragments. Stovho soils are cryic.

Typical pedon of Virkula silt loam in an area of Grizzly-Virkula complex, 6 to 15 percent slopes, 5 miles north of Sundance, NE1/4NE1/4 sec. 8, T. 52 N., R. 63 W.

O—1 inch to 0; decomposed and partly decomposed forest litter, mainly needles, twigs, and leaves.
A1—0 to 2 inches; brown (10YR 4/3) silt loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; slightly hard, friable, nonsticky; slightly acid; abrupt smooth boundary.
A2—2 to 13 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 4/3) moist; weak medium granular structure; slightly hard, friable, slightly sticky; slightly acid; clear smooth boundary.
B&A—13 to 16 inches; clay; colors partly of the B horizon but dominantly of the A horizon; moderate medium subangular blocky structure; very hard, very firm, sticky; thick continuous clay films on many faces of peds; slightly acid; clear wavy boundary.
B2t—16 to 24 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; strong coarse prismatic structure; very hard, very firm, sticky; thick continuous clay films on faces of peds; medium acid; clear wavy boundary.
B3—24 to 27 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate medium subangular blocky structure; very hard, very firm, sticky; common moderately thick clay films occur as bridges holding mineral grains together; slightly acid; clear wavy boundary.
C—27 to 60 inches; brownish yellow (7.5YR 6/6) gravelly clay loam, brown (7.5YR 4/4) moist; massive; hard, firm, slightly sticky; slightly acid.

Thickness of the solum ranges from 22 to 55 inches. The content of rock fragments in the lower part of the C horizon in some pedons ranges up to 65 percent.

The B horizon is brown or grayish brown. The clay content averages between 35 and 50 percent.

The C horizon is gravelly clay loam or very gravelly clay loam.

Vona series

The Vona series consists of very deep, well drained soils on uplands that parallel major drainageways. These soils formed in eolian or partly wind reworked material. Slopes are gently sloping to steep and range from 2 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Vona soils are similar to Otero, Terry, and Valent soils and are near Alice, Fort Collins, Otero, Tassel, Terry, and Valent soils. Terry soils have bedrock at a depth of 20 to 40 inches. Valent soils are coarser textured. Otero soils do not have an argillic horizon. Tassel soils are 20 inches deep over bedrock. Fort Collins soils are finer textured. Alice soils have a mollic epipedon.

Typical pedon of Vona loamy fine sand in an area of Vona loamy fine sand, 2 to 6 percent slopes, 10 miles east of Moorcroft, SE1/4NE1/4 sec. 23, T. 50 N., R. 66 W.

A1—0 to 5 inches; light brownish gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; very weak platy to weak medium subangular blocky structure; soft, very friable, nonsticky; mildly alkaline; clear smooth boundary.
B21t—5 to 10 inches; brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky; mildly alkaline; clear smooth boundary.
B22t—10 to 14 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; weak coarse

subangular blocky structure; slightly hard, friable, slightly sticky; thin patchy clay films on vertical faces of peds; mildly alkaline; clear smooth boundary.

C1ca—14 to 22 inches; light yellowish brown (10YR 6/4) loamy sand, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable, nonsticky; calcareous; moderately alkaline; clear smooth boundary.

C2ca—22 to 60 inches; light yellowish brown (10YR 6/4) loamy sand, yellowish brown (10YR 5/4) moist; massive; soft, very friable; nonsticky; calcareous; moderately alkaline.

Thickness of the solum is 15 to 40 inches. Depth to calcareous material is 8 to 24 inches. The A horizon is light brownish gray or grayish brown.

Wages series

The Wages series consists of very deep, well drained soils on alluvial fans and uplands. These soils formed in alluvium and in material weathered from sandstone and siltstone. The slope range is 1 to 10 percent. The average annual precipitation is about 16 inches, and the average annual air temperature is about 46 degrees F.

Wages soils are similar to Ascalon, Norka, Sugardee, and Satanta soils. They are near Alice, Kim, Limon, Nunn, Thedalund, and Shingle soils. Ascalon soils are more than 35 percent fine sand and coarser material. Norka soils are fine silty. Sugardee soils have gravel at 20 to 40 inches. Alice, Kim, Limon, Thedalund, and Shingle soils do not have an argillic horizon. Shingle soils are less than 20 inches deep over bedrock, and Thedalund soils have bedrock at 20 to 40 inches. Nunn soils are more than 35 percent clay in the B horizon. The solum of Satanta soils is more than 15 inches thick.

