United States Department of Agriculture

Soil Conservation Service

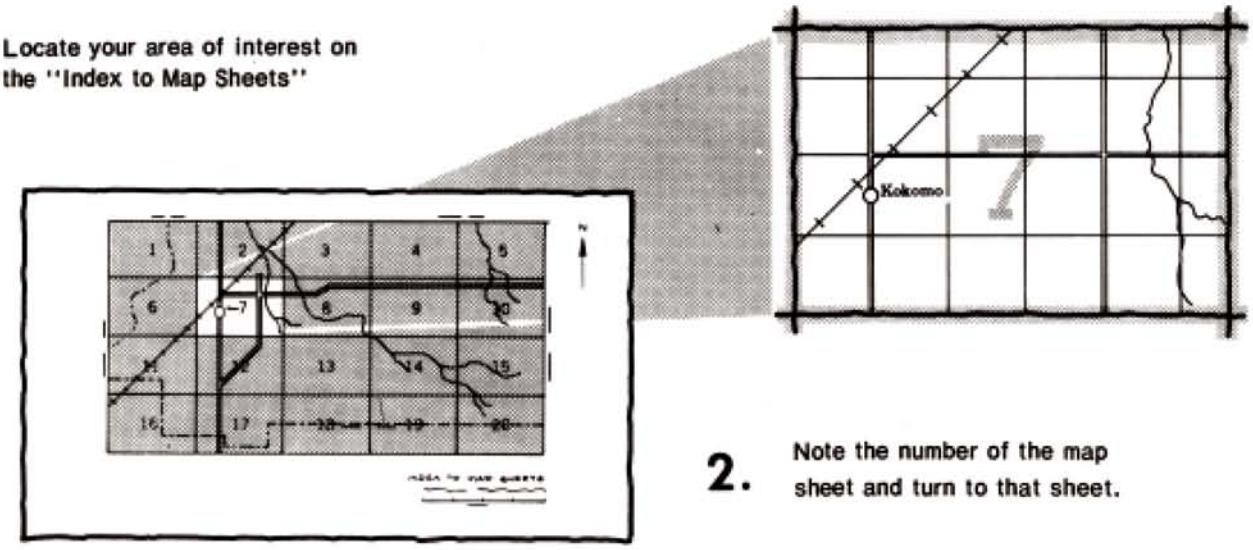
In Cooperation with Jefferson County and the Colorado Agricultural Experiment Station

Soil Survey of Golden Area, Colorado

Parts of Denver, Douglas, Jefferson, and Park Counties

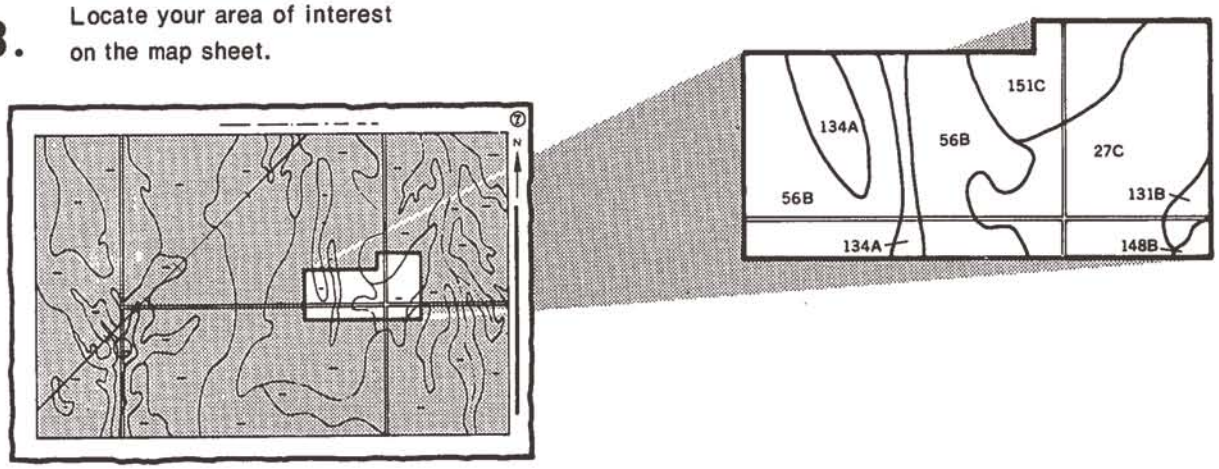
HOW TO USE

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

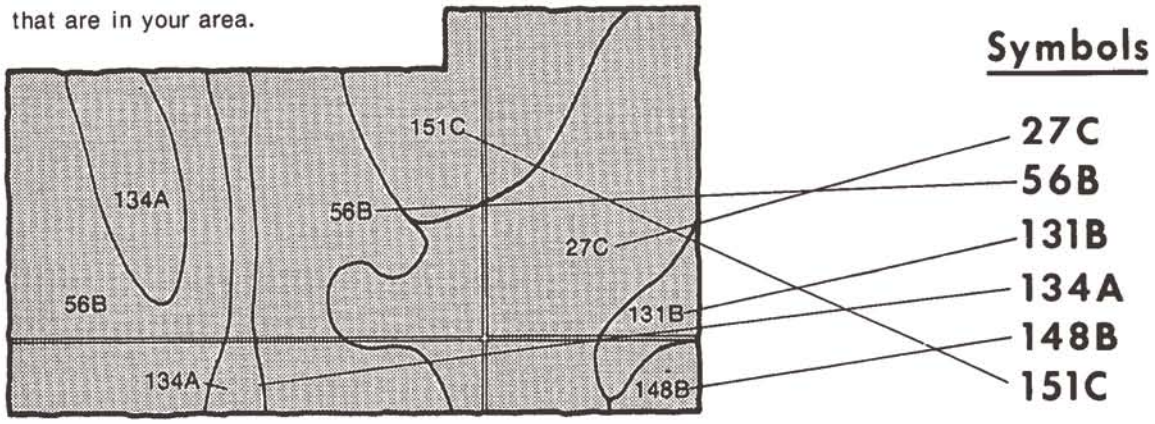


2. Note the number of the map sheet and turn to that sheet.

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

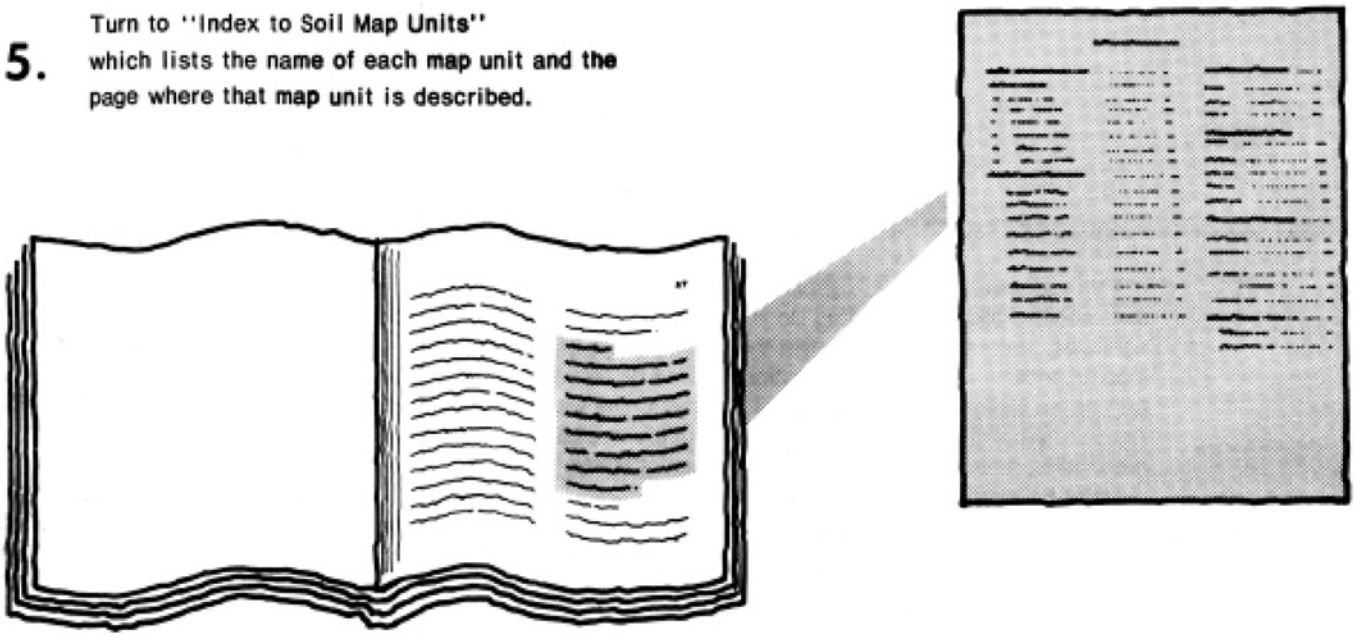


4. List the map unit symbols that are in your area.

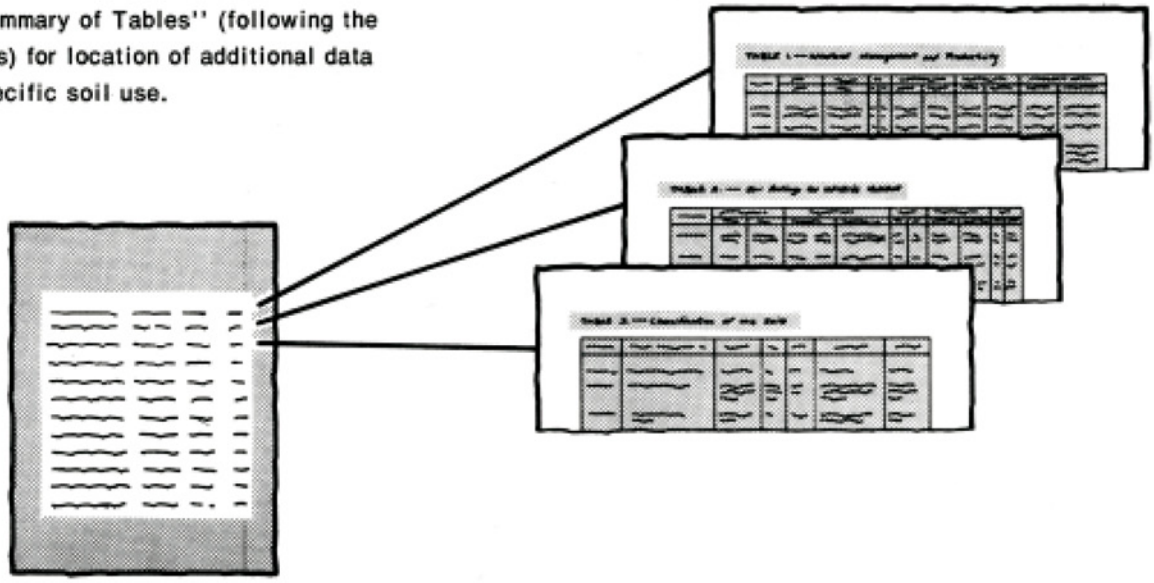


THIS SOIL SURVEY

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



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



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; 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 completed in 1980. Soil names and descriptions were approved in 1980. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980. This survey was made by the Soil Conservation Service in cooperation with the Colorado Agricultural Experiment Station and Jefferson County. It is part of the technical assistance furnished to the Jefferson County, Douglas County, and Teller-Park Conservation Districts.

Cover: Aerial view of the Golden Area, along U.S. Highway 285, showing the many uses of the soils.

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Summary of Tables

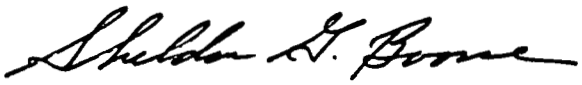
Foreword

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

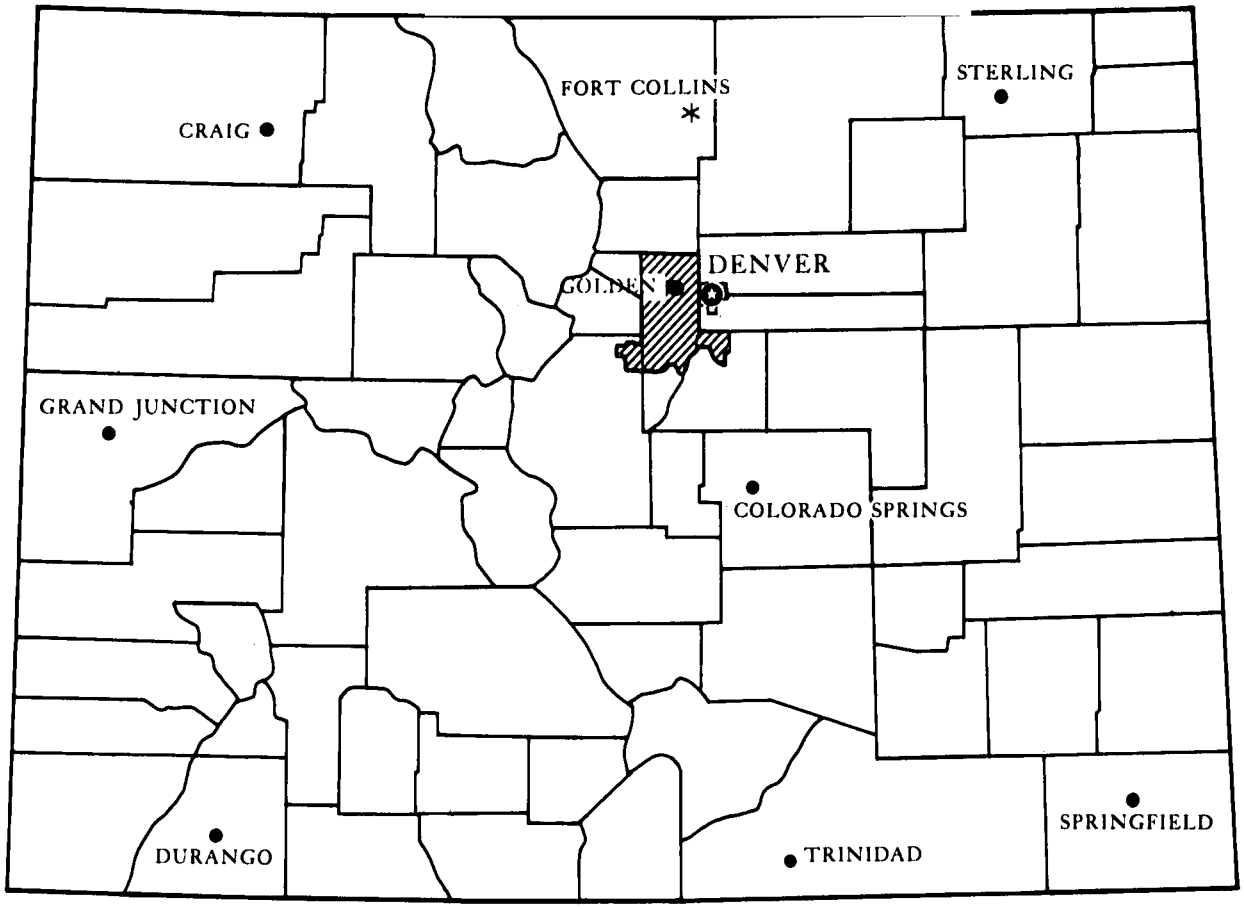
This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use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

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

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



Sheldon G. Boone
State Conservationist
Soil Conservation Service



Location of Golden Area in Colorado.

Soil survey of
Golden Area, Colorado
Parts of Denver, Douglas, Jefferson, and Park Counties

By Alan B. Price and Alan E. Amen
Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
In cooperation with Jefferson County and the
Colorado Agricultural Experiment Station

The Golden Area is in central Colorado on the eastern slope of the Rocky Mountains. The area covers 445,420 acres, or about 696 square miles. Just over half of the area is in the mountains, and the rest is on the plains and foothills. Elevation ranges from 5,200 to 10,500 feet. The area is bordered on the north by Boulder County, on the east by Adams and Arapahoe Counties and Denver County at Sheridan Boulevard, on the southeast by the South Platte River and Douglas County, on the south by Pike National Forest, and on the west by Park, Clear Creek, and Gilpin Counties. Lakewood is the largest municipality totally within the Golden Area.

The Golden Area has a broad variety of soils, primarily because of the dramatic range in elevation, climate, and parent materials (*6*). In some places the soils have been disturbed or modified by the activities of man, particularly on the plains and foothills.

The soils on the plains and foothills are used primarily for community development, crops, grazing, and recreation. The soils on the mountains are used primarily as woodland and habitat for wildlife and for community development, grazing, and recreation.

General Nature of the Survey Area

This section provides general information about the Golden Area. It discusses history and population; physiography, drainage, and relief; climate; transportation; water supply; agriculture; and industry.

History and Population

The first permanent settlement in the Golden Area was established in 1859 by men searching for gold. Golden City, which is now called Golden, was the first town in the area and was named after Thomas L. Golden, who camped there in 1858. It was the territorial capital from 1862 to 1867 and is now the county seat of Jefferson County. Jefferson and Park Counties were established in 1861. Golden offered passage from the plains to the rivers in the mountains. As the demand increased for fresh fruits and vegetables for the miners, agriculture attracted many new settlers. Agriculture and the mining of coal, clay, and gravel remained the basis for the economy in the area through World War II. Then residential growth spread over much of the farmland. The communities on the plains and foothills became indistinguishable from metropolitan Denver. Manufacturing rose sharply along with the rapid increase in population and is now the major source of income.

The area offers metropolitan life styles in the eastern part as well as agriculturally oriented and secluded mountain life styles in the western part.

Physiography, Drainage, and Relief

The survey area is within three major physiographic areas: the plains, foothills, and mountains. The kinds of soils in the survey area depend to a large extent on these physiographic areas. In general, the plains and foothills have alluvial, colluvial, and eolian deposits of Quaternary age that have been locally dissected and reworked by fluvial processes. In the mountainous areas erosion is taking place rapidly, in geologic terms, forming steep side slopes and intermontane areas of alluvial and colluvial deposition.

Elevation in the survey area ranges from about 5,200 feet above sea level in the northeast corner of Jefferson County to about 10,500 feet on Black Mountain on the western border of Jefferson County. The elevation of

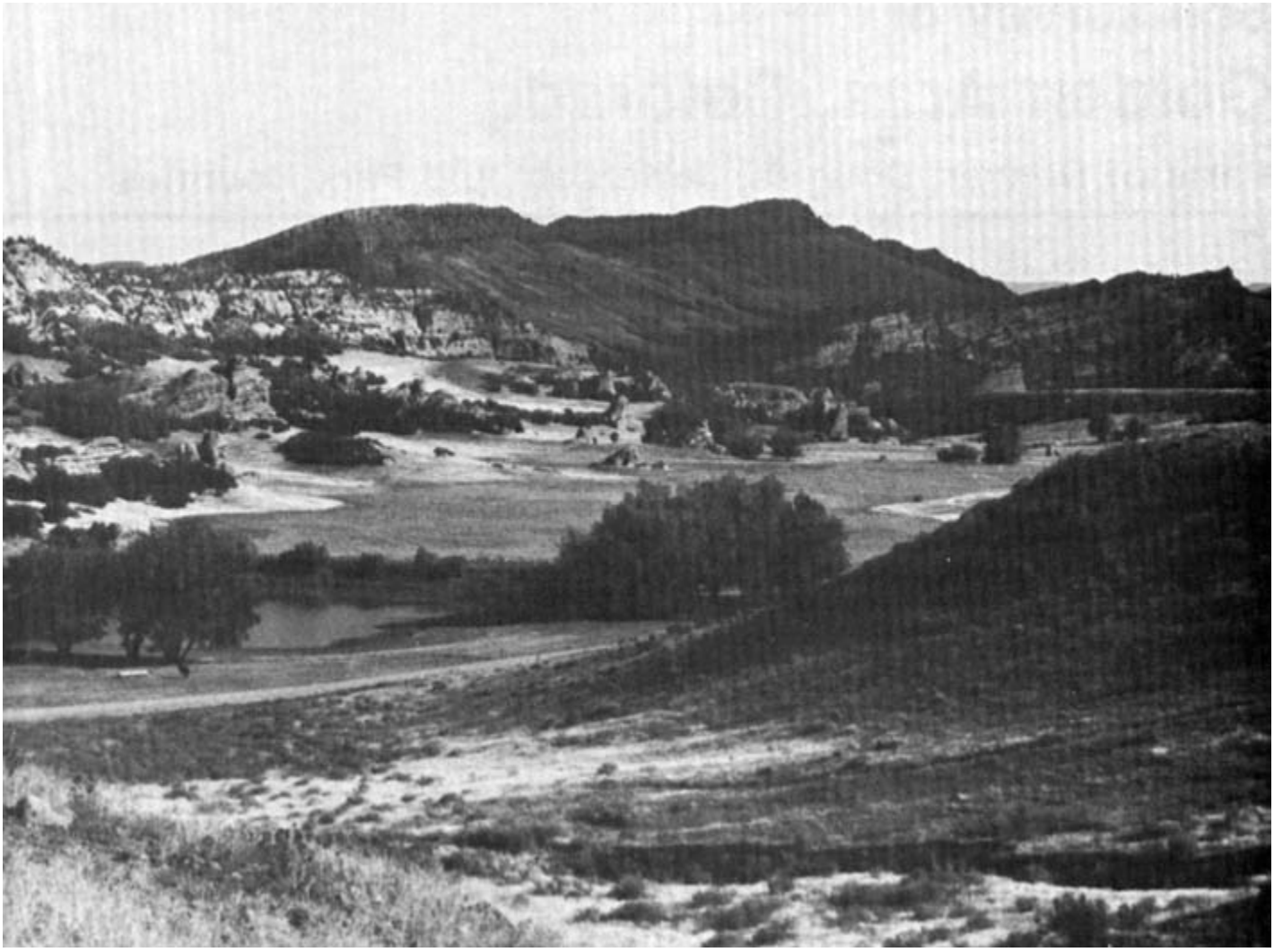


Figure 1.—View eastward from the base of the mountain front. The hogbacks are in the background. The soils in this area have many uses: recreation, habitat for wildlife, grazing, crops, and pasture.

Golden, on Clear Creek at the base of the mountains, is 5,674 feet.

The South Platte River is the major drainage system of the entire area and forms the southeast border of Jefferson County. The important streams that drain into the South Platte River from the west are Clear Creek, Bear Creek, Turkey Creek, Deer Creek, and the North Fork of the South Platte River. The primary drainage system from the Douglas County part of the survey area is Plum Creek, which drains from southeast to northwest into the South Platte River at Chatfield Reservoir.

The plains area is in the northeastern part of the survey area and consists of nearly level to gently sloping high terraces and fans, modified by local fluvial dissection that has shaped moderately sloping to moderately steep hill slopes adjacent to low terraces and flood plains. The soils generally are deep to moderately deep. Their texture commonly is clayey because the parent material derived from the interbedded shales and mudstones of the Arapahoe, Laramie, and Denver Formations and the Pierre Shale.

The foothills area is a transition zone generally parallel to and east of the mountain front. It is characterized by moderately sloping to steep hill slopes and fans. The soils in this area are shallow to deep. Their wide range of texture is due to highly contrasting parent materials.

Several prominent local landmarks are in this area: Green Mountain, North and South Table Mountains, and the hogbacks (fig. 1).

The plains and foothills are crossed by major streams that form a system of stream terraces and piedmont fans. These terraces and fans are mainly adjacent to the South Platte River, Clear Creek, Ralston Creek, Bear Creek, Coal Creek, and Deer Creek. Slopes commonly are nearly level, and the soil texture varies from sand and gravel to clay. The soils commonly are deep, and the drainage varies from somewhat excessively drained to poorly drained. The parent material generally derived from igneous and metamorphic rocks of the mountains and sedimentary rocks of the plains and foothills.

The mountain area commonly is characterized by steep side slopes and less sloping convex summits. The soils are shallow and moderately deep. The soil texture commonly is loamy, and the percentage of rock fragments varies widely. The soils in drainageways and on terraces in the mountains commonly are deep and loamy. The soils generally are well drained, but some soils on low terraces and floodplains adjacent to streams and springs commonly are poorly drained. The parent material of the soils in the mountains derived from Precambrian igneous and metamorphic rocks.

Climate

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

In the Golden Area, summers are warm or hot in most valleys and much cooler in the mountains. Winters are cold in the mountains. Valleys are colder than the lower slopes of adjacent mountains because of cold air drainage. In the mountains, precipitation occurs throughout the year, and a deep snowpack accumulates during winter. Snowmelt usually supplies much more water than can be used for agriculture in the area. In the valleys, precipitation in summer falls as showers; some thunderstorms occur. In winter the ground is covered with snow much of the time, but the snow can melt or evaporate because of the frequent Chinook winds, which blow downslope and are warm and dry.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Evergreen and Lakewood, Colorado, in the period 1962 to 1975. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperatures at Evergreen and Lakewood are 28 and 32 degrees F, respectively. The average daily minimum temperature in winter is 10 degrees at Evergreen and 20 degrees at Lakewood. The lowest temperature on record, which occurred at Evergreen on January 12, 1963, is -38 degrees. In summer the average temperature is 61 degrees at Evergreen and 69 degrees at Lakewood. The average daily maximum temperature in summer is 80 degrees. The highest recorded temperature, which occurred at Lakewood on July 13, 1971, is 100 degrees.

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

The total annual precipitation is 18 inches at Evergreen and 15 inches at Lakewood. Of this, 70 percent usually falls in April through September. The heaviest 1-day rainfall during the period of record was 3.69 inches at Evergreen on May 6, 1969. Thunderstorms occur on about 40 days each year, and most occur in summer.

The average seasonal snowfall is about 95 inches at Evergreen and about 65 inches at Lakewood. The greatest snow depth at any one time during the period of record was 22 inches at Evergreen. On an average of 45 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 40 percent. Humidity is higher at night, and the average at dawn is about 60 percent. The sun shines 70 percent of the time possible in summer and 70 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 10 miles per hour, in spring.

Transportation

The Golden Area is served by many local, state, and federal highways. Among these are Interstates 70 and 25 (just east of the area); U.S. Routes 6, 36, 40, 85, 285, and 287; and State Highways 8, 26, 58, 72, 74, 75, 93, 95, 121, 128, 391, and 470.

Several freight railroads serve the Golden Area. Amtrak provides passenger service to the area; the terminal is in downtown Denver at Union Station.

Passenger bus service is provided by two interstate carriers and several charter lines. The Regional Transportation District (RTD) provides local bus service.

Several airports serve the Golden Area. Stapleton International Airport, about 10 miles east of the area, provides commercial and charter airline service. Jefferson County Airport, which is in the northern part of the area, provides charter and private airplane service. Buckley Air National Guard Base is about 17 miles east of the survey area; it is used by military and official government personnel.

Water Supply

This section is largely based on a publication of the Denver Water Department: "Features of the Denver Water System," December 1976.

The primary source of water in the Golden Area is the South Platte River and its tributaries. However, at the turn of the century this system was recognized as being inadequate to supply the projected needs of the rapidly growing area. The Denver Water Board, which formed in 1918, began purchasing water rights on the South Platte basin and constructed reservoirs and filtration systems to store and process water. In 1936, in addition to the reservoirs on the South Platte system, water was brought into the area from the western slope of the Rocky Mountains via the Moffat Tunnel. Since then additional systems importing water from the western slope have been constructed. The Gumlick Tunnel carries water from the Williams Fork collection system. The Vasquez Tunnel was built to link the Gumlick Tunnel and the Fraser system. The Roberts Tunnel, the world's largest underground water tunnel, is 23.3 miles long. It transports water from the Blue and Snake Rivers and Ten-Mile Creek through the Continental Divide and into the North Fork of the South Platte River. New systems to collect and store water have been designed to meet the needs of the present and anticipated population of the area. The Foothills Project involves the building of the Strontia Springs Dam and Reservoir on the South Platte River. More than 30 pumping stations and reservoirs supply water to the Denver metropolitan area.

Water for agricultural use is transported primarily by contour canals and ditches from the major streams in the area. However, as the acreage of land in agricultural use diminishes because of urban expansion, some canals and ditches are no longer used.

There are many small domestic wells throughout the survey area. However, as the use of ground water increases, some wells have become dry or can pump only a small volume for short periods. In the mountains, new wells are being drilled for household use. However, locating an adequate water supply often requires more than one boring. In some areas, developing existing springs is a practical alternative to drilling wells.

Agriculture

Until the end of World War II, agriculture was the major source of income in the Golden Area. Since then, the acreage of agricultural land has decreased mainly because of the rapid population growth in the area.

The main irrigated crops east of the front range are small grains, alfalfa, vegetables and fruits grown in small truck gardens, and ornamental plants grown in nurseries and greenhouses. The most intensive irrigation is associated with lawns and gardens. The major nonirrigated crop east of the front range is small grains, mainly wheat.

The primary crops in the mountains are irrigated and nonirrigated grass hay and some nonirrigated small grains. Some people who live in the mountains raise vegetables for their own use, mainly short-season plants.

Irrigated and nonirrigated pastures are common throughout the area. They are used primarily for horses and for some cattle. Most pasture consists of native and adapted introduced grasses.

Cattle are commonly put to graze on native rangeland in the area, although this land use is less prevalent than in the past. Rangeland consists mainly of the less sloping areas in the mountains and in the foothills in the northern part of the survey area. Cow/calf operations are the most common livestock enterprise.

Local soil conservation districts have been formed to aid farmers and ranchers in selecting the best management practices to control soil erosion and improve water quality. The Jefferson County Soil Conservation District serves Jefferson County; the Teller-Park Soil Conservation District serves Park County; and the Douglas County Soil Conservation District serves Douglas County.

Industry

The Golden Area has a highly diversified economic base. Much of the industry in the area is related to manufacturing. Several manufacturing firms are located in the area. Many federal government agencies have their offices and regional headquarters in Lakewood at the Denver Federal Center.

Mining is an important industry in the survey area. Sand and gravel are mined from alluvial deposits along some of the major streams, particularly Clear Creek. Crushed aggregate is mined from igneous and metamorphic rocks, particularly along the mountain front range. Uranium is mined near Ralston Creek in the mountains. Several small gold and silver mines are also in operation. Clay is mined for the manufacture of porcelain and bricks.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other

living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

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.

Dominantly well drained, clayey and loamy soils on high terraces, hill slopes, and fans

There are four map units in this group, which makes up about 30 percent of the survey area. The soils are nearly level to steep. The native vegetation is mainly grasses and forbs. Elevation is 5,200 to 6,500 feet. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

The soils in this group are deep and moderately deep. They are well drained. They formed in clayey and loamy material derived dominantly from sedimentary rocks.

The soils are used mainly for community development, pasture, and grazing. They are also used for crops.

1. Nunn-Denver

Nearly level to gently sloping, deep, well drained, clayey soils that formed in material derived from mudstone and shale

This map unit is in the northeastern and eastern parts of the survey area. The soils are mainly on high terraces and fans. Slope is 0 to 5 percent. The vegetation is mainly grasses and forbs. Elevation is 5,200 to 6,500 feet. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

This map unit makes up about 18 percent of the survey area. It is about 45 percent Nunn soils and similar soils and 25 percent Denver soils and similar soils. The remaining 30 percent is soils of minor extent and Urban land.

Nunn soils are on high terraces and fans. These soils are deep and well drained. They formed in clayey material derived dominantly from mudstone and shale. The surface layer is clay loam. The subsoil is clay and clay loam. Below the subsoil to a depth of 60 inches the material is clay loam.

Denver soils are on high terraces and fans. These soils are deep and well drained. They formed in clayey material derived dominantly from mudstone and shale. The surface layer is clay loam. The subsoil is clay to a depth of 60 inches.

Of minor extent are Kutch and Midway soils on hill slopes and on the steeper part of slopes adjacent to stream courses, Primen and Leyden soils on gravelly and cobbly hill slopes, Haverson soils on low terraces, and Urban land.

The soils in this map unit are used mainly for community development, as pasture, and for crops. They are also used for grazing.

2. Denver-Kutch

Moderately sloping to steep, deep and moderately deep, well drained, clayey soils that formed in material derived from mudstone and shale

This map unit is in the central, north-central, and southeastern parts of the survey area. The soils are mainly on hill slopes and fans. Slope is 5 to 50 percent. The vegetation is mainly grasses and forbs. Elevation is 5,200 to 6,500 feet. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

This map unit makes up about 7 percent of the survey area. It is about 60 percent Denver soils and similar soils and 20 percent Kutch soils and similar soils. The remaining 20 percent is soils of minor extent and Urban land.