Typical pedon of Wages loam in an area of Wages loam, 1 to 6 percent slopes, about 3 miles south of Hulett, near center sec. 23, T. 54 N., R. 65 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable, nonsticky; neutral; clear wavy boundary.

B2t—4 to 11 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to strong medium subangular blocky; hard, firm, sticky; thin continuous clay films on all faces of peds; mildly alkaline; clear wavy boundary.

B3ca—11 to 15 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm, sticky; calcareous, visible calcium carbonates in soft rounded masses, moderately alkaline; clear wavy boundary.

Cca—15 to 60 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; hard, firm, sticky; calcareous, visible calcium carbonates in large irregular soft masses; moderately alkaline.

Thickness of the solum ranges from 8 to 15 inches. The mollic epipedon is 7 to 15 inches thick. Depth to calcareous material is 6 to 14 inches.

The B horizon is clay loam or sandy clay loam. The C horizon is clay loam to loam.

Winler series

The Winler series consists of moderately deep, well drained soils on uplands. These soils formed in clayey deposits weathered from shale. The slope range is 2 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Winler soils are similar to Gaynor, Limon, Razor, Samsil, and Twotop soils. They are near Gaynor, Heldt, Limon, Louviers, and Renohill soils. Gaynor, Heldt, Limon, and Razor soils are less than 60 percent clay. Twotop soils are more than 40 inches deep over bedrock. Samsil and Louviers soils are less than 20 inches deep over bedrock. Renohill soils have an argillic horizon.

Typical pedon of Winler clay loam in an area of Winler-Razor clay loams, 2 to 10 percent slopes, 3 miles west of Colony, SW1/4NW1/4 sec. 25, T. 57 N., R. 62 W.

A1—0 to 3 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium angular blocky structure; very hard, very firm, very sticky; calcareous; moderately alkaline; clear smooth boundary.

B2—3 to 10 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate fine subangular blocky structure; very hard, very firm, very sticky; calcareous; moderately alkaline; clear smooth boundary.

B3—10 to 16 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak fine subangular blocky structure; very hard, very firm, very sticky; calcareous; strongly alkaline; clear smooth boundary.

C1ca—16 to 29 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky; few fine threads of calcium carbonate, strongly calcareous; strongly alkaline; gradual smooth boundary.

C2r—29 inches; calcareous clay shale with lenses of gypsum crystals.

Thickness of the solum is 15 to 27 inches. Depth to visible salts is 8 to 20 inches. Depth to bedrock is 20 to 40 inches. When the soil is dry, cracks 1/2 to 1 inch wide and several feet long extend to a depth of 20 inches or more.

The A horizon is light brownish gray or grayish brown.

Work series

The Work series consists of very deep, well drained soils on uplands. These soils formed in deep, well graded sediments from shale. The slope range is 2 to 30 percent. The average annual precipitation is about 18 inches. The average annual air temperature is about 43 degrees F.

Work soils are similar to Nunn and Emigrant soils. They are near Larkson, Gaynor, Limon, and Samsil soils. Larkson, Gaynor, Limon, Nunn, Samsil, and Emigrant soils have soil temperatures of more than 47 degrees F. Larkson soils have an albic horizon.

Typical pedon of Work clay loam in an area of Work clay loam, 6 to 10 percent slopes, 12 miles northwest of Sundance, SE1/4SE1/4 sec. 9, T. 52 N., R. 64 W.

A1—0 to 10 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; slightly hard, friable, sticky; slightly acid; abrupt smooth boundary.

B1—10 to 12 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; moderate coarse and strong fine angular blocky structure; hard, firm, sticky; neutral; clear smooth boundary.

B2t—12 to 19 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; weak coarse prismatic structure parting to strong coarse blocky; very hard, firm, very sticky; thick continuous clay films on all faces of peds; neutral; clear wavy boundary.

B3ca—19 to 23 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; weak coarse blocky structure; hard, firm, very sticky; slightly calcareous; moderately alkaline; clear wavy boundary.

Cca—23 to 60 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, very sticky; strongly calcareous; moderately alkaline.

Thickness of the solum ranges from 15 to 24 inches. Depth to carbonates ranges from 12 to 30 inches. The mollic epipedon ranges from 10 to 16 inches thick.

The A horizon is very dark grayish brown or dark grayish brown. The C horizon is clay loam or loam. It has a continuous carbonate layer that is 5 to 15 percent carbonates.

Wyarno series

The Wyarno series consists of very deep, moderately well drained soils on alluvial fans and valley filling side slopes. These soils formed in calcareous alluvial sediments derived from sedimentary rock. The slope range is 0 to 10 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Wyarno soils are similar to Querc, Renohill, and Ulm soils. They are near Absted, Bone, Razor, Renohill, Samsil, and Ulm soils. Querc soils do not have continuous horizons of calcium carbonate accumulation. Renohill soils are 20 to 40 inches deep over bedrock. Ulm soils have a solum more than 15 inches thick. Absted soils have an abrupt boundary between the A and B horizons. Razor soils have a cambic horizon. Bone soils have a salic horizon. Samsil soils are less than 20 inches deep over bedrock.

Typical pedon of Wyarno clay loam in an area of Wyarno clay loam, 2 to 6 percent slopes, 4 miles east of Colony, SW1/4SW1/4 sec. 16, T. 56 N., R. 60 W.

A1—0 to 5 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak coarse angular blocky structure parting to fine granular; slightly hard, friable, sticky; neutral; clear smooth boundary.

B1—5 to 8 inches; pale brown (10YR 6/3) clay loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to moderate medium angular blocky; hard, firm, very sticky; neutral; clear smooth boundary.

B2t—8 to 10 inches; pale brown (10YR 6/3) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to strong coarse and fine angular blocky; hard, firm, very sticky; thin continuous clay films on all faces of peds; slightly calcareous; mildly alkaline; clear smooth boundary.

C1ca—10 to 24 inches; pale brown (10YR 6/3) clay loam, dark grayish brown (10YR 4/2) moist; very weak coarse subangular blocky structure; hard, firm, very sticky; strongly calcareous, common medium soft rounded masses of secondary lime; strongly alkaline; clear smooth boundary.

C2ca—24 to 60 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (10YR 4/2) moist; massive; hard, firm, sticky; strongly calcareous; strongly alkaline.

Depth to calcareous material ranges from 6 to 12 inches. The B2t horizon is clay or clay loam that is 35 to 50 percent clay. The C horizon is moderately to strongly alkaline.

Zigweid series

The Zigweid series consists of very deep, well drained soils formed in calcareous loamy alluvium washed from sedimentary rock. These soils are on foot slopes, terraces of rivers and streams, and alluvial fans in the valleys. The slope range is 2 to 20 percent. The average annual precipitation is about 16 inches. The average annual air temperature is about 46 degrees F.

Zigweid soils are similar to Cushman, Razor, and Suglo soils. They are near Cushman, Fort Collins, Kim, Shingle, and Thedalund soils. Cushman soils have an

argillic horizon. Razor soils are more than 35 percent clay. Suglo soils have redder hues. Kim and Thedalund soils lack the cambic horizon. Shingle soils are less than 20 inches deep over bedrock.

Typical pedon of Zigweid loam in an area of Zigweid loam, 2 to 6 percent slopes, 3 miles west of Moorcroft, NW1/4SE1/4 sec. 36, T. 50 N., R. 68 W.

A1—0 to 6 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure parting to granular; slightly hard, friable, nonsticky; neutral; clear smooth boundary.

B2—6 to 14 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky; moderately alkaline; clear smooth boundary.

B3ca—14 to 19 inches; pale brown (10YR 6/3) loam, grayish brown (10YR 5/2) moist; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky; strongly calcareous; strongly alkaline; clear smooth boundary.

Cca—19 to 60 inches; light brownish gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, slightly sticky; strongly calcareous; strongly alkaline.

The solum is 11 to 15 inches thick. Depth to carbonates is 6 to 15 inches.

The A horizon is grayish brown or light brownish gray. The C horizon is loam or clay loam.

formation of the soils

This section describes the processes of soil formation as they relate to soils in the survey area.

factors of soil formation

Soils form through the interaction of five major factors: climate, plant and animal life, parent material, relief, and time (*3*). The relative influence of each factor varies from place to place. In some places one factor dominates in the formation of a soil and determines most of its properties. Most variations in soils of Crook County are caused by differences in parent material, relief, and climate.

climate

Climate affects the kind and amount of vegetation on a soil and the rate at which organic matter decomposes. It also affects the rate at which minerals decompose and the depth to which chemical and physical changes extend into the soil. Areas below the mountains have warm summers, cold winters, and about 16 inches of precipitation annually. The mountains have cool summers, cold winters, and about 20 inches of precipitation annually. Generally, as elevations increase, the temperature decreases and precipitation increases.