Denver soils are on hill slopes and fans. These soils are deep and well drained. They formed in clayey material derived dominantly from mudstone and shale. The surface layer is clay loam. The subsoil is clay to a depth of 60 inches.

Kutch soils are on hill slopes. These soils are moderately deep and well drained. They formed in clayey material derived dominantly from mudstone and shale. The surface layer is clay loam. The subsoil is clay and clay loam. Weathered shale is at a depth of 20 to 40 inches.

Of minor extent are Midway, Leyden, and Primen soils on hill slopes, Haverson soils on flood plains and low terraces, areas of soils that have slopes of less than 5 percent, and Urban land.

The soils in this map unit are used mainly for community development, pasture, and crops. They are also used for grazing.

3. Platner-Renohill

Gently sloping to strongly sloping, deep and moderately deep, well drained, clayey soils that formed in material derived from mudstone and shale

This map unit is in the southeastern part of the survey area. The soils are mainly on high terraces and hill slopes. Slope is 3 to 15 percent. The vegetation is mainly grasses and forbs. Elevation is 5,200 to 6,000 feet. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

This map unit makes up about 3 percent of the survey area. It is about 40 percent Platner soils and similar soils and 30 percent Renohill soils. The remaining 30 percent is soils of minor extent.

Platner soils are on high terraces and hill slopes. These soils are deep and well drained. They formed in calcareous, alluvial and eolian material derived dominantly from mudstone and shale. The surface layer is loam or clay loam. The subsoil is clay loam and clay. Below the subsoil to a depth of 60 inches the material is loam and clay loam.

Renohill soils are on hill slopes. These soils are moderately deep and well drained. They formed in calcareous, clayey material derived dominantly from interbedded mudstone, shale, and sandstone. The surface layer is loam. The subsoil is clay loam. Below this to a depth of 20 to 40 inches the material is clay loam. Weathered shale is at a depth of 20 to 40 inches

Of minor extent are Haverson soils on flood plains and low terraces, Bresser and Stoneham soils on hill slopes, ridges, and knobs, and Ustic Torriorthents, loamy, on eroded hill slopes.

The soils in this map unit are used mainly for grazing, as pasture, and for crops. They are also used for community development.

4. Critchell-Lavate-Rednun

Nearly level to moderately steep, deep, well drained, loamy and clayey soils that formed in reddish material derived from sedimentary rocks

This map unit is in the central and southeastern parts of the survey area. The soils are mainly on fans, high terraces, and hill slopes. Slope is 0 to 30 percent. The vegetation is mainly grasses and forbs. Elevation is 5,200 to 6,500 feet. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

This map unit makes up about 2 percent of the survey area. It is about 35 percent Critchell soils, 20 percent Lavate soils, and 15 percent Rednun soils. The remaining 30 percent is soils of minor extent, Rock outcrop, and Urban land.

Critchell soils are on fans, hill slopes, and terraces. These soils are deep and well drained. They formed in reddish, loamy, and gravelly material derived dominantly from sedimentary rocks. The surface layer is gravelly sandy loam. The subsoil is gravelly sandy clay loam. The substratum to a depth of 60 inches is gravelly sandy loam and gravelly coarse sandy loam.

Lavate soils are on fans, terraces, and hill slopes. These soils are deep and well drained. They formed in reddish, loamy material derived dominantly from sedimentary rocks. The surface layer is sandy loam. The subsoil is sandy clay loam. The substratum to a depth of 60 inches is sandy loam.

Rednun soils are on fans, high terraces, and hill slopes. These soils are deep and and well drained. They formed in reddish, clayey material derived dominantly from sedimentary rocks. The surface layer is clay loam. The subsoil is clay. The substratum to a depth of 60 inches is sandy clay loam.

Of minor extent are Hargreave, Bernal, and Chapin Variant soils on ridges, fans, and hill slopes; Ascalon soils on fans; Argiustolls on hill slopes; Rock outcrop; Haverson soils on flood plains and low terraces; and Urban land.

The soils making up this map unit are used mainly for community development, as pasture, and for grazing. They are also used for crops.

Dominantly well drained, cobbly and gravelly soils on fans, terraces, hill slopes, and stable summits

The soils in this group make up about 3 percent of the survey area. The soils are nearly level to steep. The native vegetation is mainly grasses and shrubs. Elevation is 5,600 to 6,800 feet. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

The soils are deep and well drained. They formed in cobbly and gravelly alluvium derived dominantly from mixed sources.

Most areas of these soils are used for grazing. A few areas are used for community development.

5. Flatirons-Veldkamp

Nearly level to steep, deep, well drained, cobbly and gravelly soils that formed in mixed alluvium

This map unit is in the northern and central parts of the survey area. The soils are mainly on fans, high terraces, hill slopes, and stable summits. Slope is 0 to 50 percent. The vegetation is mainly grasses and shrubs. Elevation is 5,600 to 6,800 feet. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

This map unit makes up about 3 percent of the survey area. It is about 70 percent Flatirons soils and similar soils and 20 percent Veldkamp soils and similar soils. The remaining 10 percent is soils of minor extent.

Flatirons soils are on high terraces, fans, stable summits, and hill slopes. These soils are deep and well drained. They formed in cobbly, stony, and gravelly loamy alluvium. The surface layer is mainly very cobbly sandy loam. The subsoil is very gravelly and is clay, sandy clay, or clay loam. Below the subsoil, very gravelly sandy clay loam extends to a depth of 60 inches or more.

Veldkamp soils are on stable summits, fans, and high terraces. These soils are deep and well drained. They formed in cobbly, gravelly, clayey, and loamy material derived dominantly from mixed alluvium. The surface layer is very cobbly sandy loam. The subsoil is very cobbly clay loam or very cobbly clay. Below the subsoil, very cobbly sandy loam extends to a depth of 60 inches or more.

Of minor extent are Leyden and Primen soils on hill slopes and Rooney soils on ridges and hill slopes.

Most areas are used for grazing. A few areas are used for community development.

Dominantly well drained, stony, cobbly, or clayey soils on mesa tops, stable summits, and hill slopes

The soils in this group are in two map units, which make up about 3 percent of the survey area. The soils are nearly level to very steep. The native vegetation is mainly grasses and shrubs. Elevation is 5,600 to 6,500 feet. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

The soils in this group are deep to shallow. They are well drained. They formed in stony, cobbly, or clayey materials derived dominantly from mixed sources.

The soils are used mainly as habitat for wildlife and for grazing. They are also used for community development and recreation.

6. Leyden-Lavina

Nearly level to very steep, moderately deep to shallow, well drained, stony and clayey soils that formed in material derived from volcanic rock and shale

This map unit is in the central part of the survey area. The soils are mainly on hill slopes and mesa tops. Slope is 0 to 60 percent. The vegetation is mainly grasses and shrubs. Elevation is 5,600 to 6,500 feet. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

This map unit makes up about 1 percent of the survey area. It is about 45 percent Leyden soils and similar soils and 30 percent Lavina soils and similar soils. The remaining 25 percent is mainly Rock outcrop; volcanic rock is on shoulders and hill slopes, and shale is on back slopes.

Leyden soils are on hill slopes. They are moderately deep and well drained. They formed in gravelly, cobbly, and clayey material derived dominantly from mixed sources. The surface layer is extremely stony clay loam. The subsoil is gravelly clay loam and gravelly clay. Weathered shale is at a depth of 20 to 40 inches.

Lavina soils are on mesa tops and hill slopes. They are shallow and well drained. They formed in clayey alluvium and loess deposited over volcanic rock. The surface layer is loam. The subsoil is clay. Unweathered volcanic rock is at a depth of 8 to 20 inches.

The soils are used mainly for grazing and as habitat for wildlife. A few areas are used as a source of aggregate.

7. Nunn-Rooney-Leyden

Moderately sloping to very steep, deep, shallow, and moderately deep, well drained, clayey and cobbly soils that formed in material derived from sedimentary rocks

This map unit is in the southeastern part of the survey area. The soils are mainly on stable summits and hill slopes. Slope is 5 to 70 percent. The vegetation is mainly grasses and shrubs with some ponderosa pine. Elevation is 5,600 to 6,500 feet. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

This map unit makes up about 2 percent of the survey area. It is about 30 percent Nunn soils, 25 percent Rooney soils, and 15 percent Leyden soils. The remaining 30 percent is Rock outcrop and soils of minor extent.

Nunn soils are on stable summits and hill slopes. These soils are deep and well drained. They formed in clayey material derived dominantly from mudstone and shale. The surface layer is clay loam. The subsoil is clay and clay loam. It is underlain to a depth of 60 inches or more by clay loam.

Rooney soils are on hill slopes. These soils are shallow and well drained. They formed in cobbly and gravelly colluvium and residuum derived dominantly from conglomerate and sandstone. The surface layer is extremely cobbly sandy loam. Below this to a depth of 4

to 20 inches the soil material is very gravelly sandy loam. Weathered sandstone and conglomerate are at a depth of 4 to 20 inches.

Leyden soils are on hill slopes. These soils are moderately deep and well drained. They formed in gravelly, cobbly, and clayey material derived from mixed sources. The surface layer is cobbly clay loam. The subsoil is gravelly clay loam and gravelly clay. Weathered shale is at a depth of 20 to 40 inches.

Of minor extent are Rock outcrop, Primen soils on hill slopes, and Haverson and Paymaster soils and Torrifluvents, very gravelly, on low terraces and flood plains.

The soils in this map unit are used mainly as habitat for wildlife, for grazing, and as recreation areas. In a few places they are used for community development.

Dominantly well drained, stony and loamy soils on hogbacks and hill slopes

The soils in this group make up about 3 percent of the survey area. The soils are moderately steep to very steep. The native vegetation is mainly shrubs, trees, and grasses. Elevation is 5,600 to 6,500 feet. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

The soils are shallow to deep and are well drained. They formed in stony, loamy colluvium derived dominantly from sedimentary rocks.

In most places the soils are used as habitat for wildlife, as recreation areas, or as a source of clay. In a few places they are used for community development.

8. Argiustolls-Rock outcrop-Baller

Moderately steep to very steep, shallow to deep, well drained, stony and loamy soils that formed in colluvium derived from sedimentary rocks

This map unit is in the northern, central, and southeastern parts of the survey area. The areas are mainly on side slopes of mountains and hogbacks (fig. 2). Slope is 15 to 60 percent. The vegetation is mainly shrubs, trees, and grasses. Elevation is 5,600 to 6,500 feet. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

This map unit makes up about 3 percent of the survey area. It is about 30 percent Argiustolls, 25 percent Rock outcrop, and 10 percent Baller soils. The remaining 35 percent is soils of minor extent.

Argiustolls are on side slopes of hogbacks and ridges. These soils are shallow to deep and are well drained. They formed in stony, gravelly, and loamy colluvium and in residuum dominantly of sedimentary rocks. The soils are loamy and have varying percentages of rock fragments throughout.

Rock outcrop consists of areas of exposed sedimentary rock.

Baller soils are on the dip slope of hogbacks. These soils are shallow and well drained. They formed in stony, loamy material derived dominantly from sandstone. The surface layer is very stony sandy loam. It is underlain to a depth of 10 to 20 inches by very stony sandy loam. Unweathered sandstone is at a depth of 10 to 20 inches.

Of minor extent in this map unit are Ustorthents at a higher elevation and Ascalon, Lavate, and Bernal soils on hill slopes.

In most places the soils are used as habitat for wildlife, for recreation, or as a source of clay. In a few places they are used for community development.

Dominantly somewhat excessively drained and somewhat poorly drained, loamy, very gravelly, and sandy soils on flood plains and low terraces

The soils in this group make up about 2 percent of the survey area. The soils are nearly level. The native vegetation is mainly grasses and forbs. Elevation is 5,200 to 6,500 feet. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

The soils are deep and are somewhat excessively drained and somewhat poorly drained. They formed in alluvium derived dominantly from mixed sources.

In most places the soils are used as habitat for wildlife and for crops, pasture, and grazing. In a few places they are used for community development.

9. Alda-Torrifluvents, very gravelly

Nearly level, deep, somewhat excessively drained and somewhat poorly drained, loamy, very gravelly, and sandy soils that formed in mixed alluvium

This map unit is within the eastern part of the survey area. The soils are mainly on flood plains, alluvial valley floors, and low terraces. Slope is 0 to 3 percent. The vegetation is mainly grasses and forbs. Elevation is 5,200 to 6,500 feet. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

This map unit makes up about 2 percent of the survey area. It is about 50 percent Alda soils and similar soils and 30 percent Torrifluvents, very gravelly. The remaining 20 percent is soils of minor extent and other included areas.

Alda soils are on alluvial valley floors, low terraces, and flood plains. These soils are deep and somewhat poorly drained. They formed in alluvium derived dominantly from mixed sources. The soils are stratified loam and sandy loam and are underlain by sand and gravel at a depth of 20 to 40 inches.

Figure 2.—A typical area of the Argiustolls-Rock outcrop-Baller map unit.

Torrifluvents, very gravelly, are on flood plains and low terraces. These soils are deep and somewhat excessively drained. They formed in stratified sandy and gravelly alluvium derived dominantly from mixed sources. The soils are stratified very gravelly loamy sand and very gravelly sand throughout.

Of minor extent are Haverson, Nunn Variant, and Englewood soils on low terraces and flood plains, Gravel pits on low terraces, Arvada soils on low terraces below Standley Lake, and Urban land.

The soils in this map unit are used mainly as habitat for wildlife and for crops, pasture, and grazing. They are also used for community development.

Dominantly somewhat excessively drained and well drained, sandy and loamy soils on high terraces and hill slopes

The soils in this group are in one map unit, which makes up about 1 percent of the survey area. The soils are nearly level to strongly sloping. The native vegetation is mainly grasses and forbs. Elevation is 5,400 to 6,500 feet. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

The soils are deep and are somewhat excessively drained and well drained. They formed in eolian sand and sandy loess derived dominantly from mixed sources.

The soils are used mainly for grazing. In a few areas they are used for crops and for community development.

10. Blakeland-Truckton

Nearly level to strongly sloping, deep, somewhat excessively drained and well drained, sandy and loamy soils that formed in eolian sand and sandy loess

This map unit is in the southeastern part of the survey area. The soils are mainly on high terraces and hill slopes. Slope is 0 to 15 percent. The vegetation is mainly grasses and forbs. Elevation is 5,400 to 6,500 feet. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days.

This map unit makes up about 1 percent of the survey area. It is about 50 percent Blakeland soils and 35 percent Truckton soils and similar soils. The remaining 15 percent is soils of minor extent.

Blakeland soils are on high terraces and hill slopes. These soils are deep and somewhat excessively drained. They formed in eolian sand derived from mixed sources. The surface layer is loamy sand. The layers below the surface layer to a depth of 60 inches or more are also loamy sand.

Truckton soils are on high terraces and hill slopes. These soils are deep and well drained. They formed in sandy loess derived dominantly from mixed sources. The surface layer is sandy loam. The subsoil is sandy loam. It is underlain to a depth of 60 inches or more by loamy sand.

Of minor extent are Haverson soils on low terraces and Renohill and Manzanola soils on hill slopes.

The soils in this map unit are used mainly for grazing. In a few places they are used for crops and for community development.

Dominantly well drained, stony, gravelly, loamy, and sandy soils on mountain side slopes and stable summits and in drainageways

The soils in this group are in four map units, which make up about 58 percent of the survey area. The soils are gently sloping to very steep, The native vegetation is mainly coniferous trees, shrubs, and grasses. Elevation is 6,500 to 10,000 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 47° F, and the average frost-free season is 55 to 125 days.

The soils are shallow to deep and are well drained. They formed in stony, gravelly, loamy, and sandy material derived dominantly from igneous and metamorphic rocks.

The soils are used mainly as woodland, habitat for wildlife, and recreation areas and for grazing. They are also used for community development.

11. Ratake-Lininger

Moderately sloping to very steep, shallow to moderately deep, well drained, stony, gravelly, and loamy soils that formed in material derived from igneous and metamorphic rocks

This map unit is in the northern, central, and southern parts of the survey area. The soils are mainly on mountain side slopes and stable summits (fig. 3). Slope is 5 to 60 percent. The vegetation is mainly coniferous trees, grasses, and shrubs. Elevation is 6,500 to 7,800 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days.

This unit makes up about 17 percent of the survey area. It is about 40 percent Ratake soils and similar soils and 15 percent Lininger soils and similar soils. The remaining 45 percent is soils of minor extent and Rock outcrop.

Ratake soils are on mountain side slopes and summits. These soils are shallow and well drained. They formed in stony, gravelly, and loamy material derived dominantly from igneous and metamorphic rocks. The surface layer is stony sandy loam or very stony sandy loam. It is underlain to a depth of 10 to 20 inches by very gravelly sandy loam. Weathered bedrock is at a depth of 10 to 20 inches.

Lininger soils are on mountain side slopes and stable summits. These soils are moderately deep and well drained. They formed in stony, gravelly, and loamy material derived dominantly from igneous and metamorphic rocks. The surface layer is stony sandy loam or sandy loam. The subsoil is sandy clay loam. Weathered bedrock is at a depth of 20 to 40 inches.

Of minor extent are Grimstone, Peeler, Legault, and Hiwan soils on north-facing side slopes, Rock outcrop on shoulders and back slopes, Venable soils on low terraces, and Curecanti soils on foot slopes and fans.

The soils in this map unit are used mainly as woodland, habitat for wildlife, and recreation areas and for grazing. They are also used for community development.

12. Herbman-Hiwan

Moderately sloping to very steep, shallow, well drained, stony, gravelly, loamy, and sandy soils that formed in material derived from igneous and metamorphic rocks

This map unit is in the northwestern, western, and southwestern parts of the survey area. The soils are mainly on mountain side slopes and ridges. Slope is 5 to 70 percent. The vegetation is mainly coniferous trees, shrubs, and grasses. Elevation is 7,600 to 10,000 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season is 55 to 75 days.

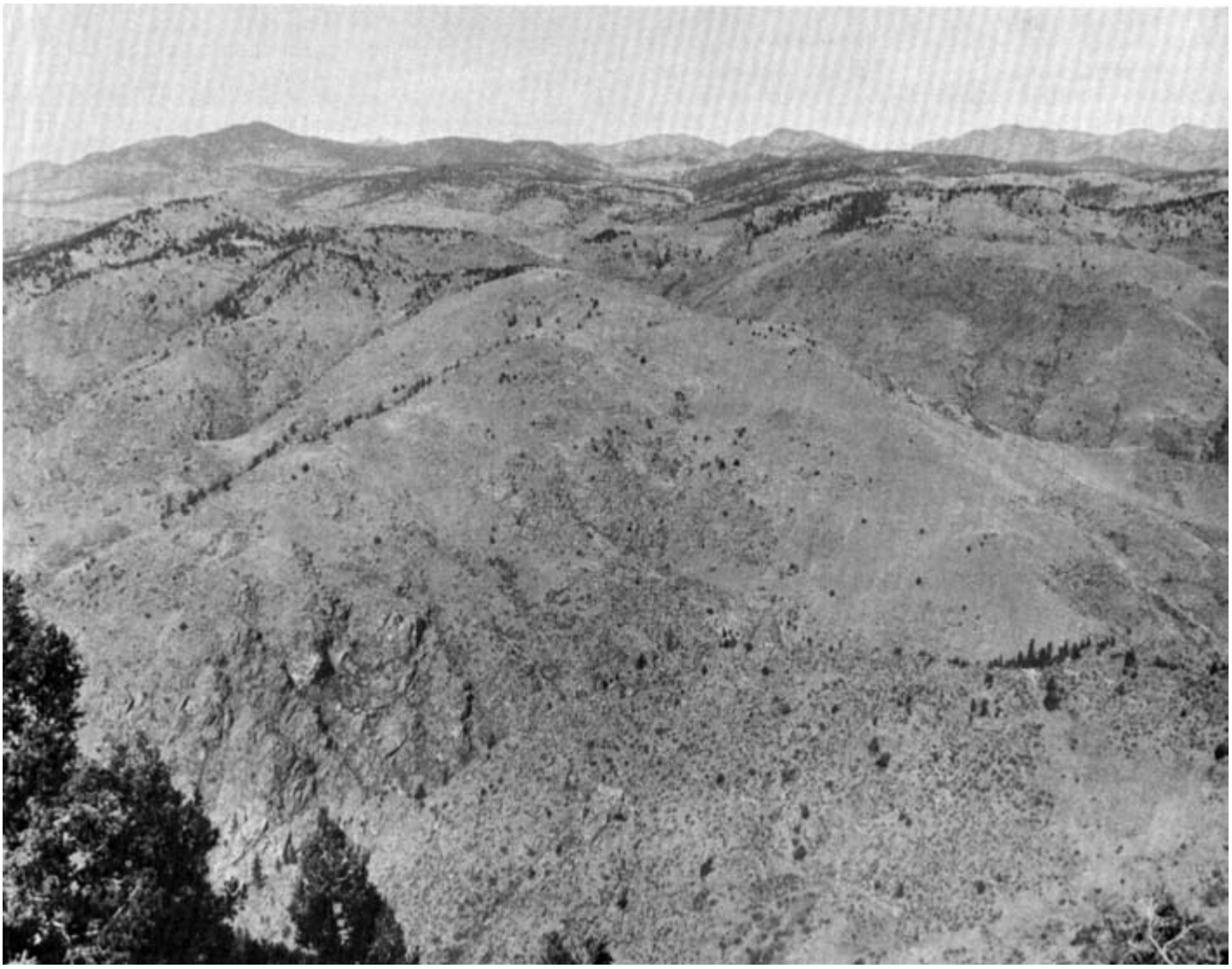


Figure 3.—An area (foreground) of the Ratake-Lininger map unit.

This map unit makes up about 33 percent of the survey area. It is about 30 percent Herbman soils and similar soils and 20 percent Hiwan soils and similar soils. The remaining 50 percent is Rock outcrop and soils of minor extent.

Herbman soils are on mountain side slopes and ridges. These soils are shallow and well drained. They formed in stony, gravelly, and loamy material derived dominantly from igneous and metamorphic rocks. The surface layer is very stony sandy loam or stony sandy loam. It is underlain by very gravelly sandy loam. Weathered soft bedrock is at a depth of 7 to 20 inches.

Hiwan soils are on mountain side slopes and ridges. The slopes mainly face north. These soils are shallow and well drained. They formed in stony, gravelly, and sandy material derived dominantly from igneous and metamorphic rocks. The surface layer is very stony loamy sand or stony loamy sand. It is underlain by very gravelly loamy sand. Weathered hard bedrock is at a depth of 5 to 20 inches.

Of minor extent are Rock outcrop on ridges and back slopes, Grimstone and Peeler soils on north-facing mountain side slopes, Kittredge and Troutdale soils on mountain side slopes and in drainageways, and Venable soils on low terraces.

The soils in this map unit are used mainly as woodland, for grazing, as habitat for wildlife, and as recreation areas. They are also used for community development.

13. Resort-Raleigh

Strongly sloping to very steep, shallow, somewhat excessively drained, gravelly, loamy soils that formed in grus of the Pikes Peak Granite

This map unit is in the southern part of the survey area. The soils are mainly on mountain side slopes and summits. Slope is 9 to 70 percent. The vegetation is mainly coniferous trees, shrubs, and grasses. Elevation is 6,500 to 7,800 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days.

This map unit makes up about 4 percent of the survey area. It is about 50 percent Resort soils and similar soils and 25 percent Raleigh soils. The remaining 25 percent is soils of minor extent and Rock outcrop.

Resort soils are on mountain side slopes and summits. These soils are shallow and somewhat excessively drained. They formed in gravelly material derived from grus of the Pikes Peak Granite. The surface layer is very gravelly sandy loam. The subsoil is very gravelly sandy loam. Below that, to a depth of 10 to 20 inches, there is very gravelly loamy sand. Weathered granite is at a depth of 10 to 20 inches.

Raleigh soils are on mountain side slopes and summits. The slopes commonly face north. These soils are shallow and somewhat excessively drained. They formed in gravelly material derived from grus of the Pikes Peak Granite. The surface layer is very gravelly sandy loam or stony sandy loam. The subsoil is very gravelly sandy loam. Below that, to a depth of 10 to 20 inches, there is extremely gravelly sandy loam. Weathered granite is at a depth of 10 to 20 inches.

Of minor extent are Garber Variant soils on toe slopes and fans, Rock outcrop on ridges and back slopes, and Rosane and Venable soils on low terraces and flood plains.

The soils in this map unit are used mainly as woodland, for grazing, as habitat for wildlife, and as recreation areas. They are also used for community development.

14. Raleigh-Earcree Variant

Gently sloping to very steep, shallow to deep, somewhat excessively drained and well drained, gravelly, loamy soils that formed in grus of the Pikes Peak Granite

This map unit is in the southwestern part of the survey area. The soils are mainly on mountain side slopes, stable summits, and fans and in drainageways. Slope is 2 to 70 percent. The vegetation is mainly coniferous trees, shrubs, and grasses. Elevation is 8,000 to 10,000 feet. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days.

This map unit makes up about 4 percent of the survey area. It is about 90 percent Raleigh soils and 5 percent Earcree Variant soils. The remaining 5 percent is Rock outcrop and soils of minor extent.

Raleigh soils are on mountain side slopes and stable summits. The soils are shallow and somewhat excessively drained. They formed in gravelly material derived from grus of the Pikes Peak Granite. The surface layer is very gravelly sandy loam or stony sandy loam. The subsoil is very gravelly sandy loam. It is underlain to a depth of 10 to 20 inches by extremely gravelly sandy loam. Weathered granite is at a depth of 10 to 20 inches.

Earcree Variant soils are in drainageways and on fans. These soils are deep and well drained. They formed in gravelly and loamy alluvium and colluvium derived dominantly from grus of the Pikes Peak Granite. The surface layer is very gravelly sandy loam. The subsoil is very gravelly sandy loam. The layers below the subsoil to a depth of 60 inches are also very gravelly sandy loam.

Of minor extent are Rock outcrop on ridges and back slopes and Venable and Rosane soils on low terraces and flood plains.

The soils in this map unit are used mainly as woodland, for grazing, as habitat for wildlife, and as recreation areas. They are also used for community 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, Nunn clay loam, 2 to 5 percent slopes, is one of several phases in the Nunn series.

Some map units in the survey area are made up of two or more major soils. Such a map unit is called a soil complex.

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. Manzanola-Renohill-Stoneham complex, 9 to 15 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. Pits, clayey, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

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

Soil Descriptions

1—Alda loam, 0 to 2 percent slopes. This is a deep, somewhat poorly drained soil on alluvial valley floors, low terraces, and flood plains. It formed in calcareous, stratified alluvium underlain by sand and gravel derived from mixed sources. The average annual precipitation is 13 to 17 inches, and the average annual air temperature is 47° F. The average frost-free season ranges from 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is mildly alkaline, dark grayish brown to grayish brown loam about 11 inches thick. The layer below that is moderately alkaline, light brownish gray loam about 6 inches thick. The underlying material in the upper 8 inches is moderately alkaline, light gray, mottled loam; in the next 4 inches it is moderately alkaline, light gray, mottled sandy loam; and in the lower part to a depth of 60 inches it is mildly alkaline, mottled loamy sand over neutral very gravelly loamy sand.

Included with this soil in mapping are small areas of Loveland and Loveland Variant soils on low terraces and Niwot soils on abandoned meander belts. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage of the map unit.

Permeability of this Alda soil is moderate to moderately rapid to a depth of 20 to 40 inches and very rapid below that. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are slight hazards. A seasonal high water table is at a depth of 24

to 36 inches in spring and summer. This soil is occasionally flooded for brief periods in spring and summer. The depth to sand and gravel ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume in the solum and 35 to 60 percent in the underlying material.

This soil is used mainly as pasture and habitat for wildlife. In a few areas it is used for crops and community development.

The native vegetation is mainly switchgrass, indiangrass, big bluestem, and western wheatgrass. The average annual production of air-dry vegetation ranges from 3,000 to 4,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The main concerns in establishing and maintaining grasses, shrubs, trees, and garden plants on this soil are wetness and flooding. Species that tolerate wetness should be selected for planting. Structures to divert runoff from the plantings are needed. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Supplemental irrigation is needed during dry periods.

Urban land is covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Runoff on Urban land is rapid; therefore, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The Alda soil is limited for community development by wetness, flooding, and seepage. Drainage and structures to divert runoff are needed where buildings and roads are constructed. Effluent from absorption fields can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Such areas can be used as greenbelts and parks planted with native vegetation and other adapted plants.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil erosion, maintaining or improving soil fertility, and reducing wetness. Tile drainage and open drainage ditches are necessary to lower the water table and minimize wetness. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain soil fertility. Land leveling is needed in some areas for the uniform distribution of water.

Management concerns in areas of nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the surface layer are of vital importance in protecting the soil from erosion and in improving tilth and conserving moisture.

This soil is in capability subclasses IIw, irrigated, and IIIs, nonirrigated; in the Wet Meadow range site; and in plant adaptability group PF-4.

2—Alda-Niwot complex, 0 to 2 percent slopes. The areas of this complex are on alluvial valley floors, abandoned meander belts, and low terraces. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,200 feet.

Alda soil makes up 45 percent of the complex, and Niwot soil makes up 40 percent. The Alda soil is on alluvial valley floors and higher lying low terraces, and the Niwot soil is on abandoned meander belts. The areas of these soils are so intricately intermingled that it was not practical to map the soils separately.

Included in mapping are small areas of Loveland and Loveland Variant soils on low terraces. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Alda soil is deep and somewhat poorly drained. It formed in calcareous, stratified alluvium underlain by sand and gravel derived from mixed sources.

Typically, the surface layer is mildly alkaline, dark grayish brown to grayish brown loam about 11 inches thick. The layer below that is moderately alkaline, light brownish gray loam about 6 inches thick. The underlying material in the upper 8 inches is moderately alkaline, light gray, mottled loam; in the next 4 inches it is moderately alkaline, light gray, mottled sandy loam; and in the lowermost part to a depth of 60 inches it is mildly alkaline, mottled loamy sand over neutral very gravelly loamy sand.

Permeability of the Alda soil is moderate to moderately rapid to a depth of 20 to 40 inches and very rapid below that. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are slight hazards. A seasonal high water table is at a depth of 24 to 36 inches in spring and summer. In some areas the soil has been artificially drained. This soil is subject to rare, brief periods of flooding in spring and summer. The depth to sand and gravel ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume in the solum and 35 to 60 percent in the underlying material.

The Niwot soil is deep and somewhat poorly drained. It formed in calcareous, stratified, loamy alluvium over sandy and gravelly alluvium derived from mixed sources.

Typically, the surface layer is mildly alkaline, dark grayish brown to grayish brown gravelly loam about 13 inches thick. The underlying material to a depth of 60 inches is neutral, light yellowish brown very gravelly sand.

Permeability of the Niwot soil is moderate to a depth of 10 to 20 inches and very rapid below that. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. A seasonal high water table is at a depth of 6 to 18 inches in spring and summer. In some areas the soil has been artificially drained. This soil is subject to rare, brief periods of flooding in spring and summer. The depth to sand and gravel ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 15 to 35 percent of the volume in the solum and 35 to 60 percent in the underlying material.

These soils are used mainly for community development and as pasture and habitat for wildlife. In a few areas they are used for crops.

The native vegetation is mainly switchgrass, indiangrass, big bluestem, and western wheatgrass. The average annual production of air-dry vegetation ranges from 3,000 to 4,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Heavy infestations of undesirable plants can be eliminated by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, in poor tilth, and in excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The main concerns in establishing and maintaining grasses, shrubs, trees, and garden plants on these soils are wetness and flooding. Plants that tolerate wetness should be selected for planting. Structures to divert runoff from the plantings are needed. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The soils making up this complex are limited for community development by wetness, flooding, and seepage. Drainage and structures to divert runoff are needed to protect buildings and roads. Effluent from absorption fields can surface downslope and create a health hazard. In some areas the soils can be used as greenbelts and parks planted with native vegetation and other adapted plants.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil erosion, maintaining or improving soil fertility, and reducing wetness. Tile drainage and open drainage ditches are necessary to lower the water table and minimize wetness. Applications of manure and commercial fertilizer that contains nitrogen and phosphorus are needed to maintain fertility. Land leveling is needed in some areas to achieve uniform distribution of water.

Management concerns in areas of nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the surface layer are essential in protecting the soils from erosion and in improving tilth and conserving moisture.

The soils are in capability subclass IIIs, irrigated and nonirrigated, in the Wet Meadow range site, and in plant adaptability group PF-4.