Soils along the western boundary of the county are light colored. The light color relates to the warmer, semi-arid climate under which less organic matter is returned to the soil. There are differences in climate within broad climatic zones. North-facing slopes generally are cooler and are more moist than south-facing slopes. Because the sun's rays do not strike them so directly, they retain moisture longer. Water movement through the soil tends to move both salts and clay and deposit them in horizons below the surface. The subsoil of these soils is clay, which has been translocated from the surface layer. All the salts may be leached from some soils.

plants and animals

All living organisms, including vegetation, bacteria, fungi, and animals, are important to soil formation. Vegetation generally supplies the organic matter that decomposes and gives a dark color to the surface horizon. The vegetation also supplies nutrients. Many of the trees, grasses, and other plants take up plant nutrients from the soil and store them in their roots, stems, and leaves. When these plants or parts of them decompose, the elements return to the soil. Bacteria and fungi decompose the vegetation. Many of the organic reactions and processes of the bacteria and fungi also release material that affects the soil-forming processes. Earthworms, ants, cicada, and burrowing animals mix soils and affect soil structure, generally making the soils more open and porous.

Kinds of vegetation may influence the micro-climate of the soil. In the mountains and foothills, forest is interspersed with parks of grass and shrubs. Where the tree cover is dense, Alfisols, such as Lakoa soils, form. Because these soils have an organic mulch on the surface and are shaded, they are cooler in summer. They have frigid and cryic soil temperature regimes. In the open parks where the soil lacks the organic mulch and is warmer, Mollisols, such as Satanta soils, form. They have a mesic soil temperature regime.

Man also affects soil structure. He makes soils more porous in some places by tillage and management practices. In other places, however, he compacts the soil by foot and vehicle traffic. Man's intensive use and disturbance of some soils have caused accelerated soil erosion losses, often accompanied by increased deposition on flood plains and in depressions. In other places man has used practices that slow the rate of erosion. Man has also altered many soils chemically through the use of lime and fertilizer, which make the soils more favorable for desired plants.

parent material

Parent material is material in which soils form. It influences the mineral and chemical composition of the soil and, to a large extent, the rate at which soil formation takes place. The soils of the survey area formed in a variety of parent materials that differ in grain size, porosity, mineralogy, and other characteristics.

In the mountains, soils formed in residuum from igneous rock, limestone, and sandstone. Examples are Citadel, Larkson, Grizzly, and McCaffery soils. These soils formed in a variety of materials and range widely in texture and soil development.

Soils of the foothills and uplands formed in sandstone and shale. For example, Butche, Nunn, and Satanta soils formed in loamy and clayey materials. They also range widely in soil development.

Soils of the red-bed valley formed in red siltstone and fine-grained sandstone. Examples are Gypnevee, Nevee, Spearfish, Sugardee, and Vale soils. These soils formed

in red silty material and range widely in development. They are also highly erodible.

Soils of the plains, for example, Absted, Fort Collins, Kim, Renohill, Shingle, Terry, and Ulm soils, formed in material weathered from sandstone and shale. These soils have a wide range of development. Some are sandy. Others have a high clay content. Some are strongly saline and alkaline.

Soils of the flood plains, for example, Glenberg, Lohmiller, and Haverson soils, formed in mixed alluvium that ranges from sand to clay. These soils have very little development.

relief

In soil formation, relief controls exposure and surface drainage and affects the percolation of water into the soil. Relief generally affects the depth of the soil, the plant and animal life, and some of the soil-forming processes. Steeper soils, for example, Shingle soils, generally are thin and have weakly expressed horizons because of erosion. Ulm soils in depressions are typically deeper and moister, whereas soils on higher convex surfaces are thinner and better drained.

In some areas, particularly in the mountains, exposure affects soil formation. North- and east-facing mountain slopes retain the overwinter snowpack longer than the south- and west-facing slopes. This is shown by the kind of vegetation and the thickness of the soil profile.

Elevation also affects soil formation through its effect on climate. In the mountains, the cooler air temperature results in a cooler soil temperature. Frigid soils, such as Lakoa soils, are on the lower mountain slopes. Above an elevation of about 7,100 feet are cryic soils, such as Lail soils.

time

The length of the time that the parent material has been in place and exposed to the active forces of climate and plant and animal life strongly influences the nature of the soil. The kinds and distinctness of horizons depend on the length of time that the other soil-forming factors have been active. The soil material along stream channels has been in place a relatively short time. Soils that formed in material along stream channels, for example, Barnum and Haverson soils, show little or no change from the original soil material. On some alluvial fans, where soils such as Heldt and Zigweid soils have been in place longer than the soils of the stream channels, distinct horizons have formed. Soils of the uplands, such as those of the Moorcroft area, formed on old land surfaces. Among these are the Briggsdale and Renohill soils, which reflect the full impact of soil-forming processes. Citadel and Larkson soils express the influence of forest vegetation along with time.

morphology of the soils

The different layers, or horizons, in a soil profile are evidence of the interaction of the factors of soil formation. The soil profile extends from the surface down to materials that are little altered by the soil-forming processes.

Most soils contain three major horizons, the A, B, and C horizons. Some soils, like Lakoa soils, also have an organic horizon at the surface. This horizon is an accumulation of organic material, such as twigs and leaves, or of decomposed organic material that has little admixture of mineral material. The major horizons can be subdivided by the use of numbers and letters to indicate differences within the horizon. The B2t horizon, for example, represents the best developed part of a B horizon that has an accumulation of clay from overlying horizons. The Satanta soils, for example, have a B2t horizon.

The A horizon is a mineral surface layer. An A1 horizon is darkened with humified organic matter. An Ap horizon is a plow layer, commonly also darkened with organic matter. The A horizon is the layer of maximum leaching or illuviation of clay and iron. If considerable leaching has taken place and organic matter has not darkened the material, the horizon is called the A2. The A2 horizon is normally the lightest colored horizon in the profile.

The B horizon, which underlies the A horizon, is commonly called the subsoil. It is the horizon of maximum accumulation of clay, iron, aluminum, or other compounds leached from the surface layer.

In some soils such as the Zigweid soils, the B horizon is formed mainly by alteration of the original material rather than by illuviation. The alteration can be caused by the weathering of the parent material, the releasing of iron to give rusty colors, and the development of soil structure in place of the original rock or sediment structure. The B horizon commonly has blocky or prismatic structure; it generally is firmer and is lighter in color than the A1 horizon, but it is darker colored than the C horizon or the A2 horizon.

The C horizon is below the A or B horizon. It consists of materials that are little altered by the soil-forming processes but may be modified by weathering.

In youthful soils such as those that formed in recent alluvium, the C horizon may be very near the soil surface.

processes of soil horizon differentiation

Several processes are involved in the formation of soil horizons. Among these are the accumulation of organic matter, the leaching of soluble constituents, the chemical reduction and movement of iron, the formation of soil structure, and the formation and translocation of clay minerals. These processes are often simultaneous. They have been going on for thousands of years.

The accumulation and incorporation of organic matter takes place as plant residue and animal-deposited organic material decompose and are mixed into the soil. These additions darken the mineral soil material and are responsible for forming the A1 horizon.

In order for soils to have a distinct subsoil, lime and more soluble materials must be leached. Once this has taken place, the clay can disperse more easily and be moved as part of the percolate. Clay has accumulated in the Bt horizon of those soils classified as Ustolls. It has been leached from overlying horizons and deposited in the B horizon as a result of flocculation and the drying up of the percolating water. Also, clay from dissolved silica and aluminum has accumulated in these horizons. More inert materials, such as silt and sand-size quartz, are concentrated in the A horizon as the more soluble materials and clay are leached out.

The naturally well drained and moderately well drained soils in the county generally have a yellowish brown or reddish brown subsoil. These colors come from finely divided iron oxide minerals that coat the sand, silt, and clay particles. These iron oxides formed from iron released during the weathering of silicate minerals. In poorly drained soils, such as Higgins soils, gray colors in the subsoil indicate the absence of free iron oxide coatings.

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glossary

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coppice mounds. Wind-deposited material around clumps of grasses or other plants.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or arresting grazing for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the

activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured soil. Sandy clay, silty clay, and clay.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of

the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that

water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to

the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.