3—Allens Park Variant-Ratake-Rock outcrop complex, 30 to 50 percent slopes. The areas of this complex are on north-facing mountain side slopes and on summits. The average annual precipitation is 17 to 20 inches, and the average annual air temperature is 43° to 47° F. The average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Allens Park Variant soil makes up 35 percent of this complex, Ratake soil makes up 30 percent, and Rock outcrop makes up 20 percent. Allens Park Variant soil is on side slopes that have an overstory of coniferous trees. Ratake soil is on side slopes and summits that have a plant cover of shrubs, grasses, and forbs. Rock outcrop is on shoulders and in places where intrusive dikes reach the surface. These soils and Rock outcrop are in such intricately intermingled areas that it was not practical to map the soils separately at the scale used in mapping.

Included in mapping are small areas of Cathedral soils on mountain side slopes and ridges, Curecanti soils on fans and foot slopes, and Lininger and Trag soils on side slopes and toe slopes. The included soils make up about 15 percent of the total acreage.

The Allens Park Variant soil is moderately deep and well drained. It formed in stony, gravelly, and loamy material derived from weathered metamorphic and igneous rocks.

Typically, the surface is covered by a mat about 1 inch thick of partly decomposed needles, twigs, and leaves. The surface layer is neutral, dark grayish brown stony sandy loam about 2 inches thick. The subsurface layer is

slightly acid, pale brown gravelly loamy sand 5 inches thick. The subsoil is slightly acid, brown and strong brown sandy clay loam 25 inches thick. Soft bedrock is at a depth of 32 inches.

Permeability of the Allens Park Variant soil is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is moderate. Rock fragments make up 5 to 35 percent of the volume.

The Ratake soil is shallow and well drained. It formed in stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark brown very stony sandy loam about 3 inches thick. The subsoil is neutral, dark brown very gravelly sandy loam 9 inches thick. Soft bedrock is at a depth of 12 inches.

Permeability of the Ratake soil is moderate. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

Rock outcrop consists of exposed igneous and metamorphic bedrock, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces.

The soils in this complex are used mainly as woodland, as habitat for wildlife, and as recreation areas. In a few places they are used for community development.

The native vegetation on the Allens Park Variant soil is mainly an overstory of ponderosa pine and Douglas-fir. There are also scattered grasses and forbs. The Ratake soil has scattered ponderosa pines and an understory of mountainmahogany, grasses, and forbs. The average annual production of air-dry vegetation ranges from 700 to 1,200 pounds per acre. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Excavated areas must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, depth to rock, and large stones. A mulch of plant residue helps to reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface in disturbed areas for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the soils in this complex for homesite development are the slope, depth to rock, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. The steep slopes are a concern in installing septic tank absorption fields. Absorption lines need to be installed on the contour. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. In constructing roads and streets in residential communities, the same practices are needed that help control erosion on access roads in wooded areas. Preserving the existing plant cover during construction helps control erosion.

This complex is in capability subclass VIIe. The Allens Park Variant soil is in the Ponderosa Pine woodland group and in plant adaptability group M-5. The Ratake soil is in the Stony Loam range site and in plant adaptability group M-4.

4—Argiustolls, loamy, 15 to 30 percent slopes. Argiustolls, loamy, are shallow to moderately deep, well drained soils on hill slopes and ridge crests that are underlain by steeply dipping sedimentary formations. The soils formed in gravelly and stony, loamy colluvium and in residuum dominantly of sedimentary rocks. The average annual precipitation is 13 to 17 inches, and the average annual air temperature is 47° F. The average frost-free season ranges from 126 to 142 days. Elevation is 5,600 to 6,500 feet.

The soils vary in depth, color, amount of rock fragments, and texture. Generally, the soils have a dark surface layer of stony sandy loam or gravelly sandy loam and a subsoil of sandy clay loam or loam. Soil characteristics vary according to the geologic formation which the soils overlie and the specific setting.

Included in mapping are small areas of Rock outcrop on ridge crests; Ascalon and Lavate soils on fans and hill slopes; soils, on stable summits, that have slopes of less than 15 percent; and shallow soils, on ridge crests, that have no accumulation of clay in the subsoil. The included areas make up about 15 percent of the total acreage.

Permeability of the Argiustolls, loamy, is moderately rapid to moderately slow. The available water capacity is low to moderate. The effective rooting depth is 10 to 40 inches. Runoff is rapid, and water erosion is a severe

hazard. Soil blowing is a slight hazard. The depth to bedrock ranges from 10 to 40 inches. The shrink-swell potential is low to moderate. Rock fragments make up 5 to 60 percent of the volume.

The soils in this map unit are used mainly for grazing, as habitat for wildlife and as recreation areas, and for community development. In some places the soils are excavated and the bedrock is mined as a source of clay.

The native vegetation is mainly sideoats grama, little bluestem, mountainmahogany, and juniper. The average annual production of air-dry vegetation ranges from 300 to 700 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Mechanical treatment is not practical because the surface is stony and the slopes are steep.

The main concerns in establishing and maintaining grasses, shrubs, trees and garden plants on these soils are slope, depth to rock, and large stones. Planting on the contour helps to conserve moisture and reduce erosion. A mulch is necessary to establish plantings on steep cut and fill slopes. Pebbles and cobbles in disturbed areas should be removed from the surface for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

These soils are limited for homesite development by depth to rock and slope. The deep cuts needed to provide a sufficiently level building site can expose bedrock. The hazard of erosion is increased if the soil is left exposed during construction. The steepness of slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from absorption fields can surface downslope and create a health hazard.

Argiustolls, loamy, are in capability subclass VIe, in the Shallow Foothill range site, and in plant adaptability group F-7.

5—Argiustolls-Rock outcrop complex, 15 to 60 percent slopes. The areas of this complex are on hill slopes and escarpments. They are mainly on the hogback of the Dakota and Morrison Formations and on toe slopes of the mountain front. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

This complex is 65 percent Argiustolls and 20 percent Rock outcrop. Argiustolls are on hill slopes, and Rock outcrop is on ridge crests and shoulders and in eroded areas. The areas of Argiustolls and of Rock outcrop are so intricately intermingled that it was not practical to map them separately at the scale used in mapping.

Included in mapping are small areas of Ascalon soils on hill slopes and fans and small areas of Urban land. In a few of the mapped areas there is no Rock outcrop. The included soils and Urban land make up about 15 percent of the total acreage of the complex.

The Argiustolls are shallow to deep and well drained. They formed in stony, loamy colluvium derived dominantly from sedimentary rocks.

The Argiustolls are highly variable in depth, color, percent of rock fragments, and reaction. However, the surface layer commonly is dark colored stony sandy loam or very stony sandy loam. The subsoil commonly is very gravelly sandy loam or very gravelly sandy clay loam.

Permeability of the Argiustolls is moderately rapid. The available water capacity is low to high. The effective rooting depth is 10 to 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft or hard bedrock ranges from 10 to 60 inches or more. The shrink-swell potential commonly is low. Rock fragments make up 10 to 70 percent of the volume.

Rock outcrop consists of areas where sedimentary rocks are exposed and talus and large boulders are on the surface. In areas of Rock outcrop, runoff is rapid, but water erosion is only a slight to moderate hazard.

In most places, the soils in this complex are used mainly as recreation areas, as habitat for wildlife, as pasture, and for grazing. In a few places, they are used for community development.

The native vegetation is mainly Rocky Mountain juniper, mountainmahogany, Griffith wheatgrass, and big bluestem. The average annual production of air-dry vegetation ranges from 900 to 1,500 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The soils are difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. The steepness of slopes limits access by livestock and promotes overgrazing of the less sloping areas. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on these soils because of slope, depth to rock, and large stones. A mulch of plant residue reduces runoff, improves soil tilth, and conserves moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is necessary in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the

surface in disturbed areas for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land in this complex are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The soils in this complex are limited for community development by slope, depth to rock, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Structures to divert runoff from buildings and roads are needed. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Effluent from absorption fields can surface downslope and create a health hazard. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be advantageously used as open space or as parks planted with native vegetation and other adapted plants.

Argiustolls are in capability subclass VIIe, in the Rocky Foothill range site, and in plant adaptability group F-6. Rock outcrop is in capability class VIII.

6—Arvada clay loam, 0 to 2 percent slopes. This is a deep, well drained soil on low terraces and flood plains. This soil formed in calcareous, clayey alluvium derived dominantly from weathered shale and mudstone. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is moderately alkaline, grayish brown clay loam about 6 inches thick. The subsoil in the upper 6 inches is strongly alkaline, grayish brown clay. In the lower 31 inches it is strongly alkaline, light yellowish brown clay and clay loam. The substratum to a depth of 60 inches is strongly alkaline, pale brown clay loam.

Included in this map unit are small areas of Manzanola soils on hill slopes, Nunn soils on high terraces, Nunn Variant soils on terraces, and Renohill soils on hill slopes and ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage of the map unit.

Permeability of this Arvada soil is slow. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. This soil is subject to flooding for brief periods in spring and summer. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume. The soil is affected by salinity and alkalinity.

This soil is used mainly for grazing. In a few places it is used for community development and irrigated crops.

The native vegetation is mainly alkali sacaton, western wheatgrass, blue grama, and saltgrass. The average annual production of air-dry vegetation ranges from 500 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. This soil is difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on this soil because of excess salts and sodium. Only those plants that tolerate saline-alkaline conditions should be selected for planting. Amendments, fertilizer, and the leaching of salts help the plants to survive and become established. A mulch of plant residue helps reduce soil blowing and runoff, improve soil tilth, and conserve moisture. Tillage is difficult because of the clay loam surface layer and clayey subsoil.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The Arvada soil is limited for community development by the shrink-swell potential, flooding, low strength, slow permeability, and corrosivity. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and also minimize the effects of shrinking and swelling. Structures to divert runoff are needed. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Special consideration of building materials is needed to forestall corrosion caused by the saline-alkaline condition. Some areas can be used as greenbelts or as parks planted with native vegetation and other adapted plants.

If this soil is used for irrigated crops, the main concerns in management are proper use of irrigation water, controlling soil erosion, maintaining or improving fertility, and reducing the saline-alkaline condition. The saline-alkaline condition restricts the choice of crops. Intensive management is required to reduce salinity and maintain soil productivity. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

On this soil, nonirrigated cropland generally produces minimal yields.

This soil is in capability subclasses IVs, irrigated, and VIs, nonirrigated, in the Salt Flat range site, and in plant adaptability group PF-3.

7—Ascalon sandy loam, 5 to 9 percent slopes. This is a deep, well drained soil on hill slopes and fans. It formed in calcareous, loamy material derived from mixed sources. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, grayish brown and dark grayish brown sandy loam about 7 inches thick. The subsoil in the upper 11 inches is mildly alkaline, brown sandy clay loam. In the lower 5 inches it is moderately alkaline, very pale brown sandy loam. The substratum to a depth of 60 inches is mildly alkaline and moderately alkaline, very pale brown sandy loam.

Included in mapping are small areas of Nunn soils on fans, soils that have a dark surface layer more than 20 inches thick and are in concave drainageways, Lavate and Critchell soils in areas adjacent to red sandstone and shale, and soils that have a stony or cobbly surface and are on the slopes of hogbacks. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Ascalon soil is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low to moderate. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing and as pasture and habitat for wildlife. In a few areas it is used for crops and community development.

The native vegetation is mainly western wheatgrass, blue grama, junegrass, and green needlegrass. The average annual production of air-dry vegetation ranges from 900 to 1,500 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

This soil is well suited to grasses, shrubs, trees, and garden plants. A mulch of plant residue helps to reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus help to maintain fertility. Planting on the contour helps to conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

This soil is well suited to homesite development. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve soil tilth. Applications of manure and commercial fertilizer that contains nitrogen and phosphorus are needed to maintain fertility. Land leveling is needed in some areas for the uniform application of water. Light, frequent applications of irrigation water are needed to prevent soil loss because of slope.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting soil from erosion, and maintaining fertility. Maintaining crop residue on or near the surface reduces runoff and soil blowing and helps to maintain soil tilth and the content of organic matter. Soil blowing can be reduced by planting crops in alternate strips and at right angles to the prevailing wind. Terraces and diversions help to reduce runoff and to conserve moisture.

This soil is in capability subclass IVe, irrigated and nonirrigated, in the Loamy Foothill range site, and in plant adaptability group F-3.

8—Ascalon sandy loam, 9 to 15 percent slopes. This is a deep, well drained soil on hill slopes and fans. It formed in calcareous, loamy material derived from mixed sources. The average annual precipitation is 13 to

17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, grayish brown and dark grayish brown sandy loam about 7 inches thick. The subsoil in the upper 11 inches is mildly alkaline, brown sandy clay loam. In the lower 5 inches it is moderately alkaline, very pale brown sandy loam. The substratum to a depth of 60 inches is mildly alkaline and moderately alkaline, very pale brown sandy loam.

Included with this soil in mapping are small areas of Nunn soils on fans; soils, in concave drainageways, that have a dark surface layer more than 20 inches thick; Lavate and Critchell soils in areas adjacent to red sandstone and shale; and soils, on the slopes of hogbacks, that have a stony or cobbly surface layer. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Ascalon soil is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is medium. Water erosion and soil blowing are moderate hazards. The shrink-swell potential is low to moderate. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, pasture, and wildlife habitat. In a few areas it is used for community development and crops.

The native vegetation is mainly western wheatgrass, blue grama, junegrass, and green needlegrass. The average annual production of air-dry vegetation ranges from 900 to 1,500 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the slope. A mulch of plant residue helps to reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus help to maintain fertility. Planting on the contour helps to conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The Ascalon soil is limited for use as homesites mainly by slope. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Revegetating disturbed areas around a construction site as soon as possible helps to control soil blowing. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

Most of the areas that are used for crops are severely eroded. Seeding them to grass helps check erosion.

This soil is in capability subclass VIe, in the Loamy Foothill range site, and in plant adaptability group F-3.

9—Baller-Rock outcrop complex, 15 to 50 percent slopes. The areas of this complex are on the hill slopes of hogbacks commonly associated with the Dakota Formation. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Baller soil makes up 60 percent of this complex, and Rock outcrop makes up 25 percent. Baller soil is on hill slopes, and Rock outcrop is on ridge crests and in eroded areas.

Included in mapping are small areas of the stony Midway soils, which are underlain by shale, and areas of Leyden, Standley, Ulm, and Denver soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Baller soil is shallow and well drained. It formed in noncalcareous, stony, loamy material derived from sandstone of the Dakota Formation.

Typically, the surface layer is neutral, dark grayish brown very stony sandy loam about 4 inches thick. The layer below that is neutral, dark grayish brown very stony sandy loam about 10 inches thick. Hard sandstone is at a depth of 14 inches.

Permeability of the Baller soil is moderately rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 50 percent of the volume.

Rock outcrop consists of exposures of sedimentary rocks, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard.

Most areas of this complex are used as habitat for wildlife, recreation areas, and pasture. A few areas are used as a source of decorative rock and clay and for community development.

The native vegetation is mainly Rocky Mountain juniper, mountainmahogany, Griffith wheatgrass, and sideoats grama. The average annual production of air-dry vegetation ranges from 300 to 700 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The Baller soil is difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. The steepness of slopes limits access by livestock and promotes overgrazing of the less sloping areas. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, depth to rock, and large stones. A mulch of plant residue helps to reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface in disturbed areas for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally are not subject to flooding.

The main limitations to use of the Baller soil for homesite development are slope, depth to rock, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Structures to divert runoff from buildings and roads are needed. If the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Effluent from absorption fields can surface downslope and create a health hazard. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as open space and parks planted with native vegetation and other adapted plants.

This complex is in capability subclass VIIe. The Baller soil is in the Shallow Foothill range site and in plant adaptability group F-7.

10—Baller Variant-Lavina-Rock outcrop complex, 5 to 15 percent slopes. The areas of this complex are on hill slopes and ridges associated with extrusive volcanic flows and dikes. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Baller Variant soil makes up 45 percent of this complex, Lavina soil makes up 25 percent, and Rock outcrop makes up 20 percent. Baller Variant soil is on hill slopes and ridges, Lavina soil is on hill slopes, and Rock outcrop is on shoulders and in eroded areas. The soils and Rock outcrop are in areas so intricately intermingled that it was not practical to map them separately at the scale used in mapping.

Included in mapping are small areas of Denver and Kutch soils on hill slopes and terraces. The included soils make up about 10 percent of the total acreage.

The Baller Variant soil is shallow and well drained. It formed in noncalcareous, gravelly, loamy material derived from volcanic rock.

Typically, the surface layer is neutral, dark yellowish brown stony sandy loam about 3 inches thick. The lower part of the surface layer is neutral, brown to dark brown very gravelly sandy loam 5 inches thick. Below that, there is a layer of soft, weathered bedrock 9 inches thick. Hard bedrock (latite) is at a depth of 17 inches.

Permeability of the Baller Variant soil is moderately rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 60 percent of the volume.

The Lavina soil is shallow and well drained. It formed in calcareous, clayey alluvium and loess deposited over hard volcanic rock.

Typically, the surface layer is neutral, brown to dark brown loam about 5 inches thick. The subsoil is neutral, dark yellowish brown clay about 7 inches thick. Hard bedrock (latite) is at a depth of 12 inches.

Permeability of the Lavina soil is slow. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 10 to 20 inches. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

Rock outcrop consists of exposures of volcanic rock, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard.

The soils in this complex are used mainly for grazing and as pasture, as habitat for wildlife, and as recreation areas. A few areas are used as a source of aggregate.

The native vegetation is mainly big bluestem, mountainmahogany, Griffith wheatgrass, and sideoats grama. The average annual production of air-dry vegetation ranges from 300 to 700 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Proper grazing use is needed to prevent depletion because the soils are difficult to revegetate. Seeding speeds the revegetation of areas depleted by heavy grazing or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of shallowness to rock, slope, and large stones. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted vegetation is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface in disturbed areas for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the soils for homesite development are the shallowness to rock, the slope, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. The effects of shrinking and swelling in areas of the Lavina soil can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This complex is in capability subclass VIs. The Baller Variant and Lavina soils are in the Shallow Foothill range site and in plant adaptability group F-7.

11—Baller Variant-Lavina-Rock outcrop complex, 15 to 30 percent slopes. The areas of this complex are on hill slopes and ridges associated with extrusive volcanic flows and dikes. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Baller Variant soil makes up 45 percent of this complex, Lavina soil makes up 25 percent, and Rock outcrop makes up 20 percent. Baller Variant soil is on hill slopes and ridges, Lavina soil is on hill slopes, and Rock outcrop is on shoulders and in eroded areas. The soils and Rock outcrop are in areas so intricately intermingled that it was not practical to map them separately at the scale used in mapping.

Included in mapping are small areas of Denver and Kutch soils on hill slopes and terraces. The included soils make up about 10 percent of the total acreage.

The Baller Variant soil is shallow and well drained. It formed in noncalcareous, gravelly, loamy material derived from volcanic rock.

Typically, the surface layer is neutral, dark yellowish brown stony sandy loam about 3 inches thick. The lower part of the surface layer is neutral, brown to dark brown very gravelly sandy loam 5 inches thick. Below that, there is a layer of soft, weathered bedrock 9 inches thick. Hard bedrock (latite) is at a depth of 17 inches.

Permeability of the Baller Variant soil is moderately rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 60 percent of the volume.

The Lavina soil is shallow and well drained. It formed in calcareous, clayey alluvium and loess deposited over hard volcanic rock.

Typically, the surface layer is neutral, brown to dark brown loam about 5 inches thick. The subsoil is neutral, dark yellowish brown clay 7 inches thick. Hard bedrock (latite) is at a depth of 12 inches.

Permeability of the Lavina soil is slow. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 10 to 20 inches. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

Rock outcrop consists of exposures of volcanic rock, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard.

The soils in this complex are used mainly for grazing and as pasture, as habitat for wildlife, and as recreation areas. A few areas are used as a source of aggregate.

The native vegetation is mainly big bluestem, mountainmahogany, Griffith wheatgrass, and sideoats grama. The average annual production of air-dry vegetation ranges from 300 to 700 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The soils are difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Seeding hastens the revegetation of areas depleted by heavy grazing or other disturbances. Small pastures commonly are severely overgrazed and

eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the shallowness to rock, slope, and large stones. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. The removal of pebbles and cobbles in disturbed areas is needed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to the use of the soils in this complex for homesite development are the shallowness to rock, the slope, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. The effects of shrinking and swelling in areas of the Lavina soil can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This complex is in capability subclass VIe. The Baller Variant and Lavina soils are in the Shallow Foothill range site and in plant adaptability group F-7.

12—Blakeland loamy sand, 0 to 9 percent slopes. This is a deep, somewhat excessively drained soil on high terraces, hill slopes, and fans. It formed in noncalcareous eolian sand derived from mixed sources. The average annual precipitation is 13 to 17 inches, and the average annual air temperature is 47° F. The average frost-free season ranges from 126 to 142 days. Elevation is 5,400 to 6,500 feet.

Typically, the surface layer is neutral, grayish brown and brown to dark brown loamy sand about 7 inches thick. The layer below that is neutral, brown to dark brown loamy sand about 12 inches thick. The underlying material to a depth of 60 inches is neutral and slightly acid, brown and light yellowish brown loamy sand.

Included in mapping are small areas of Truckton and Bresser soils in positions similar to those of the Blakeland soil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Blakeland soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a severe hazard. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing and as pasture and habitat for wildlife. In a few areas it is used for community development and for crops.

The native vegetation is mainly big bluestem, little bluestem, sand reedgrass, and blue grama. The average annual production of air-dry vegetation ranges from 1,000 to 1,400 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the sandy texture and by droughtiness. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and throughout the growing season.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally are not subject to flooding.

The main limitation to the use of the Blakeland soil for homesite development is seepage. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil erosion, and maintaining or improving fertility. Applications of manure and commercial fertilizer that contains nitrogen and phosphorus are needed to maintain fertility. Sprinkler irrigation is best suited to this soil because of the rapid intake rate.

This soil is in capability subclasses IVe, irrigated, and VIs, nonirrigated, in the Sandy Foothill range site, and in plant adaptability group F-4.

13—Blakeland loamy sand, 9 to 15 percent slopes. This is a deep, somewhat excessively drained soil on high terraces, hill slopes, and fans. It formed in noncalcareous eolian sand derived from mixed sources. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,400 to 6,500 feet.

Typically, the surface layer is neutral, grayish brown and brown to dark brown loamy sand about 7 inches thick. The layer below that is neutral, brown to dark brown loamy sand about 12 inches thick. The underlying material to a depth of 60 inches is neutral and slightly acid, brown and light yellowish brown loamy sand.

Included in mapping are small areas of Truckton and Bresser soils in positions similar to those of the Blakeland soil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Blakeland soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a severe hazard. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

In most places this soil is used for grazing and as pasture and habitat for wildlife. In a few areas it is used for community development.

The native vegetation is mainly big bluestem, little bluestem, sand reedgrass, and blue grama. The average annual production of air-dry vegetation ranges from 1,000 to 1,400 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the sandy texture, droughtiness, and the slope. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and throughout the growing season.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally are not subject to flooding.

The main limitations to the use of this Blakeland soil for homesite development are seepage and slope. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Sandy Foothill range site, and in plant adaptability group F-4.

14—Breece sandy loam, 9 to 25 percent slopes. This is a deep, well drained soil on fans and toe slopes and in drainageways of the mountains. It formed in noncalcareous, loamy alluvial and colluvial material derived from igneous and metamorphic rocks. The average annual precipitation is 17 to 20 inches, and the average annual air temperature is 43° to 47° F. The average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Typically, the surface layer is neutral, dark grayish brown sandy loam about 6 inches thick. The subsoil is neutral, dark grayish brown and grayish brown sandy loam about 40 inches thick. The substratum to a depth of 60 inches is neutral, brown gravelly loamy coarse sand.

Included with the Breece soil in mapping are small areas of Trag soils in similar positions on the landscape, Lininger soils on mountain side slopes, soils that have slopes of less than 9 percent, and Venable soils on flood plains. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Breece soil is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is medium to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

This soil is used mainly for grazing and as pasture, hayland, and habitat for wildlife. In a few areas it is used for community development.

The native vegetation is mainly Arizona fescue, mountain muhly, Parry oatgrass, and slender wheatgrass. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during

the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances.

The main limitations to the use of the Breece soil as hayland and pasture are the short growing season, slope, and the moderate available water capacity. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help keep the pasture in good condition and to protect the soil from erosion. Weed control and fertilizer are needed to produce forage of excellent quality. Irrigation water can be applied by contour furrows or a sprinkler system. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the short growing season, the slope, and the moderate available water capacity. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally are not subject to flooding.

The main limitations to the use of the Breece soil for community development are slope and seepage. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Structures to divert runoff from buildings and roads are needed. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as greenbelts and parks that are planted with native vegetation and other adapted plants.

This soil is in capability subclass VIe, in the Loamy Park range site, and in plant adaptability group M-1.

15—Bresser sandy loam, 0 to 5 percent slopes. This is a deep, well drained soil on high terraces and hill slopes. This soil formed in noncalcareous eolian and alluvial material. The average annual precipitation is 13 to 17 inches, and the average annual air temperature is 47° F. The average frost-free season ranges from 126 to 142 days. Elevation is 5,400 to 6,500 feet.

Typically, the surface layer is slightly acid, brown sandy loam about 5 inches thick. The subsoil in the upper 4 inches is neutral, brown sandy loam; in the next 15 inches it is neutral, brown to dark brown and yellowish brown sandy clay loam; and in the lower 10 inches it is neutral, yellowish brown sandy loam. The substratum to a depth of 60 inches is neutral, light yellowish brown loamy sand.

Included in mapping are small areas of Blakeland and Truckton soils in similar positions on the landscape and small areas of Urban land. The included soils and Urban land make up about 15 percent of the map unit.

Permeability of this Bresser soil is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low to moderate. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, as pasture, for crops, and as habitat for wildlife. In a few areas it is used for community development.

The native vegetation is mainly big bluestem, little bluestem, sand reedgrass, and blue grama. The average annual production of air-dry vegetation ranges from 1,000 to 1,400 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding hastens revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens; the rest of the pasture can be used as exercise areas and for very limited grazing.

This soil is well suited to grasses, shrubs, trees, and garden plants. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff on Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate the flow to prevent flooding downslope in areas that normally are not subject to flooding.

The main limitation to the use of the Bresser soil for homesite development is seepage. Effluent from

absorption fields can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Revegetating disturbed areas around a construction site as soon as possible helps control soil blowing. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil blowing, and maintaining or improving fertility. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A sprinkler irrigation system is best on this soil because of the rapid intake rate. Land leveling is needed in some areas for the uniform distribution of water.

Management concerns on nonirrigated cropland include conserving soil moisture, controlling erosion, and maintaining fertility. Leaving crop residue on the surface or incorporating it into the soil reduces runoff and soil blowing and helps maintain tilth and the content of organic matter. Soil blowing can be reduced by planting crops in alternate strips at right angles to the prevailing wind and by growing a cover crop after a row crop is harvested. Terraces and diversions help reduce runoff and conserve moisture.

This soil is in capability subclass IIIe, irrigated and nonirrigated, in the Sandy Foothill range site, and in plant adaptability group F-4.

16—Bresser gravelly sandy loam, 9 to 25 percent slopes. This is a deep, well drained soil on hill slopes and knobs. It formed in noncalcareous eolian and alluvial material. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,400 to 6,500 feet.

Typically, the surface layer is neutral, dark grayish brown gravelly sandy loam about 4 inches thick. The subsoil in the upper 6 inches is neutral, brown to dark brown gravelly sandy clay loam. In the lower 11 inches it is neutral, yellowish brown gravelly sandy loam. The substratum to a depth of 60 inches is neutral, yellowish brown very gravelly loamy sand.

Included in mapping are small areas of Ulm, Manzanola, and Renohill soils on hill slopes, Fondis and Nunn soils on stable summits and high terraces, and soils that are less than 15 percent gravel in the upper part of the solum. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Bresser soil is moderately rapid to a depth of 20 to 40 inches and rapid below that. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is medium to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a moderate hazard. The depth to sand and gravel ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 15 to 35 percent of the volume in the solum and more than 35 percent in the substratum.

This soil is used mainly for grazing and as pasture and habitat for wildlife. In a few places it is used for community development.

The native vegetation is mainly needleandthread, little bluestem, sand reedgrass, and blue grama. The average annual production of air-dry vegetation ranges from 700 to 1,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Revegetation is difficult on this soil; therefore, proper grazing use is needed to prevent depletion. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the slope and small stones. A mulch of plant residue helps to reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. In disturbed areas, pebbles and cobbles should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate the heavy flows to prevent flooding downslope in areas that normally are not subject to flooding.

The main limitations to the use of this Bresser soil for homesite development are slope and seepage. Effluent from absorption fields can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Gravelly Foothill range site, and in plant adaptability group F-8.

17—Critchell gravelly sandy loam, 0 to 3 percent slopes. This is a deep, well drained soil on terraces and fans. This soil formed in reddish, gravelly, loamy alluvium derived from reddish sedimentary rocks. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, very dark grayish brown gravelly sandy loam about 6 inches thick. The subsoil in the upper 9 inches is neutral, dark grayish brown and brown gravelly sandy clay loam. In the lower 20 inches it is neutral, reddish brown gravelly sandy clay loam. The substratum to a depth of 60 inches is mildly alkaline, light reddish brown and pink gravelly sandy loam and gravelly coarse sandy loam.

Included in mapping are small areas of Lavate and Rednun soils on fans; Yoder Variant soils on ridges; and soils, on fans, that are similar to this Critchell soil except that they do not have a gravelly sandy clay loam subsoil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage of the map unit.

Permeability of this Critchell soil is moderate to rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are slight hazards. The shrink-swell potential is low to moderate. Rock fragments make up 15 to 35 percent of the volume.

Most areas of this soil are used for grazing, pasture, and crops. A few areas are used for community development.

The native vegetation is mainly needleandthread, prairie sandreed, little bluestem, sideoats grama, and mountain muhly. The average annual production of air-dry vegetation ranges from 700 to 1,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding hastens the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Hence, livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by small stones. In disturbed areas, pebbles and cobbles should be removed from the surface for best results in landscaping, particularly for lawns. Mulching, fertilizing, and irrigation are needed in establishing seeded grasses and other small plants. Selecting adapted plants is essential in establishing plantings.

The small areas of Urban land are covered by impervious structures such as streets, parking lots, sidewalks, and buildings. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate the heavy flow to reduce the hazard of flooding downslope in areas that normally are not subject to flooding.

In areas that are used for homesite development, the main limitations are small stones and the shrink-swell potential. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential. Existing vegetation should be protected during construction.

In areas used for irrigated crops, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Applications of manure and commercial fertilizers containing nitrogen and phosphorus are needed to maintain fertility. Land leveling is needed in some areas for the uniform application of water.

In areas used for nonirrigated crops the management concerns are conserving soil moisture, controlling erosion, and maintaining fertility. Stubble mulch tillage and crop residue incorporated into the soil are essential in reducing erosion, improving tilth, and conserving soil moisture. Tillage should be kept to a minimum.

This soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated, in the Gravelly Foothill range site, and in plant adaptability group F-8.

18—Critchell gravelly sandy loam, 3 to 9 percent slopes. This is a deep, well drained soil on terraces and fans. It formed in reddish, gravelly, loamy alluvium derived from reddish sedimentary rocks. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, very dark grayish brown gravelly sandy loam about 6 inches thick. The subsoil in the upper 9 inches is neutral, dark grayish brown and brown gravelly sandy clay loam. In the lower 20 inches it is neutral, reddish brown gravelly sandy clay loam. The substratum to a depth of 60 inches is mildly alkaline, light reddish brown and pink gravelly sandy loam and gravelly coarse sandy loam.

Included in mapping are small areas of Lavate and Rednun soils on fans; Yoder Variant soils on ridges; and soils, on fans, that are similar to this Critchell soil except that they do not have a gravelly sandy clay loam subsoil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Critchell soil is moderate to rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is low to moderate. Rock fragments make up 15 to 35 percent of the volume.

This soil is used mainly for grazing, as pasture, and for crops. In a few places it is used for community development.

The native vegetation is mainly needleandthread, prairie sandreed, little bluestem, sideoats grama, and mountain muhly. The average annual production of air-dry vegetation ranges from 700 to 1,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by small stones. Pebbles and cobbles in disturbed areas should be removed from the surface for best results in landscaping, particularly for lawns. Planting on the contour helps to conserve moisture and reduce erosion. Mulching, fertilizing, and irrigation are needed in establishing seeded grasses and other small plants. Selecting adapted plants is essential in establishing plantings.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff on Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally are not subject to flooding.

The main limitations to the use of this Critchell soil for homesite development are the shrink-swell potential and small stones. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Existing vegetation should be protected as much as possible during construction.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Applications of manure and commercial fertilizer that contains nitrogen and phosphorus are needed to maintain fertility. Land leveling is needed in some areas for the uniform distribution of water. Light, frequent applications of irrigation water are needed to prevent soil loss because of slope.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and crop residue incorporated into the soil are essential in protecting the soil from erosion, improving tilth, and conserving moisture. Terraces and diversions help reduce runoff and conserve moisture. Tillage should be kept to a minimum.

This soil is in capability subclass IVe, irrigated and nonirrigated, in the Gravelly Foothill range site, and in plant adaptability group F-8.

19—Critchell gravelly sandy loam, 9 to 15 percent slopes. This is a deep, well drained soil on hill slopes and fans. It formed in reddish, gravelly, loamy alluvium derived from reddish sedimentary rocks. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, very dark grayish brown gravelly sandy loam about 6 inches thick. The subsoil in the upper 9 inches is neutral, dark grayish brown and brown gravelly sandy clay loam. In the lower 20 inches it is neutral, reddish brown gravelly sandy clay loam. The substratum to a depth of 60 inches is mildly alkaline, light reddish brown to pink gravelly sandy loam and gravelly coarse sandy loam.

Included in mapping are small areas of Lavate soils on foot slopes, Rednun soils on toe slopes, and Yoder Variant soils on shoulders. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Critchell soil is moderate to rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is low to moderate. Rock fragments make up 15 to 35 percent of the volume.

This soil is used mainly for grazing and as pasture. In a few areas it is used for community development and for crops.

The native vegetation is mainly needleandthread, prairie sandreed, little bluestem, sideoats grama, and mountain muhly. The average annual production of air-dry vegetation ranges from 700 to 1,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures

commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by small stones and the slope. Pebbles and cobbles in disturbed areas should be removed from the surface for best results in landscaping, particularly for lawns. Planting on the contour helps to conserve moisture and reduce erosion. Leaving plant residue on the surface or incorporating it into the soil reduces runoff and helps to maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally are not subject to flooding.

The main limitations to use of this soil for homesite development are slope, the shrink-swell potential, and small stones. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. The hazard of erosion is increased if the soil is left exposed; therefore, structures to divert runoff from buildings and roads are needed. The steepness of slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential. Existing vegetation should be protected as much as possible during construction.

Areas that are used for crops are most commonly severely eroded.

This soil is in capability subclass VIe, in the Gravelly Foothill range site, and in plant adaptability group F-8.

20—Critchell stony sandy loam, 0 to 5 percent slopes. This is a deep, well drained soil on terraces and fans. It formed in reddish, gravelly, loamy alluvium derived from reddish sedimentary rocks. The average annual precipitation is 13 to 17 inches, and the average annual air temperature is 47° F. The average frost-free season ranges from 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, very dark grayish brown stony sandy loam about 6 inches thick. The subsoil in the upper 9 inches is neutral, dark grayish brown and brown gravelly sandy clay loam. In the lower 20 inches it is neutral, reddish brown gravelly sandy clay loam. The substratum to a depth of 60 inches is mildly alkaline, light reddish brown and pink gravelly sandy loam and gravelly coarse sandy loam.

Included in mapping are small areas of Lavate soils in positions similar to those of the Critchell soil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Critchell soil is moderate to rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are slight hazards. The shrink-swell potential is low to moderate. Rock fragments make up 15 to 35 percent of the volume.

This soil is used mainly for grazing, pasture, and crops and as recreation areas. In a few places it is used for community development.

The native vegetation is mainly needleandthread, little bluestem, prairie sandreed, and sideoats grama. The average annual production of air-dry vegetation ranges from 700 to 1,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by large stones. Pebbles and cobbles in disturbed areas should be removed from the surface for best results in landscaping, particularly for lawns. A mulch of plant residue helps to reduce runoff, improve soil tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

This soil is suited to homesite development. The effects of shrinking and swelling can be minimized by placing footings below the subsoil or backfilling with material that has a low shrink-swell potential. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Where the density of housing is moderate to

high, a community sewage system is needed to prevent contamination of the water supply by seepage. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil erosion, and maintaining or improving fertility. Incorporating crop residue into the soil helps maintain the content of organic matter, increase water infiltration, and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Land leveling is needed in some areas for the uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting soil from erosion, and maintaining fertility. Stubble mulch tillage and crop residue incorporated into the soil are essential to protect the soil from erosion, improve tilth, and conserve moisture. Special equipment may be needed because of stones on the surface. Terraces and diversions help to reduce runoff and conserve moisture. Tillage should be kept to a minimum.

This soil is in capability subclass IIIe, irrigated and nonirrigated, in the Gravelly Foothill range site, and in plant adaptability group F-8.

21—Cryofluvents, 0 to 5 percent slopes. This map unit consists of deep, well drained and somewhat excessively drained soils on flood plains and low terraces. The soils formed in stratified sandy, loamy, and gravelly alluvium derived from igneous and metamorphic rocks. The average annual precipitation is 17 to 20 inches, and the average annual air temperature is 41° to 47° F. The average frost-free season ranges from 55 to 125 days. Elevation is 6,500 to 9,000 feet.

Typically, Cryofluvents are stratified very gravelly and very cobbly sand to sandy loam to a depth of about 60 inches.

Included in mapping are small areas of riverwash in the stream channel, Rosane and Venable soils and Cumulic Cryoborolls on low terraces and flood plains, and Kittredge soils on the higher terraces. The included areas make up about 15 percent of the total acreage of the map unit.

Permeability of Cryofluvents is very rapid to moderate. The available water capacity is low to moderate. Runoff is slow. Water erosion is a severe hazard. The soils are subject to frequent, brief periods of flooding in spring and summer. The shrink-swell potential is low. Rock fragments make up 5 to 80 percent of the volume.

Most areas of these soils are used as habitat for wildlife and as recreation areas. A few areas are used for grazing.

The native vegetation is mainly scattered stands of western wheatgrass, Canada wildrye, slender wheatgrass, narrowleaf cottonwood, and willow. The average annual production of air-dry vegetation ranges from 100 to 4,000 pounds per acre. Revegetation is difficult; consequently, proper grazing use is needed to prevent depletion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on these soils because of flooding, the low available water capacity, small stones, and the short growing season. Selecting adapted plants is essential in establishing plantings. Applications of manure and of commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Mulching and irrigation are needed in establishing seeded grasses and other small plants. The removal of pebbles and cobbles in disturbed areas is necessary for best results in landscaping, particularly for lawns. Flood-control structures are needed to protect plantings.

The main limitations to use of these soils for homesite development are flooding and seepage. Structures to divert runoff are needed to protect buildings and roads. Special sewage systems may be needed because of seepage. Effluent from absorption fields can surface downstream and create a health hazard. Special sealing methods are needed to overcome excessive seepage. Some areas have esthetic value for use as greenbelts and parks.

These soils are in capability subclass VIw, in the River Bottom range site, and in plant adaptability group M-9.

22—Cumulic Cryoborolls, loamy, 0 to 5 percent slopes. Cumulic Cryoborolls are deep, moderately well drained and well drained soils on alluvial valley floors, in narrow, concave drainageways, and on low mountain terraces. The soils formed in gravelly, loamy alluvium derived dominantly from igneous and metamorphic rocks. The average annual precipitation is 17 to 20 inches, and the average annual air temperature is 41° to 46° F. The average frost-free season ranges from 55 to 125 days. Elevation is 6,700 to 8,000 feet.

Typically, Cumulic Cryoborolls are broadly stratified sandy loam, gravelly sandy loam, and very gravelly sandy loam to a depth of 60 inches.

Included in mapping are small areas of Cryofluvents and Venable and Rosane soils on flood plains and low terraces and Kittredge and Earcree soils on toe slopes, fans, and high terraces. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of Cumulic Cryoborolls, loamy, is moderate to rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are slight hazards. The seasonal high water table is at a depth of 48 to 72 inches in some areas in spring and summer. These soils are subject to very brief periods of flooding in spring and summer. The shrink-swell potential

is low. Rock fragments make up 0 to 50 percent of the volume.

In most places these soils are used for grazing and hay, as habitat for wildlife, and as recreation areas. In a few places they are used for community development.

The native vegetation is mainly Arizona fescue, mountain muhly, slender wheatgrass, and junegrass. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable vegetation and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding hastens revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

If these soils are used for hay and pasture, the main limitations are flooding and the short growing season. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help keep the pasture in good condition and control erosion. Irrigation water can be applied by the contour furrow and sprinkler methods. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the short growing season and flooding. Selecting adapted plants is essential in establishing plantings. Mulching with plant residue helps reduce runoff, improve tilth, and conserve soil moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. The removal of pebbles and cobbles in disturbed areas is needed for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The soils are limited for homesite development because of flooding, wetness, and seepage. Drainage and structures to divert runoff from roads and building foundations are needed. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as greenbelts and parks that are planted with native vegetation and other adapted plants.

These soils are in capability subclass Vc, in the Loamy Park range site, and in plant adaptability group M-1.

23—Curecanti very stony sandy loam, 15 to 50 percent slopes. This is a deep, well drained soil on mountain foot slopes and fans. It formed in noncalcareous, stony and gravelly colluvial material derived from schist, gneiss, and granite. The average annual precipitation is 17 to 20 inches, and the average annual air temperature is 43° to 47° F. The average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Typically, the surface layer is neutral, very dark grayish brown very stony sandy loam about 6 inches thick. The subsoil in the upper 5 inches is neutral, dark grayish brown very cobbly sandy loam. In the lower 49 inches it is neutral, brown to dark brown very cobbly sandy clay loam.

Included in mapping are small areas of Trag soils on toe slopes, Lininger and Ratake soils on mountain side slopes, and Rock outcrop on shoulders and in areas where quartzitic dikes reach the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

Permeability of this Curecanti soil is moderate. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. The shrink-swell potential is low. Rock fragments make up 35 to 70 percent of the volume.

This soil is used mainly for grazing, as habitat for wildlife, and as recreation areas. In a few places it is used for community development.

The native vegetation is mainly bluebunch wheatgrass, needlegrasses, Arizona fescue, and mountainmahogany. The average annual production of air-dry vegetation ranges from 700 to 1,200 pounds per acre. Scattered ponderosa pines are common. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. This soil is difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. The steepness of slopes limits access by livestock and promotes overgrazing of the less sloping areas. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, large stones, and the short growing season. A mulch of plant residue reduces soil blowing and runoff, improves tilth, and conserves moisture. Applications of manure and

commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles in disturbed areas should be removed from the surface for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to the use of the Curecanti soil for homesite development are slope and large stones. Effluent from an absorption field can surface downslope and create a health hazard. Structures to divert runoff from buildings and roads are needed. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIIe, in the Stony Loam range site, and in plant adaptability group M-4.

24—Dacono Variant gravelly clay loam, 0 to 3 percent slopes. This is a deep, well drained soil on high terraces. It formed in calcareous, gravelly and clayey material overlying sand and gravel derived from alluvium. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,400 to 6,500 feet.

Typically, the surface layer is neutral, dark grayish brown gravelly clay loam about 9 inches thick. The upper part of the subsoil, which is 10 inches thick, is neutral, dark grayish brown gravelly sandy clay. The lower part, which is also 10 inches thick, is moderately alkaline, brown to very pale brown gravelly sandy clay loam. The upper part of the substratum, which is 12 inches thick, is moderately alkaline, pink very gravelly sandy clay loam. The lower part, to a depth of 60 inches, is moderately alkaline, strong brown very cobbly loamy coarse sand.

Included in mapping are small areas of Nunn soils on terraces, Denver soils on adjoining hill slopes, and soils that are wet because of seepage from irrigation. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Dacono Variant soil is slow in the surface layer and subsoil and rapid in the substratum. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are slight hazards. The depth to sand, gravel, and cobbles ranges from 20 to 40 inches. The shrink-swell potential is moderate to high between depths of 20 and 40 inches; it is low below that. Rock fragments make up 15 to 35 percent of the volume in the surface layer and subsoil and 36 to 60 percent in the substratum.

This soil is used for pasture, crops, and community development and as a source of sand and gravel.

The native vegetation is mainly western wheatgrass, green needlegrass, blue grama, and Sandberg bluegrass. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The main concerns in establishing and maintaining grasses, shrubs, trees, and garden plants on this soil are the small stones and clayey texture, which make tillage difficult. Pebbles and cobbles in disturbed areas should be removed from the surface for best results in landscaping, particularly for lawns. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted vegetation is essential in establishing plantings. Supplemental irrigation is needed at the time of planting and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to the use of the Dacono Variant soil for homesite development are the shrink-swell potential, low strength, and seepage. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Existing plant cover should be protected as much as possible during construction.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil helps maintain the content of organic matter, increase water infiltration, and improve tilth. Applications of manure and commercial fertilizer that contains nitrogen and phosphorus are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up tillage pans and improves water infiltration. Land leveling is needed in some areas for the uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue into the soil are essential in protecting soil from erosion, improving tilth, and conserving moisture. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1.

25—Denver clay loam, 0 to 2 percent slopes. This is a deep, well drained soil on high terraces, tablelands, and fans. It formed in calcareous, clayey material derived dominantly from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is mildly alkaline, grayish brown clay loam about 6 inches thick. The upper part of the subsoil is mildly alkaline and moderately alkaline, grayish brown clay 14 inches thick, and the next part is moderately alkaline, light yellowish brown clay 9 inches thick. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Included in mapping are small areas of Englewood soils in small drainageways, Nunn soils in positions similar to those of the Denver soil, Ulm soils on hill slopes, and Standley soils on gravelly terraces. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage of the map unit.

Permeability of this Denver soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, as pasture, as recreation areas, and for crops. In a few places it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. Maintaining plant residue on or near the surface reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

This soil is limited for homesite development by the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help to prevent seepage into basements and to minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems are needed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil helps maintain the content of organic matter, increase water infiltration, and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up tillage pans and improves water infiltration. Land leveling is needed in some areas to achieve uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the soil are essential in protecting the soil from erosion and in improving tilth and conserving moisture. Soil blowing can be reduced by planting crops in alternate strips at right angles to the prevailing wind. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IIe, irrigated, and IIIc, nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1.

26—Denver clay loam, 2 to 5 percent slopes. This is a deep, well drained soil on high terraces, tablelands, and fans. It formed in calcareous, clayey material derived dominantly from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is mildly alkaline, grayish brown clay loam about 6 inches thick. The upper part of the subsoil is mildly alkaline and moderately alkaline, grayish brown clay 14 inches thick, and the next part is moderately alkaline, light yellowish brown clay 9 inches thick. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Included in mapping are small areas of Englewood soils in small drainageways, Nunn soils in positions similar to those of the Denver soil, Ulm soils on hill slopes, and Standley soils on gravelly terraces. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Denver soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium. Water erosion and soil blowing are moderate hazards. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, as pasture, as recreation areas, and for crops. In a few areas it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and the clayey subsoil, which make tillage difficult. Leaving plant residue on the surface or incorporating it into the soil reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to the use of this soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil helps maintain the content of organic matter, increase water infiltration, and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up tillage pans and improves water infiltration. Light, frequent applications of irrigation water are needed to prevent soil loss because of the slope and the slow permeability. Land leveling is needed in some areas to achieve uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the soil are essential in protecting the soil from erosion, improving tilth, and conserving moisture. Soil blowing can be reduced by planting crops in alternate strips at right angles to the

prevailing wind. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IIIe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1.

27—Denver clay loam, 5 to 9 percent slopes. This is a deep, well drained soil on high terraces, hill slopes, and fans. It formed in calcareous, clayey material derived dominantly from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is mildly alkaline, grayish brown clay loam about 6 inches thick. The upper part of the subsoil is mildly alkaline and moderately alkaline, grayish brown clay 14 inches thick, and the next part is moderately alkaline, light yellowish brown clay 9 inches thick. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Included in mapping are small areas of Englewood soils in small drainageways, Nunn soils in positions similar to those of the Denver soil, Kutch soils on convex shoulders, Standley soils on gravelly terraces, and Ulm soils on hill slopes. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

Permeability of this Denver soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium. Water erosion and soil blowing are moderate hazards. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, as pasture, and as recreation areas. In a few places it is used for crops and for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. Maintaining plant residue on or near the surface reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

This soil is limited for community development by the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near the foundation. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil helps maintain the content of organic matter, increase water infiltration, and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up tillage pans and improves water infiltration. Land leveling is needed to achieve uniform distribution of water. Light, frequent applications of irrigation water are needed to prevent soil loss because of the slope.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the soil are essential in protecting the soil from erosion, improving tilth, and conserving moisture. Terracing and contour tillage are needed to reduce soil erosion. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IVe, irrigated and nonirrigated; in the Clayey Foothill range site, and in plant adaptability group F-1.

28—Denver cobbly clay loam, 5 to 9 percent slopes. This is a deep, well drained soil on high terraces, hill slopes, and fans. It formed in calcareous, cobbly, and clayey material derived dominantly from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Typically, the surface layer is mildly alkaline, dark grayish brown cobbly clay loam about 3 inches thick. The subsoil in the upper 6 inches is mildly alkaline and moderately alkaline, dark grayish brown clay. In the lower 20 inches it is moderately alkaline, brown clay. The substratum to a depth of 60 inches is moderately alkaline, brown gravelly sandy clay.

Included in mapping are small areas of Englewood soils in small drainageways and on fans, Nunn soils in positions similar to those of the Denver soil, Kutch soils on convex shoulders, Standley soils on gravelly terraces, and soils that have slopes of more than 9 percent. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage of the map unit.

Permeability of the Denver soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. Rock fragments make up 0 to 35 percent of the volume.

This soil is used mainly for grazing, as pasture, and as recreation areas. In a few places it is used for crops and for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the cobbly clay loam surface layer and the clayey subsoil, which make tillage difficult. A mulch of plant residue reduces runoff and helps maintain tilth and the organic matter content. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

This soil is limited for use as homesites by the shrink-swell potential, low strength, slow permeability, and large stones. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Pebbles and cobbles in disturbed areas should be removed from the surface for best results in landscaping, particularly for lawns. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil erosion, and maintaining or improving fertility. Incorporating crop residue into the soil helps maintain the content of organic matter, increase water infiltration, and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up tillage pans and improves water infiltration. Land leveling is needed in some areas to achieve uniform distribution of water. Light, frequent applications of water are needed to prevent soil loss because of the slope.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the soil are essential in protecting soil from erosion, improving tilth, and conserving moisture. Terracing and contour tillage are needed to reduce erosion. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IVe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1.

29—Denver-Kutch clay loams, 5 to 9 percent slopes. These soils are on hill slopes and shoulders. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

The Denver soil makes up 50 percent of this map unit, and the Kutch soil makes up 35 percent. The Denver soil is on hill slopes, and the Kutch soil is on hill slopes and shoulders. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included are small areas of Englewood soils on fans and in drainageways, Nunn soils on fans, Midway soils on ridge crests, and Renohill soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Denver soil is deep and well drained. It formed in calcareous, clayey material derived dominantly from mudstone and shale.

Typically, the surface layer is mildly alkaline, grayish brown clay loam about 6 inches thick. The upper part of the subsoil is mildly alkaline and moderately alkaline, grayish brown clay 14 inches thick, and the next part is moderately alkaline, light yellowish brown clay 9 inches thick. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Permeability of the Denver soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium. Water erosion and soil blowing are moderate hazards. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

The Kutch soil is moderately deep and well drained. It formed in calcareous, clayey residuum and colluvium derived dominantly from mudstone and shale.

Typically, the surface layer is neutral, grayish brown clay loam about 3 inches thick. The subsoil in the upper 8 inches is neutral and mildly alkaline, dark grayish brown clay. In the lower 15 inches it is moderately alkaline, grayish brown clay and clay loam. Soft, interbedded shale is at a depth of 26 inches.

Permeability of the Kutch soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. The depth to soft bedrock ranges from 20 to 40 inches. Rock fragments make up 0 to 15 percent of the volume.

In most places, the soils are used for grazing, as pasture, and as recreation areas. In a few places, they are used for community development and for crops.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Proper grazing use is needed to prevent depletion because the Kutch soil is difficult to revegetate. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed when planting and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the shrink-swell potential, the depth to rock of the Kutch soil, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Buildings and roads should be designed to offset the limited ability of the soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Effluent from an absorption field can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A tillage pan forms easily if these soils are tilled when they are wet. Chiseling or subsoiling breaks up tillage pans and improves water infiltration. Land leveling is needed for the uniform distribution of water. Light, frequent applications of water are needed to prevent soil loss because of the slope.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the soil are essential in protecting soil from erosion, improving tilth, and conserving moisture. Terracing and contour tillage are needed to reduce erosion. A tillage pan forms easily if these soils are tilled when they are wet. Tillage should be kept to a minimum.

These soils are in capability subclass IVe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1.

30—Denver-Kutch clay loams, 9 to 15 percent slopes. These soils are on hill slopes and shoulders. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Denver soil makes up 45 percent of this map unit, and Kutch soil makes up 40 percent. The Denver soil is on hill slopes, and the Kutch soil is on hill slopes and shoulders. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Englewood soils on fans and in drainageways, Nunn soils on fans, Midway soils on ridge crests, and Renohill soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Denver soil is deep and well drained. It formed in calcareous, clayey material derived dominantly from mudstone and shale.

Typically, the surface layer is mildly alkaline, grayish brown clay loam about 6 inches thick. The upper part of the subsoil is mildly alkaline and moderately alkaline, grayish brown clay 14 inches thick, and the next part is moderately alkaline, light yellowish brown clay 9 inches thick. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Permeability of the Denver soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

The Kutch soil is moderately deep and well drained. It formed in calcareous, clayey residuum and colluvium derived dominantly from mudstone and shale.

Typically, the surface layer is neutral, grayish brown clay loam about 3 inches thick. The subsoil in the upper 8 inches is neutral and mildly alkaline, dark grayish brown clay. In the lower 15 inches it is moderately alkaline, grayish brown clay and clay loam. It overlies soft, interbedded shale at a depth of 26 inches.

Permeability of the Kutch soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. The depth to soft bedrock ranges from 20 to 40 inches. Rock fragments make up 0 to 15 percent of the volume.

These soils are used mainly for grazing, as pasture, and as recreation areas. In a few places, they are used for community development and for crops.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Proper grazing use is needed to prevent depletion because the Kutch soil is difficult to revegetate. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the slope and by the clay loam surface layer and clayey subsoil, which make tillage difficult. A mulch of plant residue helps reduce runoff, improve soil tilth, and conserve moisture. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the shrink-swell potential, slope, depth to rock, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slope and slow permeability. Effluent from an absorption field can surface downslope and

create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched.

Most of the areas that are used for nonirrigated crops are severely eroded.

The soils in this map unit are in capability subclass VIe, in the Clayey Foothill range site, and in plant adaptability group F-1.

31—Denver-Kutch-Midway clay loams, 9 to 25 percent slopes. The areas of the complex are on hill slopes and ridge crests. The average annual precipitation is 13 to 17 inches, the average air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Denver soil makes up 35 percent of this complex, Kutch soil makes up 30 percent, and Midway soil makes up 20 percent. The Denver and Kutch soils are on hill slopes, and the Midway soil is on ridge crests. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Englewood soils on fans and in drainageways, Nunn soils on fans, soils that have cobbles and gravel on the surface, and Renohill soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Denver soil is deep and well drained. It formed in calcareous, clayey material derived dominantly from mudstone and shale.

Typically, the surface layer is mildly alkaline, grayish brown clay loam about 6 inches thick. The upper part of the subsoil is mildly alkaline and moderately alkaline, grayish brown clay 14 inches thick, and the next part is moderately alkaline, light yellowish brown clay 9 inches thick. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Permeability of the Denver soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

The Kutch soil is moderately deep and well drained. It formed in calcareous, clayey residuum and colluvium derived dominantly from mudstone and shale.

Typically, the surface layer is neutral, grayish brown clay loam about 3 inches thick. In the upper 8 inches, the subsoil is neutral and mildly alkaline, dark grayish brown clay. In the lower 15 inches it is moderately alkaline, grayish brown clay and clay loam. It overlies soft, interbedded shale at a depth of 26 inches.

Permeability of the Kutch soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. The depth to soft bedrock ranges from 20 to 40 inches. Rock fragments make up 0 to 15 percent of the volume.

The Midway soil is shallow and well drained. It formed in calcareous, clayey material derived from mudstone and shale.

Typically, the surface layer is neutral, olive brown clay loam about 3 inches thick. The layer below that is mildly alkaline, light olive brown clay loam about 7 inches thick. The underlying material to a depth of 14 inches is moderately alkaline, light yellowish brown clay. Soft shale is at a depth of 14 inches.

Permeability of the Midway soil is slow. The available water capacity is low. The effective rooting depth is 6 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The depth to soft bedrock ranges from 6 to 20 inches. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

In most places, the soils are used for grazing, as pasture, and as recreation areas. In a few places, they are used for community development and for crops.

The native vegetation is mainly western wheatgrass, green needlegrass, blue grama, and sideoats grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Proper grazing use is needed to prevent depletion because the soils are difficult to revegetate. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the slope, by the clay loam surface layer and clayey subsoil, which make tillage difficult, and, on the Midway soil, by shallowness to rock. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to the use of these soils for homesite development are the shrink-swell potential, slope, depth to rock, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with

material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. On the Kutch and Midway soils, the deep cuts needed to provide a sufficiently level building site can expose bedrock. Buildings and roads should be designed to offset the limited ability of the soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slope, depth to rock, and slow permeability. Effluent from an absorption field can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched.

On these soils, nonirrigated cropland generally is severely eroded.

These soils are in capability subclass VIe. The Denver and Kutch soils are in the Clayey Foothill range site and in plant adaptability group F-1. The Midway soil is in the Shaly Foothill range site and in plant adaptability group F-2.

32—Denver-Kutch-Urban land complex, 5 to 9 percent slopes. The areas of this complex are on hill slopes and shoulders. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Denver soil makes up 40 percent of this complex, Kutch soil makes up 25 percent, and Urban land makes up 20 percent. The Denver soil is on hill slopes, and the Kutch soil is on hill slopes and shoulders. Areas of Urban land are irregularly scattered. The soils and Urban land are in areas so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Englewood soils on fans and in drainageways, Nunn soils on fans, Midway soils on ridge crests, and Renohill soils on hill slopes. Also included are small areas that are less than 20 percent Urban land and are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Denver soil is deep and well drained. It formed in calcareous, clayey material derived dominantly from mudstone and shale.

Typically, the surface layer is mildly alkaline, grayish brown clay loam about 6 inches thick. The upper part of the subsoil is mildly alkaline and moderately alkaline, grayish brown clay 14 inches thick, and the next part is moderately alkaline, light yellowish brown clay 9 inches thick. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Permeability of this Denver soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium. Water erosion and soil blowing are moderate hazards. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

The Kutch soil is moderately deep and well drained. It formed in calcareous, clayey residuum and colluvium derived dominantly from mudstone and shale.

Typically, the surface layer is neutral, grayish brown clay loam about 3 inches thick. The subsoil in the upper 8 inches is neutral and mildly alkaline, dark grayish brown clay. In the lower 15 inches it is moderately alkaline, grayish brown clay and clay loam. Soft, interbedded shale is at a depth of 26 inches.

Permeability of the Kutch soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. The depth to soft bedrock ranges from 20 to 40 inches. Rock fragments make up 0 to 15 percent of the volume.

Urban land is covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

In most places, the soils in this complex are used for community development. In a few places they are used as pasture and for grazing.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. These soils are difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitations to use of the Denver and Kutch soils for homesite development are the shrink-swell potential, depth to rock, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell

potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. On the Kutch soil, the deep cuts needed to provide a sufficiently level building site can expose bedrock. Buildings and roads should be designed to offset the limited ability of the soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff on Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally are not subject to flooding. Special sewage systems must be installed because of the slow permeability. Effluent from an absorption field can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched.

The Denver and Kutch soils are in capability subclass IVe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

33—Denver-Kutch-Urban land complex, 9 to 15 percent slopes. The areas of this complex are on hill slopes and shoulders. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Denver soil makes up 35 percent of this complex, Kutch soil makes up 30 percent, and Urban land makes up 20 percent. The Denver soil is on hill slopes, the Kutch soil is on hill slopes and shoulders, and the areas of Urban land are irregularly scattered. The areas of the soils and of Urban land are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Englewood soils on fans and in drainageways, Nunn soils on fans, Midway soils on ridge crests, and Renohill soils on hill slopes. Also included are small areas that are less than 20 percent Urban land and are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Denver soil is deep and well drained. It formed in calcareous, clayey material derived dominantly from mudstone and shale.

Typically, the surface layer is mildly alkaline, grayish brown clay loam about 6 inches thick. The upper part of the subsoil is mildly alkaline and moderately alkaline, grayish brown clay 14 inches thick, and the next part is moderately alkaline, light yellowish brown clay 9 inches thick. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Permeability of the Denver soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

The Kutch soil is moderately deep and well drained. It formed in calcareous, clayey residuum and colluvium derived dominantly from mudstone and shale.

Typically, the surface layer is neutral, grayish brown clay loam about 3 inches thick. The subsoil in the upper 8 inches is neutral and mildly alkaline, dark grayish brown clay. In the lower 15 inches it is moderately alkaline, grayish brown clay and clay loam. Soft, interbedded shale is at a depth of 26 inches.

Permeability of the Kutch soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. The depth to soft bedrock ranges from 20 to 40 inches. Rock fragments make up 0 to 15 percent of the volume.

Urban land is mainly covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

The soils in this complex are used mainly for community development. In a few places, they are used as pasture and for grazing.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. These soils are difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the slope and the clay loam surface layer and clayey subsoil, which make tillage difficult. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to the use of the soils for homesite development are the shrink-swell potential, slope, depth to rock, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with

material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. On the Kutch soil, the deep cuts needed to provide a sufficiently level building site can expose bedrock. Buildings and roads should be designed to offset the limited ability of the soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff on Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding. Special sewage systems must be installed because of the slope and slow permeability. Effluent from absorption fields can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched.

The Denver and Kutch soils are in capability subclass VIe, in the Clayey Foothill range site, and in plant adaptability group F-1. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

34—Denver-Urban land complex, 0 to 2 percent slopes. The areas of this complex are on high terraces, tablelands, and fans. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Denver soil makes up 65 percent of this complex, and Urban land makes up 20 percent. The Denver soil and Urban land are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Englewood soils in small drainageways, Nunn soils in positions similar to those of the Denver soil, and Ulm soils on hill slopes. Urban land makes up more than 20 percent of some mapped areas. Also included are small areas that are less than 20 percent Urban land and are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Denver soil is deep and well drained. It formed in calcareous, clayey material derived dominantly from shale and mudstone.

Typically, the surface layer is mildly alkaline, grayish brown clay loam about 6 inches thick. The upper part of the subsoil is mildly alkaline and moderately alkaline, grayish brown clay 14 inches thick, and the next part is moderately alkaline, light yellowish brown clay 9 inches thick. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Permeability of this Denver soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

Urban land is mainly covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

In most places, the areas of this complex are used for community development. In a few places, the Denver soil is used as pasture and for grazing.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. Maintaining plant residue on or near the surface reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitations to use of the Denver soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the Denver soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff is rapid on Urban land, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding. Special sewage systems must be installed because of the slow permeability. Erosion and

sedimentation can be controlled by maintaining an adequate plant cover.

The Denver soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

35—Denver-Urban land complex, 2 to 5 percent slopes. The areas of this complex are on high terraces, tablelands, and fans. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Denver soil makes up 65 percent of this complex, and Urban land makes up 20 percent. The areas are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Englewood soils in small drainageways, Nunn soils in positions similar to those of the Denver soil, and Ulm soils on hill slopes. Urban land makes up more than 20 percent of some mapped areas. Also included are small areas that are less than 20 percent Urban land and are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Denver soil is deep and well drained. It formed in calcareous, clayey material derived dominantly from shale and mudstone.

Typically, the surface layer is mildly alkaline, grayish brown clay loam about 6 inches thick. The upper part of the subsoil is mildly alkaline and moderately alkaline, grayish brown clay 14 inches thick, and the next part is moderately alkaline, light yellowish brown clay 9 inches thick. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Permeability of this Denver soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium. Water erosion and soil blowing are moderate hazards. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

Urban land is mainly covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

In most places the areas of this complex are used for community development. In a few places, the Denver soil is used as pasture and for grazing.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are impeded by the clay loam surface layer and clayey subsoil, which make tillage difficult. Maintaining plant residue on or near the surface reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at the time of planting and during dry periods. Irrigation water should be applied frequently for short periods to prevent excessive runoff and erosion.

The main limitations to use of the Denver soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff is rapid on Urban land, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally are not subject to flooding. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

The Denver soil is in capability subclass IIIe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

36—Denver-Urban land complex, 5 to 9 percent slopes. The areas of this complex are on high terraces, hill slopes, and fans. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Denver soil makes up 65 percent of this complex, and Urban land makes up 20 percent. The areas are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Englewood soils in small drainageways, Nunn soils in positions

similar to those of the Denver soil, and Kutch soils on hill slopes. Urban land makes up more than 20 percent of some mapped areas. Also included are small areas that are less than 20 percent Urban land and are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Denver soil is deep and well drained. It formed in calcareous, clayey material derived dominantly from shale and mudstone.

Typically, the surface layer is mildly alkaline, grayish brown clay loam about 6 inches thick. The upper part of the subsoil is mildly alkaline and moderately alkaline, grayish brown clay 14 inches thick, and the next part is moderately alkaline, light yellowish brown clay 9 inches thick. The lower part of the subsoil to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Permeability of this Denver soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium. Water erosion and soil blowing are moderate hazards. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

Urban land is mainly covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

In most places, the areas of this complex are used for community development. In a few places the Denver soil is used as pasture and for grazing.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. Maintaining plant residue on or near the surface reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitations to use of the Denver soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff is rapid on Urban land, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

The Denver soil is in capability subclass IVe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

37—Earcree gravelly sandy loam, 9 to 15 percent slopes. This is a deep, well drained soil in drainageways and on mountain toe slopes and alluvial fans. It formed in noncalcareous, loamy alluvium and colluvium derived dominantly from igneous and metamorphic rocks. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,600 to 9,500 feet.

Typically, the surface is covered by a mat of partly decomposed leaves, needles, and twigs, which is about 2 inches thick. The surface layer is slightly acid, grayish brown gravelly sandy loam about 7 inches thick. The next layer is neutral, brown gravelly sandy loam 13 inches thick. The substratum to a depth of 60 inches is neutral, brown, stratified gravelly sandy loam.

Included in this map unit are small areas of soils that do not have a dark surface layer; these soils have a thick overstory of coniferous trees. Also included are small areas of Kittredge soils on concave toe slopes and Legault soils on steep, adjoining mountain side slopes. The included soils make up about 15 percent of the total acreage.

Permeability of this Earcree soil is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. The shrink-swell potential is low. Rock fragments make up 15 to 35 percent of the volume.

This soil is used as woodland, as recreation areas, as habitat for wildlife, and for community development.

The native vegetation is mainly an overstory of aspen, Douglas-fir, and lodgepole pine and an understory of shrubs and grasses. The wooded areas are managed

mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas include or are adjacent to homesites; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the slope, the short growing season, and small stones. Mulching, fertilizing, and irrigation are needed to establish seeded grasses and other small plants. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface of disturbed areas for best results in landscaping, particularly for lawns.

The main limitation to use of this soil for homesite development is the slope. Preserving the existing plant cover during construction helps to control erosion. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. In constructing roads and streets in residential communities, the same practices are needed that help control erosion on access roads in wooded areas. The steepness of slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage.

This soil is in capability subclass VIe, in the Douglas-fir—Lodgepole Pine woodland group, and in plant adaptability group M-7.

38—Earcree Variant very gravelly sandy loam, 3 to 9 percent slopes. This is a deep, well drained soil on fans and toe slopes and in drainageways. It formed in stratified, gravelly, loamy alluvium and in colluvium derived dominantly from grus of the Pikes Peak Granite. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 8,000 to 9,500 feet.

Typically, the surface layer is neutral, dark grayish brown very gravelly sandy loam about 12 inches thick. The subsoil is neutral, dark grayish brown very gravelly sandy loam about 21 inches thick. The substratum to a depth of 60 inches is neutral, brown to dark brown very gravelly sandy loam.

Included in mapping are small areas of soils that are dark colored to a depth of less than 20 inches; these soils are on foot slopes. Also included are small areas of the poorly drained Venable soils on low terraces and Raleigh soils on adjoining mountain side slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Earcree Variant soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 35 to 60 percent of the volume.

This soil is used mainly for grazing, as habitat for wildlife, as recreation areas, and for community development. In a few areas it is used for hay and as pasture.

The native vegetation is mainly Arizona fescue, mountain muhly, Parry oatgrass, and western wheatgrass. There are a few scattered ponderosa pines. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are hard to establish and maintain on this soil because of the small stones, the short growing season, and the low available water capacity. Pebbles and cobbles in disturbed areas should be removed from the surface for best results in landscaping, particularly for lawns. Selecting climatically adapted plants is essential in establishing plantings. Mulching, fertilizing, and irrigation are needed in establishing seeded grasses and other small plants.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the Earcree Variant soil for homesite development are seepage and small stones. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Existing vegetation should be protected as much as possible during construction. Some areas can be used

as greenbelts or as parks planted with native vegetation and other adapted plants.

This soil is in capability subclass VIs, in the Loamy Park range site, and in plant adaptability group M-1.

39—Earcree Variant very gravelly sandy loam, 9 to 15 percent slopes. This is a deep, well drained soil on fans and toe slopes and in drainageways. It formed in stratified, gravelly, loamy alluvium and in colluvium derived dominantly from grus of the Pikes Peak Granite. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 8,000 to 9,500 feet.

Typically, the surface layer is neutral, dark grayish brown very gravelly sandy loam about 12 inches thick. The subsoil is neutral, dark grayish brown very gravelly sandy loam about 21 inches thick. The substratum to a depth of 60 inches is neutral, brown to dark brown very gravelly sandy loam.

Included in mapping are small areas of soils that are dark colored to a depth of less than 20 inches; these soils are on foot slopes. Also included are small areas of poorly drained Venable soils on low terraces and Raleigh soils on adjoining mountain side slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Earcree Variant soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate to severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 35 to 60 percent of the volume.

This soil is used mainly for grazing, as habitat for wildlife and recreation areas, and for community development. In a few areas it is used for hay and as pasture.

The native vegetation is mainly Arizona fescue, mountain muhly, Parry oatgrass, and western wheatgrass. There are a few scattered ponderosa pines. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are hard to establish and maintain on this soil because of the small stones, the short growing season, the slope, and the low available water capacity. Pebbles and cobbles in disturbed areas should be removed from the surface for best results in landscaping, particularly for lawns. Selecting climatically adapted plants is essential in establishing plantings. Mulching, fertilizing, and irrigation are needed in establishing seeded grasses and other small plants. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this Earcree Variant soil for homesite development are slope, seepage, and small stones. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Existing vegetation should be protected as much as possible during construction. Some areas can be used as greenbelts and parks planted with native vegetation and other adapted plants.

This soil is in capability subclass VIe, in the Loamy Park range site, and in plant adaptability group M-1.

40—Earcree Variant-Venable complex, 0 to 15 percent slopes. These soils are mainly on flood plains, fans, toe slopes, and low terraces. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 8,000 to 9,500 feet.

Earcree Variant soil makes up 45 percent of this complex, and Venable soil makes up 40 percent. The Earcree Variant soil is steeper and is on toe slopes and fans, and the Venable soil is less sloping and is on flood plains, alluvial valley floors, and low terraces. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of deep, moderately well drained soils on low terraces above the flood plain, Rosane soils on low terraces and flood plains, well drained Kittredge soils on higher terraces, and Raleigh soils on steep, adjoining mountain side slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Earcree Variant soil is deep and well drained. It formed in gravelly, loamy alluvium and in colluvium derived dominantly from grus of the Pikes Peak Granite.

Typically, the surface layer is neutral, dark grayish brown very gravelly sandy loam about 12 inches thick. The subsoil is neutral, dark grayish brown very gravelly sandy loam about 21 inches thick. The substratum to a depth of 60 inches is neutral, brown to dark brown very gravelly sandy loam.

Permeability of the Earcree Variant soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 35 to 60 percent of the volume.

The Venable soil is deep and poorly drained. It formed in loamy alluvium derived from igneous and metamorphic rocks.

Typically, the surface layer is neutral, very dark grayish brown loam about 5 inches thick. The subsoil in the upper 9 inches is neutral, very dark grayish brown sandy clay loam. In the lower 29 inches it is neutral, dark grayish brown clay loam that is mottled throughout. The substratum to a depth of 60 inches is neutral, grayish brown sandy loam that is mottled throughout.

Permeability of the Venable soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. A seasonal high water table is at a depth of 6 to 30 inches in spring and summer. In some areas the soil has been drained by artificial means or by gullying. This soil is subject to very brief periods of flooding in spring and summer. The depth to bedrock is more than 60 inches. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

The soils are used mainly for grazing, as habitat for wildlife and recreation areas, and for community development. In a few areas they are used for hay and as pasture.

The native vegetation on the Earcree Variant soil is mainly Arizona fescue, mountain muhly, and Parry oatgrass. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. On the Venable soil, the native vegetation is mainly tufted hairgrass, Canada sedge, and Baltic rush. The average annual production of air-dry vegetation ranges from 2,000 to 4,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. On the Venable soil, wetness limits the choice of plants and the period of cutting or grazing. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment of grasses, shrubs, trees, and garden plants on these soils is limited by the short growing season. The main concerns in management are small stones and the low available water capacity on the Earcree Variant soil and wetness on the Venable soil. Selecting climatically adapted plants is essential in establishing plantings. Only those plants that tolerate wetness are adapted to survive and become established on the Venable soil. On the Earcree Variant soil, pebbles and cobbles in disturbed areas should be removed from the surface for best results in landscaping, particularly for lawns; also, mulching, fertilizing, and irrigation are needed in establishing seeded grasses and other small plants.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are wetness and flooding on the Venable soil and slope, seepage, and small stones on the Earcree Variant soil. Drainage and structures to divert runoff are needed to protect buildings and roads. Effluent from absorption fields can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Existing vegetation should be protected as much as possible during construction. Some areas can be used as greenbelts and parks that are planted with native vegetation and other adapted plants.

This complex is in capability subclass VIe. The Earcree Variant soil is in the Loamy Park range site and in plant adaptability group M-1. The Venable soil is in the Mountain Meadow range site and in plant adaptability group M-2.

41—Englewood clay loam, 0 to 2 percent slopes. This is a deep, well drained soil on alluvial fans and in drainageways. It formed in calcareous, clayey alluvium derived dominantly from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, dark gray and very dark gray clay loam about 9 inches thick. The subsoil in the upper 30 inches is neutral and mildly

alkaline, dark grayish brown clay. In the lower 21 inches it is mildly alkaline, brown to pale brown clay and clay loam.

Included in mapping are small areas of Denver and Nunn soils on fans, Haverson and wet Englewood soils in drainageways and on flood plains, and soils that are on fans and low terraces and are similar to this Englewood soil except that they have less clay in the subsoil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Englewood soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, as pasture and recreation areas, and for crops. In a few areas it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the clay loam surface layer and clayey subsoil, which make tillage difficult. Maintaining plant residue on or near the surface reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

If this soil is used for homesite development, the main limitations are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help to prevent seepage into basements and to minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up tillage pans and improves water infiltration. Land leveling is needed in some areas for the uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue into the soil are essential in protecting soil from erosion, improving tilth, and conserving moisture. Soil blowing can be reduced by planting crops in alternate strips at right angles to the prevailing wind. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1.

42—Englewood clay loam, 2 to 5 percent slopes. This is a deep, well drained soil on alluvial fans and in drainageways. It formed in calcareous, clayey alluvium derived dominantly from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, dark gray and very dark gray clay loam about 9 inches thick. The subsoil in the upper 30 inches is neutral and mildly alkaline, dark grayish brown clay. In the lower 21 inches it is mildly alkaline, brown to pale brown clay and clay loam.

Included in mapping are small areas of Denver and Nunn soils on fans, Haverson and wet Englewood soils in drainageways and on flood plains, and soils that are on fans and low terraces and are similar to this Englewood soil except that they have less clay in the subsoil. Also included are small areas of Urban land. The

included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Englewood soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion and soil blowing are moderate hazards. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, pasture, recreation areas, and crops. In a few areas it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the clay loam surface layer and clayey subsoil, which make tillage difficult. Maintaining plant residue on or near the surface reduces runoff and helps to maintain tilth and the content of organic matter. Planting on the contour helps to conserve moisture and reduce erosion. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this Englewood soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Light, frequent applications of irrigation water are needed to prevent soil loss because of the slope and slow permeability. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up tillage pans and improves water infiltration. Land leveling is needed in some areas for the uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue are essential in protecting soil from erosion, improving tilth and conserving moisture. Terraces and diversions help reduce runoff and conserve moisture. Soil blowing can be reduced by planting crops in alternate strips at right angles to the prevailing wind. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IIIe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1.

43—Englewood clay loam, wet, 0 to 3 percent slopes. This is a deep, moderately well drained soil on alluvial fans and flood plains and in drainageways. It formed in calcareous, clayey alluvium derived dominantly from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, dark gray and very dark gray clay loam about 9 inches thick. The subsoil in the upper 38 inches is neutral and mildly alkaline, dark grayish brown to brown clay. In the lower 13 inches it is mildly alkaline, pale brown clay loam and clay.

Included in mapping are small areas of Denver and Nunn soils on fans, Haverson soils, which are well drained, on low terraces and on flood plains, and soils that are on fans and low terraces and are similar to this Englewood soil except that they have less clay in the subsoil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. A seasonal high water table, caused by seepage from irrigation

canals and surface irrigation, is at a depth of 60 to 72 inches. This soil is subject to rare, brief periods of flooding in spring and summer. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, pasture, recreation areas, and crops. In a few areas it is used for community development.

The native vegetation is mainly western wheatgrass, alkali sacaton, and switchgrass. The average annual production of air-dry vegetation ranges from 1,000 to 3,000 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and increased runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the clay loam surface layer and clayey subsoil, which make tillage difficult. Maintaining plant residue on or near the surface reduces runoff and helps to maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. In some areas, only those plants that tolerate saline soil should be selected for planting. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are flooding, the shrink-swell potential, low strength, and wetness. Structures to divert runoff and drains are needed to protect roads and building foundations from flooding and wetness. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Some areas can be used as greenbelts and parks that are planted with native vegetation and other adapted plants.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, maintaining or improving fertility, and reducing salinity and wetness. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Land leveling is needed in some areas for the uniform distribution of water. The saline condition can influence the choice of crops. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum. Tile drains and open drainage ditches may be needed to lower the water table and minimize wetness.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Maintaining crop residue on or near the surface reduces runoff and soil blowing and helps maintain tilth and the content of organic matter. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

The soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated; in the Salt Meadow range site; and in plant adaptability group PF-2.

44—Englewood-Urban land complex, 0 to 2 percent slopes. The areas of this complex are on alluvial fans and in drainageways. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

This complex is 65 percent Englewood soil and 20 percent Urban land. The areas are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Denver and Nunn soils on fans, Haverson and wet Englewood soils in drainageways and on flood plains, and soils that are on fans and low terraces and are similar to Englewood soils except that they have less clay in the subsoil. Also included are areas that are more than 20 percent Urban land and small areas that are less than 20 percent Urban land and are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Englewood soil is deep and well drained. It formed in calcareous, clayey alluvium derived dominantly from mudstone and shale.

Typically, the surface layer is neutral, dark gray and very dark gray clay loam about 9 inches thick. The subsoil in the upper 30 inches is neutral and mildly alkaline, dark grayish brown clay. In the lower 21 inches it is mildly alkaline, brown to pale brown clay and clay loam.

Permeability of the Englewood soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water

erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

Urban land is mainly covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

Most areas of this complex are used for community development. In a few areas, the Englewood soil is used as pasture and for grazing.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding hastens the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the clay loam surface layer and clayey subsoil, which make tillage difficult. Maintaining plant residue on or near the surface reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the Englewood soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff on Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally are not subject to flooding. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining adequate plant cover.

The Englewood soil in this complex is in capability subclasses IIe, irrigated, and IIIc, nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

45—Flatirons very cobbly sandy loam, 0 to 3 percent slopes. This is a deep, well drained soil on high terraces and piedmonts. It formed in noncalcareous, stony to gravelly, and loamy material of the Rocky Flats Alluvium. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 6,000 to 6,600 feet.

Typically, the surface layer is neutral and slightly acid, very dark grayish brown very cobbly sandy loam about 13 inches thick. The subsoil in the upper 8 inches is medium acid, reddish brown very gravelly clay; in the next 26 inches it is slightly acid and neutral, strong brown very gravelly sandy clay; and below that to a depth of 60 inches it is neutral, strong brown very gravelly sandy clay loam.

Included in mapping are small areas of calcareous soils near the edge of terraces, Veldkamp soils in positions similar to those of the Flatirons soil, soils near the mouth of Coal Creek Canyon that have a very stony surface layer, and soils that have a dark surface layer more than 20 inches thick and are on mounds. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Flatirons soil is slow. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion and soil blowing are slight hazards. The shrink-swell potential is moderate. Rock fragments make up 35 to 80 percent of the volume.

This soil is used mainly for grazing and as habitat for wildlife and recreation areas. In a few areas it is used for community development.

The native vegetation is mainly big bluestem, little bluestem, needleandthread, and mountain muhly. The average annual production of air-dry vegetation ranges from 1,000 to 2,300 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. This soil is difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Mechanical treatment is not practical because the surface is stony. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on this soil because of the large stones. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is

essential in establishing plantings. Pebbles and cobbles in disturbed areas should be removed from the surface for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

This Flatirons soil is limited for homesite development by the large stones, the shrink-swell potential, and the slow permeability. Excavating this soil for buildings and roads is difficult because of the large stones, and large equipment may be needed. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIIs, in the Cobbly Foothill range site, and in plant adaptability group F-5.

46—Flatirons very stony sandy loam, 0 to 5 percent slopes. This is a deep, well drained soil on undulating, dissected fan piedmonts. It formed in noncalcareous, cobbly, stony, gravelly, and loamy material of the Rocky Flats Alluvium. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 6,000 to 6,600 feet.

Typically, the surface layer is neutral and slightly acid, very dark grayish brown very stony sandy loam about 13 inches thick. The subsoil in the upper 8 inches is medium acid, reddish brown very gravelly clay; in the next 26 inches it is slightly acid and neutral, strong brown very gravelly sandy clay; and below that to a depth of 60 inches it is neutral, strong brown very gravelly sandy clay loam.

Included in mapping are small areas of calcareous soils near the edge of terraces, Veldkamp soils in positions similar to those of the Flatirons soil, and soils that have a very cobbly surface layer and are near the eastern limit of the map unit. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Flatirons soil is slow. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion and soil blowing are slight hazards. The shrink-swell potential is moderate. Rock fragments make up 35 to 80 percent of the volume.

In most places this soil is used for grazing and as wildlife habitat and recreation areas. In a few places it is used for community development.

The native vegetation is mainly big bluestem, little bluestem, needleandthread, and mountain muhly. The average annual production of air-dry vegetation ranges from 1,000 to 2,300 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. This soil is difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Mechanical treatment is not practical because the surface is stony. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on this soil because of the large stones. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

This Flatirons soil is limited for use as homesites by the large stones, the shrink-swell potential, and the slow permeability. Excavating this soil for buildings and roads is difficult because of the large stones, and large equipment may be needed. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIIs, in the Cobbly Foothill range site, and in plant adaptability group F-5.

47—Flatirons very stony sandy loam, 5 to 9 percent slopes. This is a deep, well drained soil on piedmonts and hill slopes. It formed in noncalcareous, cobbly, stony, gravelly, and loamy material of the Rocky Flats Alluvium. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 6,000 to 6,800 feet.

Typically, the surface layer is neutral and slightly acid, very dark grayish brown very stony sandy loam about 13 inches thick. The subsoil in the upper 8 inches is medium acid, reddish brown very gravelly clay; in the next 26 inches it is slightly acid and neutral, strong brown very gravelly sandy clay; and below that to a depth of 60 inches it is neutral, strong brown very gravelly sandy clay loam.

Included in mapping are small areas of Nederland soils on terrace escarpments, soils that have soft, reddish shale at a depth of 20 to 40 inches and are on convex shoulders and back slopes, and Veldkamp soils in positions similar to those of the Flatirons soil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Flatirons soil is slow. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is moderate. Rock fragments make up 35 to 80 percent of the volume.

This soil is used mainly for grazing and as wildlife habitat and recreation areas. In a few places it is used for community development.

The native vegetation is mainly big bluestem, little bluestem, needleandthread, and mountain muhly. The average annual production of air-dry vegetation ranges from 1,000 to 2,300 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. This soil is difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Mechanical treatment is not practical because the surface is stony. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on this soil because of the large stones. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Planting on the contour helps to conserve moisture and reduce erosion. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The Flatirons soil is limited for homesite development by the large stones, the shrink-swell potential, and the slow permeability. Excavating this soil for buildings and roads is difficult because of the large stones, and large equipment may be needed. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIIs, in the Cobbly Foothill range site, and in plant adaptability group F-5.

48—Flatirons very stony sandy loam, 9 to 15 percent slopes. This is a deep, well drained soil on hill slopes and ridges. It formed in noncalcareous, cobbly, stony, gravelly, and loamy material of the Rocky Flats Alluvium. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 6,000 to 6,800 feet.

Typically, the surface layer is neutral and slightly acid, very dark grayish brown very stony sandy loam about 13 inches thick. The subsoil in the upper 8 inches is medium acid, reddish brown very gravelly clay; in the next 26 inches it is slightly acid and neutral, strong brown very gravelly sandy clay; and below that to a depth of 60 inches it is neutral, strong brown very gravelly sandy clay loam.

Included in mapping are small areas of Nederland soils on terrace escarpments, soils that have soft, reddish shale at a depth of 20 to 40 inches and are on convex shoulders and back slopes, and Veldkamp soils in positions similar to those of the Flatirons soil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Flatirons soil is slow. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is moderate. Rock fragments make up 35 to 80 percent of the volume.

In most places this soil is used for grazing and as wildlife habitat and recreation areas. In a few places it is used for community development.

The native vegetation is mainly big bluestem, little bluestem, needleandthread, and mountain muhly. The average annual production of air-dry vegetation ranges from 1,000 to 2,300 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. This soil is difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Mechanical treatment is not practical because the surface is stony. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on this soil because of the large stones and the slope. A mulch of plant residue helps to reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Planting on the contour helps to conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to the use of this Flatirons soil for homesite development are the large stones, the shrink-swell potential, the slope, and the slow permeability. Excavating this soil for buildings and roads is difficult because of the large stones, and large equipment may be needed. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and controlling surface and subsurface drainage near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Special sewage systems must be installed because of the slow permeability. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIIs, in the Cobbly Foothill range site, and in plant adaptability group F-5.

49—Flatirons very stony sandy loam, 15 to 30 percent slopes. This is a deep, well drained soil on hill slopes and ridges. It formed in noncalcareous, cobbly, stony, gravelly, and loamy material of the Rocky Flats Alluvium. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 6,000 to 6,800 feet.

Typically, the surface layer is neutral and slightly acid, very dark grayish brown very stony sandy loam about 13 inches thick. The subsoil in the upper 8 inches is medium acid, reddish brown very gravelly clay; in the next 26 inches it is slightly acid and neutral, strong brown very gravelly sandy clay; and below that to a depth of 60 inches it is neutral, strong brown very gravelly sandy clay loam.

Included in mapping are small areas of Nederland soils on terrace escarpments, soils that have soft, reddish shale at a depth of 20 to 40 inches and are on convex shoulders and back slopes, and Veldkamp soils in positions similar to those of the Flatirons soil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Flatirons soil is slow. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is moderate. Rock fragments make up 35 to 80 percent of the volume.

This soil is used mainly for grazing and as habitat for wildlife and recreation areas. In a few places it is used for community development.

The native vegetation is mainly big bluestem, little bluestem, needleandthread, and mountain muhly. The average annual production of air-dry vegetation ranges from 1,000 to 2,300 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Proper grazing use is needed to prevent depletion because this soil is difficult to revegetate. Mechanical treatment is not practical because the surface is stony. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on this soil because of the large stones and the slope. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Pebbles and cobbles on the surface should be removed for best results in

landscaping, particularly for lawns. Planting on the contour helps to conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this Flatirons soil for homesite development are large stones, the shrink-swell potential, the slope, and the slow permeability. Excavating this soil for buildings and roads is difficult because of the large stones, and large equipment may be needed. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Special sewage systems must be installed because of the slope and the slow permeability. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIIs, in the Cobbly Foothill range site, and in plant adaptability group F-5.

50—Fluvaquents, sandy, 0 to 2 percent slopes. This map unit consists of deep, somewhat poorly drained and poorly drained soils on flood plains and low terraces adjacent to large perennial streams that commonly have a braided pattern. These soils formed in sandy alluvium derived from mixed sources. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, Fluvaquents are stratified loamy sand ranging to clay loam to a depth of about 10 to 20 inches. Below that, there is stratified very gravelly loamy sand and very gravelly sand.

Included in mapping are small areas of Paymaster soils on terraces. The included soils make up about 15 percent of the total acreage.

Permeability of Fluvaquents, sandy, is moderate to rapid. The available water capacity is low. Runoff is slow, and water erosion is a moderate hazard. A seasonal high water table is at a depth of 10 to 60 inches in winter and spring. These soils are subject to frequent, brief periods of flooding in spring and summer. The shrink-swell potential is low.

In most places these soils are used as habitat for wildlife and as recreation areas. In a few places they are used for grazing.

The native vegetation is mainly scattered stands of sandreed, prairie cordgrass, annual weeds, willow, and cottonwood. The average annual production of air-dry vegetation ranges from 100 to 4,000 pounds per acre. Revegetation is difficult; consequently, proper grazing use is needed to prevent depletion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of flooding, wetness, and small stones. Selecting adapted plants that tolerate wetness is necessary to establish plantings on these soils. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Flood-control structures are needed to protect plantings.

The main limitations to use of these soils for homesite development are flooding, wetness, and seepage. Drainage and structures to divert runoff are needed to protect buildings and roads from flooding and wetness. Special sewage systems must be installed because of seepage and wetness. Effluent from absorption fields can surface downstream and create a health hazard. Special sealing methods are needed to overcome excessive seepage. Some areas can be used as greenbelts and parks that are planted with native vegetation and other adapted plants.

These soils are in capability subclass VIw, in the River Bottom range site, and in plant adaptability group PF-5.

51—Fondis loam, 0 to 3 percent slopes. This is a deep, well drained soil on high terraces, tablelands, and convex ridges. It formed in calcareous, loamy eolian material derived from sedimentary rocks. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, grayish brown loam about 5 inches thick. The subsoil in the upper 20 inches is neutral, brown clay. In the lower 35 inches it is moderately alkaline, pale brown to brownish yellow clay loam and sandy clay loam.

Included in mapping are small areas of Platner, Nunn, and Denver soils in positions similar to those of the Fondis soil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Fondis soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion and soil blowing are slight hazards. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used for grazing, crops, and community development.

The native vegetation is mainly blue grama, western wheatgrass, and green needlegrass. The average annual

production of air-dry vegetation ranges from 900 to 1,500 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

This soil is well suited to grasses, shrubs, trees, and garden plants. A mulch of plant residue reduces soil blowing and runoff, improves tilth, and conserves moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Tillage is difficult because of the clayey subsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Land leveling is needed in some areas for the uniform distribution of water. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling can break up tillage pans and improve water infiltration.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue into the soil are essential in protecting soil from erosion and in improving tilth and conserving moisture. Growing a cover crop after a row crop is harvested and incorporating crop residue during periods of fallow are needed to control soil blowing. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated; in the Loamy Foothill range site; and in plant adaptability group F-3.

52—Garber Variant very gravelly sandy loam, 5 to 9 percent slopes. This is a deep, somewhat excessively drained soil on alluvial fans and toe slopes and in drainageways of the mountains. It formed in noncalcareous, gravelly, loamy grus derived dominantly from the Pikes Peak Granite. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Typically, the surface layer is neutral, dark grayish brown very gravelly sandy loam about 17 inches thick. The layer below that is neutral, grayish brown very gravelly sandy loam 8 inches thick. The underlying material to a depth of 60 inches is neutral, grayish brown very gravelly loamy sand.

Included in mapping are small areas of Sphinx and Resort soils on ridges and mountain side slopes that have a south aspect, Raleigh soils on mountain side slopes and summits that have a north aspect, and soils that have stones and cobbles on the surface. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Garber Variant soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 35 to 60 percent of the volume.

This soil is used mainly for grazing, pasture, habitat for wildlife, and recreation areas. In a few places it is used for community development.

The native vegetation is mainly Arizona fescue, mountain muhly, Parry oatgrass, and, in some areas, scattered ponderosa pines. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The

rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment of grasses, shrubs, trees, and garden plants is limited by the short growing season and low available water capacity. Selecting climatically adapted plants is essential in establishing plantings. Supplemental irrigation is needed at planting time and during dry periods. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Deep cuts made in land grading should be covered with a layer of topsoil. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitation to use of the soil for homesite development is seepage. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass IVe, irrigated and nonirrigated, in the Loamy Park range site, and in plant adaptability group M-1.

53—Garber Variant very gravelly sandy loam, 9 to 15 percent slopes. This is a deep, somewhat excessively drained soil on alluvial fans and toe slopes and in drainageways of the mountains. It formed in noncalcareous, gravelly, loamy grus derived dominantly from the Pikes Peak Granite. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Typically, the surface layer is neutral, dark grayish brown very gravelly sandy loam about 17 inches thick. The layer below that is neutral, grayish brown very gravelly sandy loam 8 inches thick. The underlying material to a depth of 60 inches is neutral, grayish brown very gravelly loamy sand.

Included in mapping are small areas of Sphinx and Resort soils on ridges and mountain side slopes that have a south aspect, Raleigh soils on mountain side slopes and summits that have a north aspect, and soils that have stones and cobbles on the surface. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Garber Variant soil is rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 35 to 60 percent of the volume.

This soil is used mainly for grazing, pasture, habitat for wildlife, and recreation areas. In a few places it is used for community development.

The native vegetation is mainly Arizona fescue, mountain muhly, Parry oatgrass, and, in some areas, scattered ponderosa pines. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the short growing season, slope, and low available water capacity. Selecting climatically adapted plants is essential in establishing plantings. Supplemental irrigation is needed at planting time and during dry periods. Planting on the contour helps conserve moisture and reduce erosion. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are seepage and slope. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of

the water supply by seepage. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Loamy Park range site, and in plant adaptability group M-1.

54—Grimstone stony sandy loam, 9 to 15 percent slopes. This is a moderately deep, well drained soil on north-facing mountain side slopes. It formed in noncalcareous, stony, gravelly, and loamy material derived from igneous and metamorphic rocks. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,200 to 9,500 feet.

Typically, the surface is covered by a 1-inch mat of partly decomposed needles, leaves, and twigs. The surface layer is neutral, grayish brown stony sandy loam about 1 inch thick. The subsurface layer is medium acid, very pale brown gravelly loamy sand about 10 inches thick. The layer below that is medium acid, pale brown gravelly sandy loam about 5 inches thick. The subsoil in the upper 7 inches is strongly acid, strong brown gravelly sandy clay loam. In the lower 13 inches it is strongly acid, strong brown gravelly sandy loam. Soft schist is at a depth of 36 inches.

Included in mapping are small areas of Peeler soils on mountain side slopes, Legault and Hiwan soils on ridges and mountain side slopes, Rock outcrop on ridge crests and shoulders, and areas of soils that do not have stones on the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

Permeability of this Grimstone soil is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

This soil is used mainly as woodland, habitat for wildlife, and recreation areas. In a few places it is used for community development.

The native vegetation is mainly an overstory of Douglas-fir and some lodgepole pine and ponderosa pine and an understory of common juniper, kinnikinnick, and scattered grasses and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the slope, large stones, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the slope, depth to rock, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. The steepness of slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. Structures to divert runoff from buildings and roads are needed. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Douglas-fir—Lodgepole Pine woodland group, and in plant adaptability group M-7.

55—Grimstone-Hiwan-Rock outcrop complex, 30 to 60 percent slopes. This complex is on north-facing mountain side slopes and ridges. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,000 to 9,500 feet.

Grimstone soil makes up 35 percent of this complex, Hiwan soil makes up 30 percent, and Rock outcrop makes up 20 percent. Grimstone soil is on mountain side slopes, Hiwan soil is on ridges and side slopes, and Rock outcrop is on ridges and side slopes. The areas are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Legault soils on ridges and side slopes and Tolvar and Peeler soils on mountain side slopes. Also included are small areas of Urban land. Rock outcrop makes up less than 20 percent of some mapped areas. The included areas make up about 15 percent of the map unit.

The Grimstone soil is moderately deep and well drained. It formed in noncalcareous, stony, gravelly, and loamy material derived from igneous and metamorphic rocks.

Typically, the surface is covered by a mat about 1 inch thick of partly decomposed needles, leaves, and twigs. The surface layer is neutral, grayish brown stony sandy loam about 1 inch thick. The subsurface layer is medium acid, very pale brown gravelly loamy sand about 10 inches thick. The layer below that is medium acid, pale brown gravelly sandy loam about 5 inches thick. The subsoil in the upper 7 inches is strongly acid, strong brown gravelly sandy clay loam. In the lower 13 inches it is strongly acid, strong brown gravelly sandy loam. Soft schist is at a depth of 36 inches.

Permeability of the Grimstone soil is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

The Hiwan soil is shallow and well drained. It formed in acidic, stony, gravelly, and sandy material derived from igneous and metamorphic rocks.

Typically, the surface is covered by a mat about 1 inch thick of partly decomposed needles, leaves, and twigs. The surface layer is medium acid, dark grayish brown stony loamy sand about 1 inch thick. The subsurface layer is strongly acid, very pale brown very gravelly loamy sand about 14 inches thick. Hard quartz monzonite is at a depth of 15 inches.

Permeability of the Hiwan soil is rapid. The available water capacity is low. The effective rooting depth is 5 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 5 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

Rock outcrop consists of exposures of igneous and metamorphic rocks, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces.

The soils are used mainly as woodland, as habitat for wildlife, and as recreation areas. In a few areas they are used for community development.

The native vegetation is mainly an overstory of Douglas-fir and some lodgepole pine and ponderosa pine and an understory of common juniper, kinnikinnick, and scattered grasses and forbs. Management of the wooded areas is for wildlife, recreation, watershed, and community development. Thinning overcrowded stands and removing dead trees help reduce susceptibility to insect attack and ensure healthier and more productive trees. Maintaining sufficient ground cover is necessary to control erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, large stones, depth to rock, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve soil moisture. Applications of manure and commercial fertilizers containing nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. The removal of pebbles and cobbles in disturbed areas is required for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the soils for homesite development are slope, depth to rock, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from absorption fields can surface downslope and create a health hazard. Structures to divert runoff are needed where buildings and roads are constructed. The design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This complex is in capability subclass VIIe. The Grimstone and Hiwan soils are in the Douglas-fir—Lodgepole Pine woodland group and in plant adaptability group M-7.

56—Grimstone-Peeler-Rock outcrop complex, 15 to 30 percent slopes. The areas of this complex are on north-facing mountain side slopes. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,000 to 9,500 feet.

Grimstone soil makes up 40 percent of this complex, Peeler soil makes up 25 percent, and Rock outcrop makes up 20 percent. Grimstone soil is on side slopes, Peeler soil is on side slopes, and Rock outcrop is on shoulders and side slopes. The areas are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Legault and Hiwan soils on ridges and side slopes and Tolvar soils on side slopes. Rock outcrop makes up less than 20 percent of some mapped areas. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Grimstone soil is moderately deep and well drained. It formed in noncalcareous, stony, gravelly, and loamy material derived from igneous and metamorphic rocks.

Typically, the surface is covered by a 1-inch mat of partly decomposed needles, leaves, and twigs. The surface layer is neutral, grayish brown stony sandy loam about 1 inch thick. The subsurface layer is medium acid, very pale brown gravelly loamy sand about 10 inches thick. The layer below that is medium acid, pale brown gravelly sandy loam about 5 inches thick. The subsoil in the upper 7 inches is strongly acid, strong brown gravelly sandy clay loam. In the lower 13 inches it is strongly acid, strong brown gravelly sandy loam. Soft schist is at a depth of 36 inches.

Permeability of the Grimstone soil is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

The Peeler soil is deep and well drained. It formed in acidic, stony, gravelly, and loamy material derived from igneous and metamorphic rocks.

Typically, the surface is covered by a 1-inch mat of partly decomposed twigs, needles, and leaves. The surface layer is slightly acid, dark grayish brown stony sandy loam about 4 inches thick. The subsurface layer is strongly acid, pale brown gravelly loamy sand about 6 inches thick. The layer below that is very strongly acid, light yellowish brown gravelly loamy sand about 5 inches thick. The upper part of the subsoil is very strongly acid, brown and strong brown gravelly sandy loam and gravelly sandy clay loam 20 inches thick. The lower part to a depth of 60 inches is strongly acid, strong brown gravelly sandy loam.

Permeability of the Peeler soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

Rock outcrop consists of exposures of igneous and metamorphic rocks, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces.

The soils are used mainly as woodland, as habitat for wildlife, and as recreation areas. In a few places they are used for community development.

The native vegetation is mainly an overstory of Douglas-fir and some lodgepole pine and ponderosa pine and an understory of common juniper, kinnikinnick, and scattered grasses and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, large stones, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitations to use of the soils for homesite development are the slope, depth to rock, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Structures to divert runoff from buildings and roads are needed. In constructing roads and streets in residential communities, the same practices are needed that help control erosion on access roads in wooded areas. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from absorption fields can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This complex is in capability subclass VIe. The Grimstone and Peeler soils are in the Douglas-fir—Lodgepole Pine woodland group and in plant adaptability group M-7.

57—Grimstone-Peeler-Rock outcrop complex, 30 to 50 percent slopes. The areas of this complex are on north-facing mountain side slopes. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free

season ranges from 55 to 75 days. Elevation is 7,000 to 9,500 feet.

Grimstone soil makes up 40 percent of this complex, Peeler soil makes up 25 percent, and Rock outcrop makes up 20 percent. Grimstone soil is on side slopes, Peeler soil is on side slopes, and Rock outcrop is on shoulders and side slopes. The areas are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Legault and Hiwan soils on ridges and side slopes and Tolvar soils on side slopes. Rock outcrop makes up less than 20 percent of some mapped areas. Also included are small areas of Urban land. The included soil and Urban land make up about 15 percent of the total acreage.

The Grimstone soil is moderately deep and well drained. It formed in noncalcareous, stony, gravelly, and loamy material derived from igneous and metamorphic rocks.

Typically, the surface is covered by a 1-inch mat of partly decomposed needles, leaves, and twigs. The surface layer is neutral, grayish brown stony sandy loam about 1 inch thick. The subsurface layer is medium acid, very pale brown gravelly loamy sand about 10 inches thick. The layer below that is medium acid, pale brown gravelly sandy loam about 5 inches thick. The subsoil in the upper 7 inches is strongly acid, strong brown gravelly sandy clay loam. In the lower 13 inches it is strongly acid, strong brown gravelly sandy loam. Soft schist is at a depth of 36 inches.

Permeability of the Grimstone soil is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

The Peeler soil is deep and well drained. It formed in acidic, stony, gravelly, and loamy material derived from igneous and metamorphic rocks.

Typically, the surface is covered by a 1-inch mat of partly decomposed twigs, needles, and leaves. The surface layer is slightly acid, dark grayish brown stony sandy loam about 4 inches thick. The subsurface layer is strongly acid, pale brown gravelly loamy sand about 6 inches thick. The layer below that is very strongly acid, light yellowish brown gravelly loamy sand about 5 inches thick. The upper part of the subsoil is very strongly acid, brown and strong brown gravelly sandy loam and gravelly sandy clay loam 20 inches thick. The lower part to a depth of 60 inches is strongly acid, strong brown gravelly sandy loam.

Permeability of the Peeler soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

Rock outcrop consists of exposures of igneous and metamorphic rocks, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces.

The soils are used mainly as woodland, as habitat for wildlife, and as recreation areas. In a few places they are used for community development.

The native vegetation is mainly an overstory of Douglas-fir and some lodgepole pine and ponderosa pine and an understory of common juniper, kinnikinnick, and scattered grasses and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, large stones, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles should be removed for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitations to use of the soils for homesite development are the slope, depth to rock, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Structures to divert runoff from buildings and roads are needed. In constructing roads and streets in residential communities, the same practices are needed that help control erosion on access roads in wooded areas. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from absorption fields can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This complex is in capability subclass VIIe. The Grimstone and Peeler soils are in the Douglas-fir—Lodgepole Pine woodland group and in plant adaptability group M-7.

58—Hargreave sandy loam, 3 to 9 percent slopes. This is a moderately deep, well drained soil on ridges and hill slopes. It formed in noncalcareous, reddish, loamy material derived from red sedimentary rocks. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average annual frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Typically, the surface layer is neutral, dark grayish brown sandy loam about 4 inches thick. The subsoil in the upper 14 inches is neutral, brown and dark reddish gray sandy clay loam. In the lower 11 inches it is neutral, reddish brown sandy loam. Soft sandstone is at a depth of 29 inches.

Included in mapping are small areas of Bernal soils on ridges and hill slopes, Ascalon and Lavate soils on fans and hill slopes, and Nunn and Rednun soils on fans. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Hargreave soil is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Runoff is slow, and water erosion and soil blowing are moderate hazards. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is moderate. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, as habitat for wildlife, and for community development. In a few areas it is used for crops.

The native vegetation is mainly western wheatgrass, blue grama, Sandberg bluegrass, and Griffith wheatgrass. The average annual production of air-dry vegetation ranges from 900 to 1,500 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

This soil is well suited to grasses, shrubs, trees, and garden plants. A mulch of plant residue helps to reduce soil blowing and runoff, to improve soil tilth, and to conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps to conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that would normally not be subject to flooding.

If the Hargreave soil is used for homesite development, the main limitations are the depth to rock and the shrink-swell potential. The deep cuts needed to provide a sufficiently level building site can expose bedrock. The effects of shrinking and swelling can be minimized by proper engineering design. Revegetating disturbed areas around construction sites as soon as possible helps control soil blowing. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Land leveling is needed in some areas for the uniform distribution of water, but there is a risk of exposing bedrock in leveling operations. Light, frequent applications of irrigation water are needed to prevent soil loss because of the slope. Tillage should be kept to a minimum.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue into the soil are essential in protecting soil from erosion, improving tilth, and conserving moisture. Soil blowing can be reduced by planting crops in alternate strips at right angles to the prevailing wind. Terraces and diversions help reduce runoff and conserve moisture. Tillage should be kept to a minimum.

This soil is in capability subclass IVe, irrigated and nonirrigated; in the Loamy Foothill range site; and in plant adaptability group F-3.

59—Hargreave-Bernal sandy loams, 9 to 15 percent slopes. These soils are on hill slopes, convex knobs, and ridges. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Hargreave soil makes up 45 percent of this map unit, and Bernal soil makes up 40 percent. Hargreave soil is on hill slopes, and Bernal soil is on convex knobs and

ridges. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Ascalon soils on toe slopes, Critchell soils on fans, and Lavate soils on toe slopes and foot slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Hargreave soil is moderately deep and well drained. It formed in noncalcareous, reddish, loamy material derived from red sedimentary rocks.

Typically, the surface layer is neutral, dark grayish brown sandy loam about 4 inches thick. The subsoil in the upper 14 inches is neutral, brown and dark reddish gray sandy clay loam. In the lower 11 inches it is neutral, reddish brown sandy loam. Soft sandstone is at a depth of 29 inches.

Permeability of the Hargreave soil is moderate. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Runoff is medium. Water erosion and soil blowing are moderate hazards. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is moderate. Rock fragments make up 0 to 15 percent of the volume.

The Bernal soil is shallow and well drained. It formed in noncalcareous, mixed material derived from reddish sandstone.

Typically, the surface layer is slightly acid, reddish gray sandy loam about 2 inches thick. The subsoil in the upper 4 inches is slightly acid, reddish brown sandy loam. In the lower 7 inches it is medium acid, light reddish brown sandy loam. Hard sandstone is at a depth of 13 inches.

Permeability of the Bernal soil is moderately rapid. The available water capacity is low. The effective rooting depth is 8 to 20 inches. Runoff is medium. Water erosion and soil blowing are moderate hazards. The depth to hard bedrock ranges from 8 to 20 inches. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

The soils are used mainly for community development and grazing and as habitat for wildlife. In a few areas they are used for nonirrigated crops.

The native vegetation is mainly western wheatgrass, blue grama, junegrass, and green needlegrass. The average annual production of air-dry vegetation ranges from 900 to 1,500 pounds per acre on the Hargreave soil and from 300 to 600 pounds per acre on the Bernal soil. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by depth to bedrock and slope. Applications of manure and of commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A mulch is essential in establishing good stands of plantings on steep cut and fill slopes. Supplemental irrigation is needed at the time of planting and during dry periods. Planting on the contour helps conserve moisture and reduce erosion. Selecting adapted plants is essential in establishing plantings.

The main limitations to use of the soils for homesite development are depth to rock and slope and, on the Hargreave soil, the shrink-swell potential. The deep cuts needed to provide a sufficiently level building site can expose bedrock. The effects of shrinking and swelling can be minimized by proper engineering design. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Revegetating disturbed areas around construction sites as soon as possible helps control erosion. Effluent from absorption fields can surface downslope and create a health hazard.

Areas that are used for nonirrigated crops are most commonly severely eroded. Seeding them to grass helps check erosion.

These soils are in capability subclass VIe. The Hargreave soil is in the Loamy Foothill range site and in plant adaptability group F-3. The Bernal soil is in the Shallow Foothill range site and in plant adaptability group F-7.

60—Haverson loam, 0 to 3 percent slopes. This is a deep, well drained soil on flood plains and low terraces. It formed in stratified loamy alluvium of mixed origin. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, grayish brown loam about 6 inches thick. The upper part of the underlying material is moderately alkaline, brown, stratified clay loam and gravelly loam about 40 inches thick. The lower part to a depth of 60 inches is mildly alkaline, grayish brown, stratified very gravelly loamy sand.

Included in mapping are small areas of the poorly drained McClave soils on low flood plains, Englewood soils in drainageways adjacent to higher lying clayey soils, Paymaster soils on low terraces adjacent to higher lying loamy soils, and the somewhat poorly drained Alda soils on low terraces. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Haverson soil is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. This soil is subject to very brief periods of flooding in spring and summer. The shrink-swell potential is low. Rock fragments make up 0 to 35

percent of the volume, but in some areas they make up more than 35 percent below a depth of 40 inches.

This soil is used mainly for grazing and crops and as habitat for wildlife. In a few areas it is used for community development.

The native vegetation is mainly western wheatgrass, switchgrass, blue grama, and forbs. The average annual production of air-dry vegetation ranges from 1,000 to 2,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment.

This soil is well suited to grasses, shrubs, trees, and garden plants. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitation to use of this soil for homesite development is flooding. Structures to divert runoff are needed to protect buildings and roads. Properly installed tile drains below the foundation and minimal surface watering near the foundation help control seepage into basements. Some areas can be used as greenbelts and parks that are planted with native vegetation and other adapted plants.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Land leveling is needed in some areas for the uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue into the soil are essential in protecting soil from erosion, improving tilth, and conserving moisture. Tillage should be kept to a minimum.

This soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated; in the Overflow range site; and in plant adaptability group PF-1.

61—Haverson loam, 3 to 9 percent slopes. This is a deep, well drained soil on flood plains and low terraces. It formed in stratified loamy alluvium of mixed origin. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, grayish brown loam about 6 inches thick. The upper part of the underlying material is moderately alkaline, brown, stratified clay loam and gravelly loam about 40 inches thick. The lower part to a depth of 60 inches is mildly alkaline, grayish brown, stratified very gravelly loamy sand.

Included in mapping are small areas of the poorly drained McClave soils on low flood plains, Englewood soils in drainageways adjacent to higher lying clayey soils, Paymaster soils on low terraces adjacent to higher lying loamy soils, the somewhat poorly drained Alda soils on low terraces, and stony soils on fans and toe slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Haverson soil is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium. Water erosion and soil blowing are moderate hazards. This soil is subject to very brief periods of flooding in spring and summer. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume; in some areas, they make up more than 35 percent below a depth of 40 inches.

This soil is used mainly for grazing and crops and as habitat for wildlife. In a few areas it is used for community development.

The native vegetation is mainly western wheatgrass, switchgrass, blue grama, and forbs. The average annual production of air-dry vegetation ranges from 1,000 to 2,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment.

This soil is well suited to grasses, shrubs, trees, and garden plants. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding

downslope in areas that normally would not be subject to flooding.

The main limitation to use of this soil for homesite development is flooding. Structures to divert runoff are needed where buildings and roads are constructed. Properly installed tile drains below the foundation and minimal watering on the surface near the foundation help control seepage into basements. Some areas can be used as greenbelts and parks that are planted with native vegetation and other adapted plants.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Irrigation water should be applied lightly and frequently to prevent soil loss because of the slope. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Land leveling is needed in some areas for the uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue into the soil are essential in protecting soil from erosion, improving tilth, and conserving moisture. Terraces and diversions help reduce runoff and conserve moisture. Tillage should be kept to a minimum.

This soil is in capability subclass IVe, irrigated and nonirrigated; in the Overflow range site; and in plant adaptability group PF-1.

62—Heldt clay, 3 to 9 percent slopes. This is a deep, well drained soil on alluvial fans, high terraces, and hill slopes. It formed in calcareous, clayey material derived dominantly from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is moderately alkaline and mildly alkaline, grayish brown and light olive brown clay about 6 inches thick. The subsoil is moderately alkaline and mildly alkaline, light yellowish brown clay 36 inches thick. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Included in mapping are small areas of Denver soils in positions similar to those of the Heldt soil, Nunn and Ulm soils on fans, Renohill and Razor soils on ridges and hill slopes, and Manzanola soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Heldt soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion and soil blowing are moderate hazards. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing and as pasture. In a few areas it is used for crops and community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the clayey surface layer and subsoil, which make tillage difficult. A mulch of plant residue helps to reduce runoff and to maintain tilth and the content of organic matter. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Planting on the contour helps to conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the Heldt soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining

the content of organic matter increase water infiltration and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up tillage pans and improves water infiltration. Light, frequent applications of irrigation water are needed to prevent soil loss because of the slope. Land leveling is needed for the uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue into the soil are essential in protecting the soil from erosion, improving tilth, and conserving moisture. Terracing and contour tillage are needed to reduce erosion. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IVe, irrigated and nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1.

63—Heldt clay, 9 to 15 percent slopes. This is a deep and well drained soil on hill slopes and alluvial fans. It formed in calcareous, clayey material derived dominantly from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is moderately alkaline and mildly alkaline, grayish brown and light olive brown clay about 6 inches thick. The subsoil is moderately alkaline and mildly alkaline, light yellowish brown clay 36 inches thick. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Included in mapping are small areas of Denver soils in positions similar to those of the Heldt soil, Nunn and Ulm soils on fans, Renohill and Razor soils on ridges and hill slopes, and Manzanola soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Heldt soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing and pasture. In a few areas it is used for community development and crops.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Proper grazing use is needed to prevent depletion because this soil is difficult to revegetate. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the slope and the clayey surface layer and subsoil, which make tillage difficult. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this Heldt soil for homesite development are the shrink-swell potential, slope, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slope and slow permeability. Effluent from an absorption field can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched.

Most of the areas that are used for nonirrigated crops are severely eroded. Seeding them to grass helps to check erosion.

This soil is in capability subclass VIe, irrigated and nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1.

64—Herbman-Sprucedale-Rock outcrop complex, 9 to 15 percent slopes. The areas of this complex are on mountain side slopes, summits, and ridges that have an east, west, or south aspect. The average annual precipitation is 17 to 20 inches, the average annual air

temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,600 to 9,500 feet.

Herbman soil makes up 35 percent of this complex, Sprucedale soil makes up 30 percent, and Rock outcrop makes up 15 percent. The Herbman soil is on ridges and side slopes, the Sprucedale soil is on side slopes and summits, and Rock outcrop is on ridges.

Included in mapping are small areas of Earcree soils in drainageways and on toe slopes, Troutdale soils on side slopes, Legault soils on north-facing ridges, directly under coniferous trees, and Rogert soils on ridges that have hard bedrock. Also included are small areas where the bedrock is less resistant to weathering; in these areas there are no stones on the surface and no Rock outcrop. Also included are small areas of Urban land. The included areas make up about 20 percent of the total acreage.

The Herbman soil is shallow and well drained. It formed in noncalcareous, stony, gravelly, and loamy material derived from igneous and metamorphic rocks.

Typically, the surface layer is slightly acid, dark grayish brown stony sandy loam about 4 inches thick. The layer below that is neutral, brown to dark brown very gravelly sandy loam about 9 inches thick. Soft schist is at a depth of 13 inches.

Permeability of the Herbman soil is moderately rapid. The available water capacity is low. The effective rooting depth is 7 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 7 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Sprucedale soil is shallow and well drained. It formed in noncalcareous, micaceous, gravelly, and loamy alluvial and colluvial material derived from igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark grayish brown gravelly sandy loam about 6 inches thick. The subsoil is neutral, brown to dark brown gravelly sandy loam 6 inches thick. Soft schist is at a depth of 12 inches.

Permeability of the Sprucedale soil is moderately rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

Rock outcrop consists of exposures of igneous and metamorphic bedrock, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces.

In most places the soils are used as woodland, as habitat for wildlife and as recreation areas. In a few places they are used for grazing and community development.

The native vegetation is mainly an overstory of ponderosa pine and Douglas-fir and an understory of common juniper, mountainmahogany, and a variety of grasses and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help reduce susceptibility to insect attack and help keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the shallowness to rock, the slope, the small and large stones, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Selecting adapted plants is essential in establishing plantings. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the Herbman and Sprucedale soils for homesite development are the slope and shallowness to rock. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Preserving the existing plant cover during construction helps to control erosion. Cuts and fills should be seeded or mulched. In constructing roads and streets in residential communities, the same practices are needed that help control erosion on access roads in wooded areas. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply as a result of seepage along the bedrock contact.

This complex is in capability subclass VIe. The Herbman and Sprucedale soils are in the Mixed Conifer woodland group and in plant adaptability group M-6.

65—Herbman-Sprucedale-Rock outcrop complex, 15 to 30 percent slopes. The areas of this complex are on mountain side slopes, summits, and ridges that have an east, west, or south aspect. The average annual

precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,600 to 9,500 feet.

Herbman soil makes up 40 percent of this complex, Sprucedale soil makes up 25 percent, and Rock outcrop makes up 15 percent. Herbman soil is on ridges and side slopes, Sprucedale soil is on side slopes and summits, and Rock outcrop is on ridges.

Included in mapping are small areas of Earcree soils in drainageways and on toe slopes, Troutdale soils on side slopes, Legault soils on north-facing ridges, directly under coniferous trees, and Rogert soils on ridges that have hard bedrock. Also included are small areas where the bedrock is less resistant to weathering; in these areas there are no stones on the surface and no Rock outcrop. Also included are small areas of Urban land. The included areas make up about 20 percent of the total acreage.

The Herbman soil is shallow and well drained. It formed in noncalcareous, stony, gravelly, and loamy material derived from igneous and metamorphic rocks.

Typically, the surface layer is slightly acid, dark grayish brown stony sandy loam about 4 inches thick. The layer below that is neutral, brown to dark brown very gravelly sandy loam about 9 inches thick. Soft schist is at a depth of 13 inches.

Permeability of the Herbman soil is moderately rapid. The available water capacity is low. The effective rooting depth is 7 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 7 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Sprucedale soil is shallow and well drained. It formed in noncalcareous, micaceous, gravelly, and loamy alluvial and colluvial material derived from igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark grayish brown gravelly sandy loam about 6 inches thick. The subsoil is neutral, brown to dark brown gravelly sandy loam 6 inches thick. Soft schist is at a depth of 12 inches.

Permeability of the Sprucedale soil is moderately rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

Rock outcrop consists of exposures of igneous and metamorphic bedrock, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces.

In most places the soils in this complex are used as woodland, as habitat for wildlife, and as recreation areas. In a few places they are used for community development and grazing.

The native vegetation is mainly an overstory of ponderosa pine and Douglas-fir and an understory of common juniper, mountainmahogany, and a variety of grasses and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help reduce susceptibility to insect attack and help keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the shallowness to rock, the slope, the small and large stones, and the short growing season. A mulch is essential in establishing good stands of plantings on steep cut and fill slopes. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Selecting adapted plants is essential in establishing plantings. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the Herbman and Sprucedale soils for homesite development are slope and shallowness to rock. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Preserving the existing plant cover during construction helps control erosion. In constructing roads and streets in residential communities, the same practices are needed that help control erosion on access roads in wooded areas. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply as a result of seepage along the bedrock contact.

This complex is in capability subclass VIe. The Herbman and Sprucedale soils are in the Mixed Conifer woodland group and in plant adaptability group M-6.

66—Kittredge-Earcree complex, 3 to 9 percent slopes. These soils are on terraces, fans, and mountain toe slopes and in drainageways. The average annual

precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,600 to 9,500 feet.

Kittredge soil makes up 60 percent of this complex, and Earcree soil makes up 25 percent. Kittredge soil is on toe slopes and terraces, and Earcree soil is on fans and in drainageways. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Troutdale soils on side slopes, Rogert soils on ridges, the poorly drained Venable soils on flood plains and low terraces, and Cryofluvents on flood plains. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Kittredge soil is deep and well drained. It formed in loamy alluvium and colluvium derived from igneous and metamorphic rocks.

Typically, the surface layer is slightly acid, dark grayish brown sandy loam about 8 inches thick. The subsoil in the upper 31 inches is slightly acid, dark grayish brown and grayish brown sandy clay loam. In the lower 12 inches it is neutral, dark brown sandy loam. The substratum to a depth of 60 inches is neutral, brown sandy loam.

Permeability of the Kittredge soil is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow to medium, and water erosion is a slight to moderate hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

The Earcree soil is deep and well drained. It formed in loamy alluvium and colluvium derived dominantly from igneous and metamorphic rocks.

Typically, the surface layer is neutral, very dark grayish brown gravelly sandy loam about 11 inches thick. The subsoil is neutral, very dark grayish brown gravelly sandy loam about 34 inches thick. The substratum to a depth of 60 inches is neutral, dark grayish brown gravelly sandy loam.

Permeability of the Earcree soil is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low. Rock fragments make up 15 to 35 percent of the volume.

These soils are used mainly for grazing and as recreation areas and wildlife habitat. In a few places they are used as hayland and for community development.

The native vegetation is mainly Arizona fescue, mountain muhly, Parry oatgrass, and bluegrass. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Where the range vegetation has seriously deteriorated, seeding is needed. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the short growing season and small stones. Selecting climatically adapted plants is essential in establishing plantings. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Mulching and irrigation are needed to establish seeded grasses and other small plants. The removal of pebbles in disturbed areas is required for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitation to use of the soils for homesite development is seepage. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as greenbelts and parks that are planted with native vegetation and other adapted plants.

Areas that are used for crops commonly are gullied. Seeding them to grass helps prevent further erosion.

These soils are in capability subclass VIe, in the Loamy Park range site, and in plant adaptability group M-1.

67—Kittredge-Earcree complex, 9 to 20 percent slopes. These soils are on terraces, fans, and mountain toe slopes and in drainageways. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,600 to 9,500 feet.

Kittredge soil makes up 45 percent of this complex, and Earcree soil makes up 40 percent. Kittredge soil is on toe slopes and terraces, and Earcree soil is on fans

and in drainageways. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Troutdale soils on side slopes, Rogert soils on ridges, poorly drained Venable soils on flood plains and low terraces, and Cryofluvents on flood plains. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Kittredge soil is deep and well drained. It formed in loamy alluvium and colluvium derived from igneous and metamorphic rocks.

Typically, the surface layer is slightly acid, dark grayish brown sandy loam about 8 inches thick. The subsoil in the upper 31 inches is slightly acid, dark grayish brown and grayish brown sandy clay loam. In the lower 12 inches it is neutral, dark brown sandy loam. The substratum to a depth of 60 inches is neutral, brown sandy loam.

Permeability of the Kittredge soil is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is medium to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

The Earcree soil is deep and well drained. It formed in loamy alluvium and colluvium derived dominantly from igneous and metamorphic rocks.

Typically, the surface layer is neutral, very dark grayish brown gravelly sandy loam about 11 inches thick. The subsoil is neutral, very dark grayish brown gravelly sandy loam about 34 inches thick. The substratum to a depth of 60 inches is neutral, dark grayish brown gravelly sandy loam.

Permeability of the Earcree soil is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is medium. Water erosion and soil blowing are moderate hazards. The shrink-swell potential is low. Rock fragments make up 15 to 35 percent of the volume.

The soils are used mainly for grazing and as recreation areas and habitat for wildlife. In a few places they are used as hayland and for community development.

The native vegetation is mainly Arizona fescue, mountain muhly, Parry oatgrass, and bluegrass. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Where the range vegetation has seriously deteriorated, seeding is needed. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees and garden plants are restricted by the short growing season, small stones, and slope. Selecting climatically adapted plants is essential in establishing plantings. The removal of pebbles in disturbed areas is required for best results in landscaping, particularly for lawns. Planting on the contour helps conserve moisture and reduce erosion. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Mulching and irrigation are needed to establish grasses and other small seeded plants. Deep cuts made in land grading should be covered with a layer of topsoil.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are seepage and slope. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as greenbelts and parks that are planted with native vegetation and other adapted plants.

Areas that are used for crops commonly are gullied. Seeding them to grass helps prevent further erosion.

These soils are in capability subclass VIe, in the Loamy Park range site, and in plant adaptability group M-1.

68—Kittredge-Venable complex, 0 to 15 percent slopes. These soils are on alluvial valley floors, flood plains, fans, and mountain toe slopes. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,200 to 9,500 feet.

Kittredge soil makes up 50 percent of this complex, and Venable soil makes up 35 percent. Kittredge soil is comparatively steep and is on toe slopes and fans, and Venable soil is less sloping and is on flood plains and alluvial valley floors. The areas of these soils are so

intricately intermingled that is was not practical to map them separately.

Included in mapping are small areas of Earcree soils on fans, Troutdale soils on side slopes, Rosane soils on low terraces, and soils that have gravel on the surface. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Kittredge soil is deep and well drained. It formed in loamy alluvium and colluvium derived from igneous and metamorphic rocks.

Typically, the surface layer is slightly acid, dark grayish brown sandy loam about 8 inches thick. The subsoil in the upper 31 inches is slightly acid, dark grayish brown and grayish brown sandy clay loam. In the lower 12 inches it is neutral, dark brown sandy loam. The substratum to a depth of 60 inches is neutral, brown sandy loam.

Permeability of the Kittredge soil is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is medium. Water erosion and soil blowing are moderate hazards. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent.

The Venable soil is deep and poorly drained. It formed in loamy alluvium derived from igneous and metamorphic rocks.

Typically, the surface layer is neutral, very dark grayish brown loam about 5 inches thick. The subsoil in the upper 9 inches is neutral, very dark grayish brown sandy clay loam. In the lower 29 inches it is neutral, dark grayish brown clay loam that is mottled throughout. The substratum to a depth of 60 inches is neutral, grayish brown sandy loam that is mottled throughout.

Permeability of the Venable soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow to medium, and water erosion is a slight to moderate hazard. Soil blowing is a slight hazard. A seasonal high water table is at a depth of 6 to 30 inches in spring and summer. In some areas this soil has been drained artificially or by gullying. It is subject to very brief periods of flooding in spring and summer. The depth to bedrock is more than 60 inches. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

The soils are used for grazing, as pasture, hayland, wildlife habitat, and recreation areas, and for community development.

The native vegetation is mainly Arizona fescue, mountain muhly, and Parry oatgrass on the Kittredge soil and tufted hairgrass, Canada sedge, and Baltic rush on the Venable soil. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre on the Kittredge soil and from 2,000 to 4,000 pounds per acre on the Venable soil. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps to maintain or improve the range condition. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances.

If these soils are used for hay and as pasture, the main limitations are the short growing season and, on the Venable soil, wetness. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Wetness limits the choice of plants and the period of cutting or grazing. Irrigation water can be applied by contour furrows or sprinklers. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the short growing season, by the slope on the Kittredge soil, and by wetness on the Venable soil. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are wetness and flooding on the Venable soil and slope on the Kittredge soil. Structures to divert runoff from buildings and roads are needed, and drainage is needed on the Venable soil. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Areas that are planted with native vegetation and other adapted plants can be used as greenbelts and parks.

These soils are in capability subclass VIe. The Kittredge soil is in the Loamy Park range site and in plant adaptability group M-1. The Venable soil is in the

Mountain Meadow range site and in plant adaptability group M-2.

69—Laporte Variant complex, 15 to 60 percent slopes. These soils are on hill slopes, shoulders, and fans associated with the hogbacks of the Fort Hays Limestone Member of the Niobrara Formation. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Laporte Variant soil makes up 60 percent of this complex, a moderately deep soil makes up 15 percent, and a deep soil makes up 10 percent. The Laporte Variant soil is on shoulders and hill slopes, the moderately deep soil is on hill slopes and fans, and the deep soil is on fans. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping and making up about 15 percent of the total acreage are small areas of Rock outcrop on ridge crests.

The Laporte Variant soil is shallow and well drained. It formed in calcareous, channery, loamy material derived from limestone and shale.

Typically, the surface layer is moderately alkaline, grayish brown, channery loam about 4 inches thick. The layer below that is moderately alkaline, grayish brown channery loam 6 inches thick. The underlying material is moderately alkaline, pale brown channery loam 8 inches thick. Soft, white limestone is at a depth of 18 inches.

Permeability of the Laporte Variant soil is moderate. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is only a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 15 to 35 percent of the volume.

The moderately deep soil is well drained. It formed in calcareous, channery, loamy material derived from limestone and shale.

Typically, the moderately deep soil is channery loam about 20 to 40 inches deep. It overlies limestone and shale.

Permeability of the moderately deep soil is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 15 to 35 percent of the volume.

The deep soil is well drained. It formed in calcareous, channery, loamy material derived from limestone and shale.

Typically, the deep soil is channery clay loam to a depth of 60 inches or more.

Permeability of the deep soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is low to moderate. Rock fragments make up 15 to 35 percent of the volume.

In most areas these soils are used for grazing, as pasture, and as habitat for wildlife. In a few areas they are used as a source of limestone and decorative rock.

The native vegetation is mainly big bluestem, mountainmahogany, Griffith wheatgrass, and sideoats grama. The average annual production of air-dry vegetation ranges from 300 to 700 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The soils are difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. The steepness of slopes limits access by livestock and promotes overgrazing of the less sloping areas. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on the Laporte Variant soil because of the slope, shallowness to rock, and small stones. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the soils for homesite development are slope and depth to rock. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This complex is in capability subclass VIIe. The Laporte Variant soil is in the Shallow Foothill range site and in plant adaptability group F-7. The moderately deep and deep soils are in the Gravelly Foothill range site and in plant adaptability group F-8.

70—Lavate sandy loam, 3 to 9 percent slopes. This is a deep, well drained soil on terraces, hill slopes, and fans. It formed in reddish, loamy material derived from sedimentary rocks. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Typically, the surface layer is neutral, brown to dark brown sandy loam about 5 inches thick. The upper part of the subsoil is neutral, brown to dark brown, dark reddish gray, and reddish brown sandy clay loam 28 inches thick. The lower part of the subsoil and the substratum to a depth of 60 inches are mildly alkaline, reddish brown sandy loam.

Included in mapping are small areas of Critchell soils on fans, Ascalon soils on hill slopes, Rednun soils on high terraces, and Bernal soils on ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of the Lavate soil is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low to moderate. Rock fragments make up 0 to 15 percent of the volume.

This soil is used for grazing and crops, as habitat for wildlife, for community development, and as recreation areas.

The native vegetation is mainly western wheatgrass, blue grama, Sandberg bluegrass, and Griffith wheatgrass. The average annual production of air-dry vegetation ranges from 900 to 1,500 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

This soil is well suited to grasses, shrubs, trees, and garden plants. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Leaving plant residue on the surface or incorporating it into the soil reduces runoff and soil blowing and helps maintain tilth and the content of organic matter. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the Lavate soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Existing vegetation should be protected as much as possible during construction.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Land leveling is needed in some areas for the uniform distribution of water. Irrigation water should be applied lightly and frequently to prevent soil loss because of slope. Tillage should be kept to a minimum.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Leaving crop residue on the surface or incorporating it into the soil reduces runoff and soil blowing and helps to maintain tilth and the content of organic matter. Soil blowing can be reduced by planting crops in alternate strips at right angles to the prevailing wind. Terraces and diversions help to reduce runoff and to conserve moisture. Tillage should be kept to a minimum.

This soil is in capability subclass IVe, irrigated and nonirrigated; in the Loamy Foothill range site; and in plant adaptability group F-3.

71—Lavate sandy loam, 9 to 15 percent slopes. This is a deep, well drained soil on hill slopes and fans. It formed in reddish, loamy material derived from sedimentary rocks. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Typically, the surface layer is neutral, brown to dark brown sandy loam about 5 inches thick. The upper part of the subsoil is neutral, brown to dark brown, dark reddish gray, and reddish brown sandy clay loam 28 inches thick. The lower part of the subsoil and the substratum to a depth of 60 inches are mildly alkaline, reddish brown sandy loam.

Included in mapping are small areas of Critchell soils on fans, Ascalon soils on hill slopes, Rednun soils on high terraces, and Bernal soils on ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Lavate soil is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion and soil blowing are moderate hazards. The shrink-swell potential is low to moderate. Rock fragments make up 0 to 15 percent of the volume.

This soil is used for grazing, for community development, as habitat for wildlife, and as recreation areas. In a few areas it is used for crops.

The native vegetation is mainly western wheatgrass, blue grama, Sandberg bluegrass, and Griffith wheatgrass. The average annual production of air-dry vegetation ranges from 900 to 1,500 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees and garden plants are limited by slope. Planting on the contour helps to conserve moisture and reduce erosion. Mulching is essential in establishing good stands of plantings on steep cut and fill slopes. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the Lavate soil for homesite development are the shrink-swell potential, slope, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential. Structures to divert runoff from buildings and roads are needed. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability and slope. The steepness of slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Existing vegetation should be protected as much as possible during construction.

Most of the areas that are used for crops are severely eroded. Seeding them to grass helps control erosion.

This soil is in capability subclass VIe, in the Loamy Foothill range site, and in plant adaptability group F-3.

72—Lavate-Bernal-Rock outcrop complex, 15 to 30 percent slopes. The areas of this complex are on hill slopes, fans, ridges, and convex knobs between the hogback and the mountains. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Lavate soil makes up 45 percent of this complex, Bernal soil makes up 25 percent, and Rock outcrop makes up 15 percent. Lavate soil is on hill slopes and fans, Bernal soil is on hill slopes, convex knobs, and ridges, and Rock outcrop is on ridges. The areas are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Critchell soils on fans, Hargreave soils on ridges and hill slopes, Haverson soils in drainageways, and soils that have stones on the surface. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Lavate soil is deep and well drained. It formed in reddish, loamy material derived from sedimentary rocks.

Typically, the surface layer is neutral, brown to dark brown sandy loam about 5 inches thick. The upper part of the subsoil is neutral, brown to dark brown, dark reddish gray, and reddish brown sandy clay loam 28 inches thick. The lower part of the subsoil and the substratum to a depth of 60 inches are mildly alkaline, reddish brown sandy loam.

Permeability of the Lavate soil is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low to moderate. Rock fragments make up 0 to 15 percent of the volume.

The Bernal soil is shallow and well drained. It formed in noncalcareous, mixed material derived from reddish sandstone.

Typically, the surface layer is slightly acid, reddish gray sandy loam about 2 inches thick. The subsoil in the upper 4 inches is slightly acid, reddish brown sandy loam. In the lower 7 inches it is medium acid, light reddish brown sandy loam. Hard sandstone is at a depth of 13 inches.

Permeability of the Bernal soil is moderately rapid. The available water capacity is low. The effective rooting depth is 8 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The depth to hard bedrock ranges from 8 to 20 inches. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

Rock outcrop consists of exposures of sedimentary rocks, talus, and large boulders. Rock outcrop is very slowly permeable or is impermeable. Plants can root only in cracks and fissures. Runoff is rapid, but erosion is only a slight hazard.

The soils in this complex are used for grazing, as habitat for wildlife and as recreation areas, and for community development.

The native vegetation is mainly western wheatgrass, blue grama, Griffith wheatgrass, and sideoats grama. The average annual production of air-dry vegetation ranges from 900 to 1,500 pounds per acre on the Lavate soil and from 300 to 700 pounds per acre on the Bernal soil. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The soils are difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope and the shallowness to rock of the Bernal soil. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to the use of the soils for homesite development are the slope and shallowness to rock. On the Bernal soil, the deep cuts needed to provide a sufficiently level building site expose bedrock. Structures to divert runoff from buildings and roads are needed. Effluent from an absorption field can surface downslope and create a health hazard. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply as a result of seepage along the bedrock contact. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas that are planted with native vegetation and other adapted plants can be used as parks.

This complex is in capability subclass VIe. The Lavate soil is in the Loamy Foothill range site and in plant adaptability group F-3. The Bernal soil is in the Shallow Foothill range site and in plant adaptability group F-7.

73—Lavina loam, very rocky, 0 to 5 percent slopes. This is a shallow, well drained soil on top of the volcanic mesas called North and South Table Mountains. This soil formed in calcareous, clayey alluvium and loess deposited over hard volcanic rock. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation ranges from 5,600 to 6,500 feet.

Typically, the surface layer is neutral, brown to dark brown loam about 5 inches thick. The subsoil is neutral, dark yellowish brown clay about 7 inches thick. Hard latite (fine-grained volcanic rock) is at a depth of 12 inches. Small areas of exposed volcanic rock make up 5 to 10 percent of the surface.

Included in mapping are small areas of Denver and Kutch soils on hill slopes and terraces, slick spots in small basins, and Baller Variant soils on ridges. The included areas make up about 10 percent of the total acreage.

Permeability of this Lavina soil is slow. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is slow, and water erosion and soil blowing are slight hazards. The depth to hard bedrock ranges from 10 to 20 inches. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing and as recreation areas and habitat for wildlife. In a few places it is used as a source of aggregate.

The native vegetation is mainly big bluestem, mountainmahogany, Griffith wheatgrass, and sideoats grama. The average annual production of air-dry vegetation ranges from 300 to 700 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing or other disturbances. Mechanical treatment is not practical because the surface is rocky. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the shallowness to rock and exposed bedrock, which make tillage difficult. A mulch of plant residue helps reduce soil

blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the Lavina soil for homesite development are its shallowness to rock and the shrink-swell potential. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIs, in the Shallow Foothill range site, and in plant adaptability group F-7.

74—Lebsack clay loam, saline, 0 to 2 percent slopes. This is a deep, moderately well drained soil on flood plains and low terraces. It formed in calcareous, saline, clayey alluvium derived dominantly from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is moderately alkaline, dark gray clay loam about 5 inches thick. The subsoil is moderately alkaline, dark grayish brown to grayish brown clay about 18 inches thick. The substratum to a depth of 60 inches is moderately alkaline, light brownish gray clay. There are visible accumulations of salts and carbonates throughout the subsoil and substratum.

Included in mapping are small areas of Nunn soils on fans and terraces, Arvada soils in positions similar to those of the Lebsack soil, Englewood soils in drainageways, and Haverson soils on flood plains. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Lebsack soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion and soil blowing are slight hazards. A seasonal high water table is at a depth of 60 to 72 inches in spring and summer. This soil is subject to rare, brief periods of flooding in spring and summer. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing and as pasture and habitat for wildlife. In a few places it is used for community development and for crops.

The native vegetation is mainly alkali sacaton, western wheatgrass, switchgrass, and saltgrass. The average annual production of air-dry vegetation ranges from 1,000 to 3,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Revegetation is difficult; therefore, proper grazing use is needed to prevent depletion. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the salinity and the clayey texture. Only those plants that tolerate a saline condition can survive and grow well on this soil. The clay loam surface layer and clayey subsoil make tillage difficult. Mulching, fertilizing, amendments, and irrigation are needed to establish grasses and other small seeded plants.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the Lebsack soil for homesite development are the shrink-swell potential, low strength, flooding, wetness, and corrosivity. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Drainage and structures to divert runoff from roads and building foundations are needed. Building materials should be resistant to corrosiveness caused by the saline condition. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas that are planted with native vegetation and other adapted plants can be used as greenbelts and parks.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, maintaining or improving fertility, and reducing salinity. The saline condition limits the choice of crops. Intensive management is required to reduce salinity and maintain soil productivity. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and of nitrogen and

phosphate fertilizers are needed to maintain fertility. Land leveling is needed in some areas for the uniform distribution of water. Tillage should be kept to a minimum.

This soil is in capability subclasses IVs, irrigated, and VIs, nonirrigated; in the Salt Meadow range site; and in plant adaptability group PF-2.

75—Legault-Hiwan stony loamy sands, 5 to 15 percent slopes. These soils are on mountain side slopes, ridges, and shoulders. The slopes most commonly face north. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,600 to 10,000 feet.

Legault soil makes up 45 percent of this map unit, and Hiwan soil makes up 40 percent. The Legault soil is on side slopes and overlies soft bedrock, and the Hiwan soil is on side slopes, ridges, and shoulders and overlies hard bedrock. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Earcree soils in drainageways, Grimstone and Peeler soils on side slopes, Rock outcrop on shoulders and ridges, and Herbman soils on side slopes that do not face north. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Legault soil is shallow and well drained. It formed in acidic, gravelly, stony, and sandy material derived dominantly from igneous and metamorphic rocks.

Typically, the surface is covered by a 1-inch mat of partly decomposed leaves, needles, twigs, and bark. The surface layer is slightly acid, grayish brown stony loamy sand about 1 inch thick. The subsurface layer is medium acid, light gray very gravelly loamy sand about 12 inches thick. Soft bedrock is at a depth of 13 inches.

Permeability of the Legault soil is rapid. The available water capacity is low. The effective rooting depth is 5 to 20 inches. Runoff is medium to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 5 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Hiwan soil is shallow and well drained. It formed in acidic, gravelly, stony, and sandy material derived from igneous and metamorphic rocks.

Typically, the surface layer is medium acid, dark grayish brown stony loamy sand about 1 inch thick. The subsurface layer is strongly acid, very pale brown very gravelly loamy sand about 14 inches thick. Hard bedrock is at a depth of 15 inches.

Permeability of the Hiwan soil is rapid. The available water capacity is low. The effective rooting depth is 5 to 20 inches. Runoff is medium to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 5 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The soils are used mainly as woodland, as recreation areas, and as habitat for wildlife. In a few places they are used for community development.

The native vegetation is mainly an overstory of Douglas-fir and lodgepole pine and an understory of common juniper, kinnikinnick, grasses, and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the short growing season, shallowness to rock, small and large stones, low available water capacity, and slope. Selecting climatically adapted plants is essential in establishing plantings. Pebbles and cobbles should be removed for best results in landscaping, particularly for lawns. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Mulching is essential in establishing good stands on steep cut and fill slopes. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The soils are limited for use as homesites by shallowness to rock, slope, and seepage. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIs, in the Douglas-fir—Lodgepole Pine woodland group, and in plant adaptability group M-7.

76—Legault-Hiwan stony loamy sands, 15 to 30 percent slopes. These soils are on mountain side slopes, ridges, and shoulders. The slopes most commonly face north. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,600 to 10,000 feet.

Legault soil makes up 45 percent of this map unit, and Hiwan soil makes up 40 percent. The Legault soil is on side slopes and overlies soft bedrock, and the Hiwan soil is on side slopes, ridges, and shoulders and overlies hard bedrock. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Earcree soils in drainageways, Grimstone and Peeler soils on side slopes, Rock outcrop on shoulders and ridges, and Herbman soils on side slopes that do not face north. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Legault soil is shallow and well drained. It formed in acidic, gravelly, stony, and sandy material derived dominantly from igneous and metamorphic rocks.

Typically, the surface is covered by a 1-inch mat of partly decomposed leaves, needles, twigs, and bark. The surface layer is slightly acid, grayish brown stony loamy sand about 1 inch thick. The subsurface layer is medium acid, light gray very gravelly loamy sand about 12 inches thick. Soft bedrock is at a depth of 13 inches.

Permeability of the Legault soil is rapid. The available water capacity is low. The effective rooting depth is 5 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 5 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Hiwan soil is shallow and well drained. It formed in acidic, stony, gravelly, and sandy material derived dominantly from igneous and metamorphic rocks.

Typically, the surface layer is medium acid, dark grayish brown stony loamy sand about 1 inch thick. The subsurface layer is strongly acid, very pale brown very gravelly loamy sand about 14 inches thick. Hard bedrock is at a depth of 15 inches.

Permeability of the Hiwan soil is rapid. The available water capacity is low. The effective rooting depth is 5 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 5 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

In most places the soils are used as woodland, recreation areas, and habitat for wildlife. In a few places they are used for community development.

The native vegetation is mainly an overstory of Douglas-fir and lodgepole pine and an understory of common juniper, kinnikinnick, grasses, and forbs. The wooded areas are managed as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the short growing season, shallowness to rock, small and large stones, low available water capacity, and slope. Selecting climatically adapted plants is essential in establishing plantings. Pebbles and cobbles should be removed for best results in landscaping, particularly for lawns. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Mulching is essential in establishing good stands on steep cut and fill slopes. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods. Planting on the contour helps to conserve moisture and reduce erosion.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The soils are limited for use as homesites by the shallowness to rock, the slope, and seepage. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Structures to divert runoff are needed where buildings and roads are constructed. The steepness of slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIe, in the Douglas-fir—Lodgepole Pine woodland group, and in plant adaptability group M-7.

77—Legault-Hiwan-Rock outcrop complex, 30 to 50 percent slopes. The areas of this complex are on north-facing mountain side slopes and ridges. The average

annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,600 to 10,000 feet.

Legault soil makes up 35 percent of this complex, Hiwan soil makes up 30 percent, and Rock outcrop makes up 20 percent. The Legault soil is on side slopes and ridges over soft bedrock, the Hiwan soil is on side slopes and ridges over hard bedrock, and Rock outcrop is on shoulders and ridges. The soils and Rock outcrop are in areas so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Tolvar, Grimstone, and Peeler soils on side slopes and Herbman and Rogert soils on side slopes that face south, east, or west. The included soils make up about 15 percent of the total acreage.

The Legault soil is shallow and well drained. It formed in acidic, stony, gravelly, and sandy material derived dominantly from igneous and metamorphic rocks.

Typically, the surface is covered by a 1-inch mat of partly decomposed leaves, twigs, needles, and bark. The surface layer is slightly acid, grayish brown very stony loamy sand about 1 inch thick. The subsurface layer is medium acid, light gray very gravelly loamy sand about 12 inches thick. Soft bedrock is at a depth of 13 inches.

Permeability of the Legault soil is rapid. The available water capacity is low. The effective rooting depth is 5 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 5 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Hiwan soil is shallow and well drained. It formed in acidic, stony, gravelly, and sandy material derived dominantly from igneous and metamorphic rocks.

Typically, the surface is covered by a mat about 1 inch thick of partly decomposed leaves, twigs, needles, and bark. The surface layer is medium acid, dark grayish brown very stony loamy sand about 1 inch thick. The subsurface layer is strongly acid, very pale brown very gravelly loamy sand about 14 inches thick. Hard bedrock is at a depth of 15 inches.

Permeability of the Hiwan soil is rapid. The available water capacity is low. The effective rooting depth is 5 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 5 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

Rock outcrop consists of exposures of igneous and metamorphic rocks, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces.

In most places, the soils in this complex are used as woodland, as habitat for wildlife, and as recreation areas. In a few places they are used for community development.

The native vegetation is mainly an overstory of Douglas-fir and lodgepole pine and an understory of kinnikinnick, common juniper, grasses, and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas include or are adjacent to homesites; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees and garden plants are difficult to establish and to maintain because of the large and small stones, shallowness to rock, slope, the short growing season, and the low available water capacity. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface in disturbed areas for best results in landscaping, particularly for lawns. A mulch of plant residue helps to reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain soil fertility. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the soils for homesite development are the slope, shallowness to rock, and large stones. The deep cuts needed to provide a sufficiently level building site expose bedrock. The hazard of erosion increases if the soil is left exposed during site development. Special sewage systems must be installed because of depth to rock, slope, and seepage. Effluent from absorption fields can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. The steepness of slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour.

This complex is in capability subclass VIIe. The Legault and Hiwan soils are in the Douglas-fir—Lodgepole Pine woodland group and in plant adaptability group M-7.

78—Legault-Tolvar-Rock outcrop complex, 50 to 70 percent slopes. The areas of this complex are on mountain side slopes that most commonly face north. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41 to 43° F, and the

average frost-free season is 55 to 75 days. Elevation is 7,000 to 9,500 feet.

This complex is 35 percent Legault soil, 30 percent Tolvar soil, and 20 percent Rock outcrop. The Legault soil is on side slopes and ridges, the Tolvar soil is on side slopes, and Rock outcrop is on shoulders and ridges. The soils and Rock outcrop are in areas so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Hiwan soils in positions similar to those of the Legault soil and small areas of Peeler and Grimstone soils on side slopes. The included soils make up about 15 percent of the total acreage.

The Legault soil is shallow and well drained. It formed in acidic, stony, gravelly, and sandy material derived dominantly from igneous and metamorphic rocks.

Typically, the surface is covered by a 1-inch mat of partly decomposed leaves, needles, and twigs. The surface layer is slightly acid, grayish brown very stony loamy sand about 1 inch thick. The subsurface layer is medium acid, light gray very gravelly loamy sand about 12 inches thick. Soft granitic rock is at a depth of 13 inches.

Permeability of the Legault soil is rapid. The available water capacity is low. The effective rooting depth is 5 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 5 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Tolvar soil is deep and well drained. It formed in stony, gravelly, and loamy material derived from igneous and metamorphic rocks.

Typically, the surface is covered by a 2-inch mat of partly decomposed needles, twigs, and leaves. The surface layer is slightly acid, grayish brown very stony loamy sand about 1 inch thick. The subsurface layer is strongly acid, white very stony loamy sand about 20 inches thick. The layer below that is strongly acid, light brown very gravelly sandy loam about 8 inches thick. The subsoil is strongly acid, light brown very gravelly sandy clay loam about 31 inches thick.

Permeability of the Tolvar soil is moderate. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

Rock outcrop consists of exposures of igneous and metamorphic rocks, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces.

The areas of this complex are used as woodland, as habitat for wildlife, and as recreation areas.

The native vegetation is mainly an overstory of Douglas-fir and some lodgepole pine and ponderosa pine and an understory of common juniper, kinnikinnick, and scattered grasses and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, large stones, shallowness to rock of the Legault soil, and the short growing season. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. A mulch of plant residue helps to reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The soils are limited for use as homesites by the slope, the shallowness to rock of the Legault soil, and large stones. On the Legault soil, the deep cuts needed to provide a sufficiently level building site expose bedrock. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. Structures to divert runoff are needed where buildings and roads are constructed. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This complex is in capability subclass VIIe. The Legault and Tolvar soils are in the Douglas-fir—Lodgepole Pine woodland group and in plant adaptability group M-7.

79—Leyden-Nunn-Rooney complex, 9 to 30 percent slopes. These soils are on ridges, hill slopes, and fans. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Leyden soil makes up 35 percent of this complex, Nunn soil makes up 30 percent, and Rooney soil makes up 20 percent. The Leyden soil is on hill slopes and is underlain by shale and mudstone, the Nunn soil is on hill

slopes and fans, and the Rooney soil is on ridges and hill slopes and is underlain by level-bedded, thin-layered sandstone and conglomerate. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Standley soils on fans and hill slopes, Rock outcrop on shoulders of ridges and in areas where slippage has taken place, Primen soils on hill slopes, and Midway soils on hill slopes and ridges. The included soils and Rock outcrop make up about 15 percent of the total acreage.

The Leyden soil is moderately deep and well drained. It formed in calcareous, cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is neutral, very dark grayish brown cobbly clay loam about 3 inches thick. The subsoil in the upper 5 inches is neutral, dark grayish brown gravelly clay loam. In the lower 27 inches it is neutral, brown to dark brown, brown, and light yellowish brown gravelly clay and gravelly clay loam. It overlies soft mudstone at a depth of 35 inches.

Permeability of the Leyden soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is high. Rock fragments make up 15 to 35 percent of the volume.

The Nunn soil is deep and well drained. It formed in calcareous, clayey material derived from mudstone and shale.

The surface layer is neutral, dark grayish brown gravelly clay loam about 5 inches thick. The subsoil in the upper 12 inches is neutral, grayish brown clay. In the lower 10 inches it is mildly alkaline, pale brown clay. The substratum to a depth of 60 inches is moderately alkaline, very pale brown clay loam.

Permeability of the Nunn soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. Rock fragments make up 15 to 35 percent of the volume in the surface layer and less than 15 percent below that.

The Rooney soil is shallow and well drained. It formed in cobbly and gravelly colluvium and in residuum of conglomerate and sandstone.

Typically, the surface layer is neutral, grayish brown very cobbly sandy loam about 2 inches thick. The layer below that is neutral, pale brown very gravelly sandy loam 8 inches thick. It overlies soft sandstone or conglomerate at a depth of 10 inches.

Permeability of the Rooney soil is moderately rapid. The available water capacity is low. The effective rooting depth is 4 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to bedrock ranges from 4 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The soils are used for grazing, as habitat for wildlife, and as recreation areas.

The native vegetation is mainly western wheatgrass, sideoats grama, blue grama, and Gambel oak. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre on the Leyden and Nunn soils and from 300 to 700 pounds per acre on the Rooney soil. Proper grazing use and a planned grazing system are needed to maintain quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope and large stones and, on the Rooney soil, because of the shallowness to rock. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Mulching is essential in establishing plantings on steep cut and fill slopes. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface in disturbed areas for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to the use of areas of this complex for homesite development are the slope, depth to rock, large stones, soil slippage, the shrink-swell potential, low strength, and slow permeability. On Leyden and Rooney soils, the deep cuts needed to provide a level building site can expose bedrock. Structures to divert runoff are needed where buildings and roads are constructed. Buildings and roads should be designed to offset the limited ability of the Leyden and Nunn soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Where the soil is underlain by shale, landslides are a hazard when the soil is loaded, excavated, or wet. The effects of shrinking and swelling on Leyden and Nunn soils can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Special sewage systems must be installed because of the slow

permeability of the Nunn and Leyden soils, the moderate depth to rock of the Leyden soil, and the shallowness to rock of the Rooney soil. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as greenbelts and parks if planted with native vegetation and other adapted plants.

These soils are in capability subclass VIe. The Leyden and Nunn soils are in the Clayey Foothill range site and in plant adaptability group F-1. The Rooney soil is in the Shallow Foothill range site and in plant adaptability group F-7.

80—Leyden-Primen-Standley cobbly clay loams, 15 to 50 percent slopes. These soils are on hill slopes and convex ridges. The average annual precipitation ranges from 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Leyden soil makes up 35 percent of this map unit, Primen soil makes up 30 percent, and Standley soil makes up 20 percent. Leyden soil is on hill slopes, Primen soil is on convex ridges and hill slopes, and Standley soil is on hill slopes. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Denver and Nunn soils on fans, soils that have a stony surface and are on hill slopes below stony alluvial terraces, Midway soils on ridges, and Kutch soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Leyden soil is moderately deep and well drained. It formed in calcareous, cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is neutral, very dark grayish brown cobbly clay loam about 3 inches thick. The subsoil in the upper 5 inches is neutral, dark grayish brown gravelly clay loam. In the lower 27 inches it is neutral, brown to dark brown, brown, and light yellowish brown gravelly clay and gravelly clay loam. It overlies soft mudstone and shale at a depth of 35 inches.

Permeability of the Leyden soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is high. Rock fragments make up 15 to 35 percent of the volume.

The Primen soil is shallow and well drained. It formed in cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer and the upper part of the subsoil are mildly alkaline, dark grayish brown cobbly clay loam about 9 inches thick. The lower part of the subsoil is mildly alkaline, dark grayish brown cobbly and gravelly clay loam. It is about 9 inches thick. It overlies soft mudstone and shale at a depth of 18 inches.

Permeability of the Primen soil is slow. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is moderate to high. Rock fragments make up 15 to 35 percent of the volume.

The Standley soil is deep and well drained. It formed in calcareous, cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is mildly alkaline, dark grayish brown cobbly clay loam about 9 inches thick. The subsoil in the upper 8 inches is mildly alkaline, brown gravelly clay. In the lower 5 inches it is moderately alkaline, pale brown gravelly clay loam. The substratum in the upper 15 inches is moderately alkaline, very pale brown gravelly clay loam. Below that to a depth of 60 inches it is moderately alkaline, very pale brown gravelly loam.

Permeability of the Standley soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is moderate to high. Rock fragments make up 15 to 35 percent of the volume.

In most areas the soils are used for grazing and recreation, as wildlife habitat, and for community development. In a few areas they are used for nonirrigated crops.

The native vegetation is mainly western wheatgrass, green needlegrass, blue grama, and needleandthread. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Proper grazing use is needed to prevent depletion because the soils are difficult to revegetate. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, large stones, the clayey texture, and the depth to rock.

Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Tillage is difficult on these soils because of the clay loam surface layer and clayey subsoil. A mulch is essential in establishing good stands of plantings on steep cut and fill slopes. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at planting time and during dry periods. Deep cuts made in land grading should be covered with a layer of topsoil.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to the use of these soils for homesite development are the slope, the shrink-swell potential, low strength, depth to rock, slow permeability, and large stones. Structures to divert runoff from buildings and roads are needed. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help reduce seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. On Leyden and Primen soils, the deep cuts needed to provide a sufficiently level building site can expose bedrock. Special sewage systems must be installed because of the slow permeability, depth to rock, and slope. Effluent from absorption fields can surface downslope and create a health hazard. The steepness of the slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

Areas that are used for nonirrigated crops are most commonly severely eroded. Seeding them to grass helps control erosion.

These soils are in capability subclass VIIe, in the Clayey Foothill range site, and in plant adaptability group F-1.

81—Leyden-Primen-Standley extremely stony clay loams, 30 to 70 percent slopes. These soils are on hill slopes below the tops of volcanic mesas. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Leyden soil makes up 35 percent of this map unit, Primen soil makes up 30 percent, and Standley soil makes up 20 percent. The Leyden soil is on hill slopes, the Primen soil is on convex ridges and hill slopes, and the Standley soil is on hill slopes. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of shale outcrop on eroded hill slopes and above landslides, soils that are more than 35 percent rock fragments, bouldery areas on hill slopes just below the mesa tops, and stony Midway soils on hill slopes and ridges. The included areas make up about 15 percent of the total acreage.

The Leyden soil is moderately deep and well drained. It formed in calcareous, stony, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is neutral, very dark grayish brown extremely stony clay loam about 3 inches thick. The subsoil in the upper 5 inches is neutral, dark grayish brown gravelly clay loam. In the lower 27 inches it is neutral, brown to dark brown, brown, and light yellowish brown gravelly clay and gravelly clay loam. It overlies soft mudstone at a depth of 35 inches.

Permeability of the Leyden soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is high. Rock fragments make up 15 to 35 percent of the volume. They originated as rockfall from the edge of the mesa.

The Primen soil is shallow and well drained. It formed in stony, cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer and the upper part of the subsoil are mildly alkaline, dark grayish brown extremely stony clay loam about 9 inches thick. The subsoil in the next 5 inches is mildly alkaline, dark grayish brown cobbly clay loam. In the lower 4 inches it is mildly alkaline, dark grayish brown gravelly clay loam. It overlies soft mudstone at a depth of 18 inches.

Permeability of the Primen soil is slow. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is moderate to high. Rock fragments make up 15 to 35 percent of the volume. They originated as rockfall from the edge of the mesa.

The Standley soil is deep and well drained. It formed in calcareous, stony, cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is mildly alkaline, dark grayish brown extremely stony clay loam about 9 inches

thick. The subsoil in the upper 8 inches is mildly alkaline, brown gravelly clay. In the lower 5 inches it is moderately alkaline, pale brown gravelly clay loam. The substratum in the upper 15 inches is moderately alkaline, very pale brown gravelly clay loam. In the lower part to a depth of 60 inches it is moderately alkaline, very pale brown gravelly loam.

Permeability of the Standley soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. Rock fragments make up 15 to 35 percent of the volume. They originated as rockfall from the edge of the mesa.

These soils are used mainly as wildlife habitat and recreation areas. In a few places they are used for grazing.

The native vegetation is mainly bitterbrush, yucca, juniper, little bluestem, and, on north slopes, mountainmahogany. The average annual production of air-dry vegetation ranges from 900 to 1,500 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Mechanical treatment is not practical because the surface is stony and the slopes are steep. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. Periodic deferment of grazing during the growing season helps maintain or improve the range condition.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on these soils because of the slope and large stones. In addition, shallowness to rock is a limitation on the Primen soil. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and in dry periods.

The main limitations to the use of the soils for homesite development are the slope, depth to rock, soil slippage, rockfall, the shrink-swell potential, large stones, and low strength. The deep cuts needed on Leyden and Primen soils to provide a sufficiently level building site can expose bedrock. Landslides are a hazard when the soil mass is loaded, excavated, or wet. Rockfall from the mesa tops is a hazard to structures. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential. The steepness of the slope, large stones, and depth to rock are concerns in installing septic tank absorption fields. Effluent from absorption fields can surface downslope and create a health hazard. Buildings and roads should be designed to offset the limited ability of the soils to support a load. Existing vegetation should be protected as much as possible during construction. Some areas can be used as open space and parks if planted with native vegetation and other adapted plants.

These soils are in capability subclass VIIe, in the Rocky Foothill range site, and in plant adaptability group F-6.

82—Leyden-Standley-Primen cobbly clay loams, 9 to 15 percent slopes. These soils are on hill slopes, fans, and convex ridges. The average annual precipitation ranges from 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Leyden soil makes up 35 percent of this map unit, Standley soil makes up 30 percent, and Primen soil makes up 20 percent. Leyden soil is on hill slopes, Standley soil is on fans, and Primen soil is on convex ridges. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Denver and Nunn soils on fans, soils that have a stony surface layer and are on hill slopes below stony alluvial terraces, Midway soils on ridges, and Kutch soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Leyden soil is moderately deep and well drained. It formed in calcareous, cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is neutral, very dark grayish brown cobbly clay loam about 3 inches thick. The subsoil in the upper 5 inches is neutral, dark grayish brown gravelly clay loam. In the lower 27 inches it is neutral, brown to dark brown, brown, and light yellowish brown gravelly clay and gravelly clay loam. It overlies soft mudstone and shale at a depth of 35 inches.

Permeability of the Leyden soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is high. Rock fragments make up 15 to 35 percent of the volume.

The Standley soil is deep and well drained. It formed in calcareous, cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is mildly alkaline, dark grayish brown cobbly clay loam about 9 inches thick. The subsoil in the upper 8 inches is mildly alkaline, brown gravelly clay. In the lower 5 inches it is moderately alkaline, pale brown gravelly clay loam. The substratum in the upper 15 inches is moderately alkaline, very pale brown gravelly clay loam. Below that to a depth of 60 inches it is moderately alkaline, very pale brown gravelly loam.

Permeability of the Standley soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is moderate to high. Rock fragments make up 15 to 35 percent of the volume.

The Primen soil is shallow and well drained. It formed in cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer and the upper part of the subsoil are mildly alkaline, dark grayish brown cobbly clay loam about 9 inches thick. The lower part of the subsoil is mildly alkaline, dark grayish brown gravelly clay loam about 9 inches thick. It overlies soft mudstone and shale at a depth of 18 inches.

Permeability of the Primen soil is slow. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is moderate to high. Rock fragments make up 15 to 35 percent of the volume.

In most places, the soils are used for grazing, as recreation areas and wildlife habitat, and for community development. In a few places they are used for nonirrigated crops.

The native vegetation is mainly western wheatgrass, green needlegrass, blue grama, and needleandthread. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Proper grazing use is needed to prevent depletion because the soils are difficult to revegetate. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees and garden plants are difficult to establish and maintain on these soils because of the slope, large stones, the clayey texture, and the depth to rock. Planting on the contour helps conserve moisture and reduce erosion. The removal of pebbles and cobbles is required for best results in landscaping, particularly for lawns. Tillage is difficult because of the clay loam surface layer and the clayey subsoil. A mulch is essential in establishing good stands of plantings on steep cut and fill slopes. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at planting time and during dry periods. Deep cuts made in land grading should be covered with a layer of topsoil.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the slope, the shrink-swell potential, low strength, depth to rock, slow permeability, and large stones. Structures to divert runoff are needed where buildings and roads are constructed. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Special sewage systems must be installed because of the slow permeability, depth to rock, and slope. Effluent from an absorption field can surface downslope and create a health hazard. The steepness of the slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

The areas that are used for nonirrigated crops generally are severely eroded. Seeding them to grass helps control erosion.

These soils are in capability subclass VIe, in the Clayey Foothill range site, and in plant adaptability group F-1.

83—Leyden-Standley-Primen very cobbly clay loams, 30 to 60 percent slopes. These soils are on hill slopes and convex ridges. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Leyden soil makes up 30 percent of this map unit, Standley soil makes up 25 percent, and Primen soil makes up 20 percent. The Leyden and Standley soils are on hill slopes, and the Primen soil is on convex ridges. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Denver and Englewood soils on fans, soils that have a stony surface layer on hill slopes below stony alluvial deposits, Nederland Variant soils on ridges, and Rooney soils on hill slopes. The included soils make up about 25 percent of the total acreage.

The Leyden soil is moderately deep and well drained. It formed in calcareous, cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is neutral, very dark grayish brown very cobbly clay loam about 3 inches thick. The subsoil in the upper 5 inches is neutral, dark grayish brown gravelly clay loam. In the lower 27 inches it is neutral, brown to dark brown, brown, and light yellowish brown gravelly clay and gravelly clay loam. It overlies soft mudstone and shale at a depth of 35 inches.

Permeability of the Leyden soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is high. Rock fragments make up 15 to 35 percent of the volume.

The Standley soil is deep and well drained. It formed in calcareous, cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is mildly alkaline, dark grayish brown very cobbly clay loam about 9 inches thick. The subsoil in the upper 8 inches is mildly alkaline, brown gravelly clay. In the lower 5 inches it is moderately alkaline, pale brown gravelly clay loam. The substratum in the upper 15 inches is moderately alkaline, very pale brown gravelly clay loam. In the lower part to a depth of 60 inches it is moderately alkaline, very pale brown gravelly loam.

Permeability of the Standley soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is moderate to high. Rock fragments make up 15 to 35 percent of the volume.

The Primen soil is shallow and well drained. It formed in cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer and the upper part of the subsoil are mildly alkaline, dark grayish brown very cobbly clay loam about 9 inches thick. The lower part of the subsoil is mildly alkaline, dark grayish brown gravelly clay loam about 9 inches thick. It overlies soft mudstone and shale at a depth of 18 inches.

Permeability of the Primen soil is slow. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is moderate to high. Rock fragments make up 15 to 35 percent of the volume.

These soils are used mainly for grazing and as recreation areas and wildlife habitat. In a few places they are used for community development.

The native vegetation is mainly big bluestem, switchgrass, indiangrass, little bluestem, and, particularly on north slopes, some mountainmahogany. The average annual production of air-dry vegetation ranges from 1,100 to 1,500 pounds per acre. The steepness of slopes limits access by livestock and promotes overgrazing of the less sloping areas. The soils are difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, large stones, clayey texture, and depth to rock. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Tillage is difficult because of the clay loam surface layer and clayey subsoil and the large stones. A mulch is essential in establishing plantings on steep cut and fill slopes. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the soils for homesite development are slope, the shrink-swell potential, low strength, depth to rock, slow permeability, large stones, and soil slippage. Structures to divert runoff are needed where buildings and roads are constructed. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Landslides are a hazard when the soil mass is loaded, excavated, or wet. Buildings and roads should be designed to offset the limited ability of the soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. The deep cuts needed on Leyden and Primen soils to provide a sufficiently level building site can expose bedrock. Special sewage systems must be installed because of the slow permeability and slope and depth to rock on Leyden and Primen soils. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Landslides are a hazard when the soil mass is loaded, excavated, or wet. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as open space and parks if planted with native vegetation and other adapted plants.

These soils are in capability subclass VIIe, in the Cobbly Foothill range site, and in plant adaptability group F-5.

84—Lininger-Ratake complex, 5 to 15 percent slopes. These soils are on mountain side slopes, ridges, and stable summits. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Lininger soil makes up 45 percent of this complex, and Ratake soil makes up 40 percent. Lininger soil is on stable summits and side slopes, and Ratake soil is on ridges and side slopes. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Trag and Breece soils on toe slopes and in drainageways, Cathedral soils on ridges and side slopes, and Rock outcrop on shoulders and in places where quartzitic dikes reach the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Lininger soil is moderately deep and well drained. It formed in gravelly, loamy material derived from igneous and metamorphic rocks.

Typically, the surface layer and the upper part of the subsoil are neutral, dark grayish brown gravelly sandy loam about 8 inches thick. The lower part of the subsoil is slightly acid, brown gravelly sandy clay loam about 28 inches thick. Soft schist is at a depth of 36 inches.

Permeability of the Lininger soil is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

The Ratake soil is shallow and well drained. It formed in stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rock.

Typically, the surface layer is neutral, dark brown stony sandy loam about 3 inches thick. The subsoil is neutral, dark brown very gravelly sandy loam about 9 inches thick. It overlies soft schist and gneiss.

Permeability of the Ratake soil is moderate. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The soils are used mainly for grazing and as pasture, woodland, habitat for wildlife, and recreation areas. In a few places they are used for community development.

The native vegetation is mainly needleandthread, western wheatgrass, Arizona fescue, and mountain muhly and an open overstory of ponderosa pine. The average annual production of air-dry understory vegetation ranges from 1,100 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Excavated areas must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the short growing season, the slope, and large stones. Selecting climatically adapted plants is essential in establishing plantings. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface in disturbed areas for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are shallowness to rock, slope, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. In constructing roads and streets in residential communities, the same practices are needed that help control erosion on access roads in wooded areas. Topsoil can be stockpiled and

used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIs, in the Ponderosa Pine woodland group, and in plant adaptability group M-3.

85—Lininger-Ratake complex, 15 to 30 percent slopes. The soils making up this complex are on mountain side slopes, ridges, and stable summits. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Lininger soil makes up 45 percent of this complex, and Ratake soil makes up 40 percent. Lininger soil is on stable summits and side slopes, and Ratake soil is on ridges and side slopes. The areas of these soils are so intricately intermingled that it was not practical to map the soils separately at the scale used in mapping.

Included in mapping are small areas of Trag and Breece soils on toe slopes and in drainageways, Cathedral soils on ridges and side slopes, and Rock outcrop on shoulders and in places where quartzitic dikes reach the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Lininger soil is moderately deep and well drained. It formed in gravelly, loamy material derived from igneous and metamorphic rocks.

Typically, the surface layer and the upper part of the subsoil are neutral, dark grayish brown gravelly sandy loam about 8 inches thick. The lower part of the subsoil is slightly acid, brown gravelly sandy clay loam 28 inches thick. Soft schist is at a depth of 36 inches.

Permeability of the Lininger soil is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

The Ratake soil is shallow and well drained. It formed in stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rock.

Typically, the surface layer is neutral, dark brown stony sandy loam about 3 inches thick. The subsoil is neutral, dark brown very gravelly sandy loam about 9 inches thick. It overlies soft schist and gneiss.

Permeability of the Ratake soil is moderate. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The soils are used mainly for grazing and as pasture, woodland, habitat for wildlife, and recreation areas. In a few places they are used for community development.

The native vegetation is mainly needleandthread, western wheatgrass, Arizona fescue, and mountain muhly and an open overstory of ponderosa pine. The average annual production of air-dry understory vegetation ranges from 1,100 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the short growing season, the slope, and large stones. Selecting climatically adapted plants is essential in establishing plantings. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are depth to rock, slope, and large stones. Extensive excavation is needed to provide level building sites because of the slope, but the required deep cuts can expose bedrock. The steepness of the slope is a

concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. In constructing roads and streets in residential communities, the practices needed to control erosion are the same as those used in wooded areas. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIe, in the Ponderosa Pine woodland group, and in plant adaptability group M-3.

86—Lininger-Trag sandy loams, 3 to 9 percent slopes. These soils are on stable summits, mountain toe slopes, and side slopes. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation ranges from 6,500 to 7,800 feet.

Lininger soil makes up 50 percent of this map unit, and Trag soil makes up 35 percent. Lininger soil is on side slopes and stable summits, and Trag soil is on toe slopes and side slopes. The areas of these soils are so intricately intermingled that it was not practical to map the soils separately at the scale used in mapping.

Included in mapping are small areas of Ratake soils on ridges and side slopes, Rock outcrop on shoulders and in places where quartzitic dikes reach the surface, Breece soils on toe slopes, and areas of soils that have stones and cobbles on the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Lininger soil is moderately deep and well drained. It formed in gravelly, loamy material derived from igneous and metamorphic rocks.

Typically, the surface layer and the upper part of the subsoil are neutral, dark grayish brown sandy loam about 8 inches thick. The lower part of the subsoil is slightly acid, brown sandy clay loam 28 inches thick. Soft schist is at a depth of 36 inches.

Permeability of the Lininger soil is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

The Trag soil is deep and well drained. It formed in loamy alluvial and colluvial material derived from igneous and metamorphic rocks.

Typically, the surface layer is slightly acid, dark grayish brown sandy loam about 7 inches thick. The subsoil in the upper 6 inches is slightly acid, brown to dark brown sandy clay loam. In the lower 47 inches it is slightly acid and neutral, strong brown sandy clay loam.

Permeability of the Trag soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

In most places the soils are used for grazing and as pasture, as habitat for wildlife, and as recreation areas. In a few places they are used for community development and as hayland.

The native vegetation is mainly Arizona fescue, mountain muhly, Parry oatgrass, and slender wheatgrass. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Scattered ponderosa pines are common. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas that have been depleted by heavy grazing or disturbed by cultivation.

If these soils are used for hay and pasture, the main limitation is the short growing season. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Weed control and fertilizer are needed for maximum quality of forage. Irrigation water can be applied in contour furrows or by sprinklers. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment of grasses, shrubs, trees, and garden plants is restricted by the short growing season. Selecting climatically adapted plants is essential in establishing plantings. A mulch of plant residue helps to reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitation to use of these soils for homesite development is the moderate depth to rock of the Lininger soil; the deep cuts needed to provide a level building site can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

Most areas are too small for the production of field crops; however, some crops can be grown in small gardens. Selection of crops is limited by the short growing season. Planting on the contour, terraces, and diversions help reduce erosion and conserve moisture.

These soils are in capability subclass IVe, irrigated and nonirrigated, in the Loamy Park range site, and in plant adaptability group M-1.

87—Lininger-Trag sandy loams, 9 to 20 percent slopes. These soils are on stable summits, mountain toe slopes, and side slopes. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation ranges from 6,500 to 7,800 feet.

Lininger soil makes up 50 percent of this map unit, and Trag soil makes up 35 percent. Lininger soil is on side slopes and stable summits, and Trag soil is on toe slopes and side slopes. The areas of these soils are so intricately intermingled that it was not practical to map the soils separately at the scale used in mapping.

Included in mapping are small areas of Ratake soils on ridges and side slopes, Rock outcrop on shoulders and in places where quartzitic dikes reach the surface, Breece soils on toe slopes, and areas of soils that have stones and cobbles on the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Lininger soil is moderately deep and well drained. It formed in gravelly, loamy material derived from igneous and metamorphic rocks.

Typically, the surface layer and the upper part of the subsoil are neutral, dark grayish brown sandy loam about 8 inches thick. The lower part of the subsoil is slightly acid, brown sandy clay loam about 28 inches thick. Soft schist is at a depth of 36 inches.

Permeability of the Lininger soil is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

The Trag soil is deep and well drained. It formed in loamy alluvial and colluvial material derived from igneous and metamorphic rocks.

Typically, the surface layer is slightly acid, dark grayish brown sandy loam about 7 inches thick. The subsoil in the upper 6 inches is slightly acid, brown to dark brown sandy clay loam. In the lower 47 inches it is slightly acid and neutral, strong brown sandy clay loam.

Permeability of the Trag soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

In most places the soils are used for grazing and as pasture, habitat for wildlife, and recreation areas. In a few places they are used for community development and as hayland.

The native vegetation is mainly Arizona fescue, mountain muhly, Parry oatgrass, and slender wheatgrass. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Scattered ponderosa pines are common. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances.

If these soils are used for hay and pasture, the main limitations are the short growing season and the slope. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Weed control and fertilizer are needed for maximum quality of forage. Irrigation water can be applied by the contour furrow or sprinkler methods. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the short growing season and the slope. Selecting climatically adapted plants is essential in establishing plantings. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the soils for homesite development are depth to rock and the slope. On the Lininger soil, the deep cuts needed to provide a sufficiently level building site can expose bedrock. Effluent from absorption fields can surface downslope and create a health hazard. Structures to divert runoff are needed where buildings and roads are constructed. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

Areas that are used for crops most commonly are severely eroded. Seeding them to grass helps to control erosion.

These soils are in capability subclass VIe, in the Loamy Park range site, and in plant adaptability group M-1.

88—Loveland clay loam, 0 to 1 percent slopes. This is a deep, somewhat poorly drained soil on alluvial valley floors, low terraces, and flood plains of major streams. It formed in calcareous, loamy alluvium underlain by mottled sand and gravel derived from mixed sources. The average annual precipitation is 15 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 5,600 feet.

Typically, the surface layer is mildly and moderately alkaline, gray clay loam about 13 inches thick. The layer below that is moderately alkaline, light gray to gray clay loam about 12 inches thick; it has yellowish brown mottles in the lower 6 inches. The underlying material in the upper 9 inches is moderately alkaline, light brownish gray sandy clay loam that has olive yellow mottles. Below that to a depth of 60 inches it is neutral, pale yellow very gravelly sand that has olive yellow mottles.

Included in mapping are small areas of Alda and Wann soils and Fluvaquents, sandy, on flood plains and low terraces and Haverson soils on higher terraces. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Loveland soil is moderately slow to a depth of 20 to 40 inches and rapid below that. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion and soil blowing are only slight hazards. The water table is at a depth of 18 to 30 inches throughout the year. This soil is occasionally flooded for very brief periods in spring and summer. The depth to sand and gravel ranges from 20 to 40 inches. The shrink-swell potential is moderate to low. Rock fragments make up 0 to 15 percent of the volume in the solum and more than 35 percent in the underlying material.

This soil is used mainly for grazing and as pasture, for crops, and as habitat for wildlife. In a few places it is used for community development.

The native vegetation is mainly alkali sacaton, switchgrass, western wheatgrass, and saltgrass. The average annual production of air-dry vegetation ranges from 1,000 to 3,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and increased runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The main concerns in establishing and maintaining grasses, shrubs, trees, and garden plants are wetness and salinity. Only those plants that tolerate wetness and salinity are able to survive and grow well on this soil. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the Loveland soil for homesite development are wetness, flooding, and seepage. Drainage and structures to divert runoff are needed where buildings and roads are constructed. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas planted with native vegetation and other adapted plants can be used as greenbelts and parks.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, maintaining or improving fertility, and reducing salinity and wetness. Tile drainage and open drainage ditches are needed to lower the water table and reduce wetness. The saline condition limits the choice of crops. Land leveling is needed in some areas for the uniform distribution of water. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue into the soil are essential in protecting soil from erosion, improving tilth, and conserving moisture. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclasses IIIs, irrigated, and VIs, nonirrigated; in the Salt Meadow range site; and in plant adaptability group PF-2.

89—Loveland Variant gravelly sandy loam, 0 to 2 percent slopes. This is a deep, somewhat poorly drained soil on alluvial valley floors and low terraces of major streams. This soil formed in calcareous, gravelly, loamy alluvium underlain by a mixture of sand and gravel. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral and mildly alkaline, dark grayish brown gravelly sandy loam about 9 inches thick. The subsoil in the upper 3 inches is mildly alkaline, pale brown gravelly sandy clay loam. In the lower 16 inches it is mildly alkaline, light yellowish brown very gravelly sandy loam. The substratum to a depth of 60 inches is neutral, brownish yellow very gravelly sand that has many large prominent mottles.

Included in mapping are small areas of Alda soils on low terraces, very gravelly soils on convex knobs, Wann soils on convex, higher lying terraces, and Nunn soils on high terraces. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Loveland Variant soil is moderate to a depth of 20 to 40 inches and rapid below that. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are slight hazards. This soil normally has a seasonal high water table that fluctuates between depths of 24 and 60 inches. However, in most places the soil has been drained by ground water use and the water table is below a depth of 60 inches. This soil is subject to rare flooding in spring and early in summer. The shrink-swell potential is low. Rock fragments make up 15 to 35 percent of the volume in the subsoil and more than 35 percent in the substratum.

This soil is used for irrigated crops, grazing, and community development and as recreation areas.

The native vegetation is mainly switchgrass, blue grama, green needlegrass, and western wheatgrass. The average annual production of air-dry vegetation ranges from 1,000 to 2,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment.

The main concerns in establishing and maintaining grasses, shrubs, trees, and garden plants on this soil are small stones and the low available water capacity. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Pebbles and cobbles in disturbed areas should be removed from the surface for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this soil for homesite development are the rapid permeability below a depth of 20 to 40 inches, the possible recurrence of the seasonal high water table, flooding, and small stones. Buildings should be constructed on an elevated layer of suitable fill material to offset the possibility of wetness. Structures to divert runoff are needed to protect buildings and roads. Special sewage systems must be installed because of the rapid permeability and the water table. Special sealing methods are needed to prevent excessive seepage. Some areas can be used as greenbelts and parks that are planted with native vegetation and other adapted plants.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil erosion, and maintaining or improving fertility. This soil is well suited to furrow and border irrigation. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Land leveling is needed in some areas to achieve uniform distribution of water.

This soil is in capability subclasses IIs, irrigated, and IIIs, nonirrigated; in the Overflow range site; and in plant adaptability group PF-1.

90—Manzano fine sandy loam, 0 to 2 percent slopes. This is a deep, well drained soil on alluvial valley floors, fans, flood plains, and terraces and in concave drainageways. It formed in calcareous, loamy alluvium derived from mixed sources. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is mildly alkaline, very dark grayish brown fine sandy loam about 6 inches thick. The subsoil in the upper 17 inches is mildly alkaline, very dark grayish brown sandy clay loam. In the lower 8 inches it is mildly alkaline, dark grayish brown fine sandy loam. The substratum in the upper 13 inches is moderately alkaline, brown fine sandy loam. Below that to a depth of 60 inches it is moderately alkaline, brown sandy clay loam.

Included in mapping are small areas of Ascalon soils on fans, Nunn soils on higher terraces and on fans, and the somewhat poorly drained Loveland soils on low

terraces. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Manzano soil is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. This soil is subject to rare flooding in spring and summer. Soil blowing is a moderate hazard. The shrink-swell potential is moderate.

This soil is used mainly for crops and grazing, as habitat for wildlife, and as recreation areas. In a few places it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, switchgrass, and big bluestem. The average annual production of air-dry vegetation ranges from 1,000 to 2,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

This soil is well suited to grasses, shrubs, trees, and garden plants. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Supplemental irrigation is needed at the time of planting and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to the use of this soil for homesite development are flooding, the shrink-swell potential, and low strength. Structures to divert runoff are needed to protect buildings and roads. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the moderately slow permeability. Some areas planted with native vegetation and other adapted plants can be used as greenbelts and parks.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Land leveling is needed in some areas to achieve uniform distribution of water. Tillage should be kept to a minimum.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the soil are essential in protecting the soil from erosion and in improving tilth and conserving moisture. Soil blowing can be reduced by planting crops in alternate strips at right angles to the prevailing wind. Tillage should be kept to a minimum.

This soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated; in the Overflow range site; and in plant adaptability group PF-1.

91—Manzanola clay loam, 0 to 5 percent slopes. This is a deep, well drained soil on convex ridges and hill slopes. It formed in calcareous, clayey material derived from mudstone and shale. The average annual precipitation is 13 to 17 inches, and the average annual air temperature is 47° F. The average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is mildly alkaline, dark grayish brown clay loam about 5 inches thick. The subsoil in the upper 7 inches is mildly alkaline, brown clay loam. In the lower 17 inches it is moderately alkaline, pale brown and light yellowish brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown clay loam.

Included in mapping are small areas of Englewood soils in small drainageways, Ulm, Nunn, and Denver soils on hill slopes, and Renohill soils on ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Manzanola soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight to moderate hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

In most places this soil is used for grazing and community development. In a few places it is used for crops.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be

used as exercise areas and for very limited grazing. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and subsoil, which make tillage difficult. A mulch of plant residue reduces runoff and helps to maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help reduce seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of this soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration. Land leveling is needed for the uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue into the soil are essential in protecting the soil from erosion, improving tilth, and conserving moisture. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IIIe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1.

92—Manzanola clay loam, 5 to 9 percent slopes. This is a deep, well drained soil on convex ridges and hill slopes. It formed in calcareous, clayey material derived from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is mildly alkaline, dark grayish brown clay loam about 5 inches thick. The subsoil in the upper 7 inches is mildly alkaline, brown clay loam. In the lower 17 inches it is moderately alkaline, pale brown and light yellowish brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown clay loam.

Included in mapping are small areas of Englewood soils in small drainageways, Ulm, Nunn, and Denver soils on hill slopes, and Renohill soils on ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Manzanola soil is slow. The !uahl!bkd w!sdq b!o!bhty is high. The effective rooting depth is 60 inches or more. Runoff is medium. Water erosion and soil blowing are moderate hazards. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

In most places this soil is used for grazing and community development. In a few places it is used for crops.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and subsoil, which make tillage difficult. A mulch of plant residue reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps to conserve

moisture and reduce erosion. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering designs and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration. Land leveling is needed for the uniform distribution of water. Light, frequent applications of irrigation water are needed to prevent soil loss because of the slope.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue into the soil are essential in protecting the soil from erosion, improving tilth, and conserving moisture. Terracing and contour tillage are needed to reduce soil erosion. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IVe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1.

93—Manzanola clay loam, 9 to 15 percent slopes. This is a deep, well drained soil on convex ridges and hill slopes. It formed in calcareous, clayey material derived from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is mildly alkaline, dark grayish brown clay loam about 5 inches thick. The subsoil in the upper 7 inches is mildly alkaline, brown clay loam. In the lower 17 inches it is moderately alkaline, pale brown and light yellowish brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown clay loam.

Included in mapping are small areas of Englewood soils in small drainageways, Ulm, Nunn, and Denver soils on hill slopes, and Midway and Renohill soils on ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Manzanola soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

In most places this soil is used for grazing and community development. In a few places it is used for crops.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and subsoil, which make tillage difficult, and by the slope. A mulch of plant residue reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps to conserve moisture and reduce erosion. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff on Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the shrink-swell potential, low strength,

slope, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability and the slope. The steepness of the slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

Areas that are used for crops most commonly are severely eroded. Seeding them to grass helps control erosion.

This soil is in capability subclass VIe, in the Clayey Foothill range site, and in plant adaptability group F-1.

94—Manzanola clay loam, 15 to 25 percent slopes. This is a deep, well drained soil on convex ridges and hill slopes. It formed in calcareous, clayey material derived from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is mildly alkaline, dark grayish brown clay loam about 5 inches thick. The subsoil in the upper 7 inches is mildly alkaline, brown clay loam. In the lower 17 inches it is moderately alkaline, pale brown and light yellowish brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown clay loam.

Included in mapping are small areas of Englewood soils in small drainageways, Ulm and Denver soils on hill slopes, and Midway and Renohill soils on ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Manzanola soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing and as habitat for wildlife. In a few areas it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Proper grazing use is needed to prevent depletion because this soil is difficult to revegetate. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope and the clay loam texture. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Tillage is difficult because of the clay loam surface layer and subsoil. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the slope, the shrink-swell potential, low strength, and slow permeability. Special sewage systems must be installed because of the slow permeability and the slope. The steepness of the slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Clayey Foothill range site, and in plant adaptability group F-1.

95—Manzanola cobbly clay loam, 15 to 25 percent slopes. This is a deep, well drained soil on convex ridges and hill slopes. It formed in calcareous, cobbly, clayey material derived dominantly from mudstone and shale. The average annual precipitation is 13 to 17

inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is mildly alkaline, dark grayish brown cobbly clay loam about 5 inches thick. The subsoil in the upper 7 inches is mildly alkaline, brown clay loam. In the lower 17 inches it is moderately alkaline, pale brown and light yellowish brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown clay loam.

Included in mapping are small areas of Englewood soils in small drainageways, Ulm and Denver soils on hill slopes, and Midway and Renohill soils on ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Manzanola soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up as much as 15 percent of the volume, and cobbles cover 15 to 35 percent of the surface.

This soil is used mainly for grazing and as habitat for wildlife. In a few places it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Proper grazing use is needed to prevent depletion because this soil is difficult to revegetate. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The use of machinery is not practical because the surface is stony and the slopes are steep. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, the clay loam texture, and large stones. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Tillage is difficult because of the clay loam surface layer and subsoil. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this Manzanola soil for homesite development are the slope, the shrink-swell potential, low strength, slow permeability, and large stones. Special sewage systems must be installed because of the slow permeability and the slope. The steepness of the slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Clayey Foothill range site, and in plant adaptability group F-1.

96—Manzanola-Renohill-Stoneham complex, 9 to 15 percent slopes. The soils making up this complex are on hill slopes, ridges, and knobs. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Manzanola soil makes up 35 percent of the complex, Renohill soil makes up 30 percent, and Stoneham soil makes up 20 percent. The Manzanola soil is on hill slopes, the Renohill soil is on hill slopes and ridges, and the Stoneham soil is on hill slopes, ridges, and knobs. The areas of these soils are so intricately intermingled that it was not practical to map them separately at the sale used in mapping.

Included in mapping are small areas of Ulm and Nunn soils on hill slopes, Midway soils on ridges, and Primen and Leyden soils on gravelly and cobbly hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Manzanola soil is deep and well drained. It formed in calcareous, clayey material derived from mudstone and shale.

Typically, the surface layer is mildly alkaline, dark grayish brown clay loam about 5 inches thick. The subsoil in the upper 7 inches is mildly alkaline, brown clay loam. In the lower 17 inches it is moderately alkaline, pale brown and light yellowish brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown clay loam.

Permeability of the Manzanola soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

The Renohill soil is moderately deep and well drained. It formed in calcareous, clayey material derived from interbedded shale, mudstone, and sandstone.

Typically, the surface layer is neutral, grayish brown loam about 3 inches thick. The subsoil in the upper 7 inches is neutral and mildly alkaline, dark grayish brown and grayish brown clay loam. In the lower 6 inches it is moderately alkaline, light brownish gray clay loam. The substratum to a depth of 32 inches is moderately alkaline, pale yellow clay loam. Soft, weathered shale is at a depth of 32 inches.

Permeability of the Renohill soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

The Stoneham soil is deep and well drained. It formed in calcareous, loamy eolian and alluvial material derived from mixed sources.

Typically, the surface layer is neutral, brown loam about 3 inches thick. The subsoil is mildly alkaline, pale brown clay loam about 9 inches thick. The upper part of the substratum is moderately alkaline, very pale brown clay loam about 18 inches thick. The lower part to a depth of 60 inches is moderately alkaline, very pale brown loam.

Permeability of the Stoneham soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is moderate. Rock fragments make up 0 to 15 percent of the volume.

In most areas the soils are used for grazing, as pasture, and as habitat for wildlife. In a few areas they are used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, sideoats grama, and needleandthread. The average annual production of air-dry vegetation ranges from 600 to 1,500 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope and, on the Renohill soil, because of the moderate depth to rock. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the slope, the shrink-swell potential, and slow permeability. In areas of Renohill soil, the deep cuts needed to provide a sufficiently level building site can expose bedrock. Structures to divert runoff from buildings and roads are needed. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Cuts and fills should be seeded or mulched. Special sewage systems must be installed because of the slope, the slow permeability, and, on the Renohill soil, the depth to rock. Effluent from an absorption field can surface downslope and create a health hazard. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIe. The Manzanola and Renohill soils are in the Clayey Foothill range site and in plant adaptability group F-1. The Stoneham soil is in the Loamy Foothill range site and in plant adaptability group F-3.

97—McClave clay loam, 0 to 3 percent slopes. This is a deep, somewhat poorly drained soil on alluvial valley

floors, concave flood plains, and low terraces. It formed in stratified, loamy alluvium derived from mixed sources. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, dark grayish brown clay loam about 12 inches thick. The upper part of the subsoil is mildly alkaline, dark grayish brown clay loam 14 inches thick. The lower part is mildly alkaline, grayish brown clay loam 16 inches thick that has strong brown mottles. The substratum to a depth of 60 inches is moderately alkaline, brown sandy clay loam that has strong brown mottles.

Included in mapping are small areas of Englewood soils in drainageways, Nunn soils on higher terraces, and the moderately well drained, saline Lebsack soils in positions similar to those of the McClave soil. The included soils make up about 15 percent of the total acreage.

Permeability of this McClave soil is moderately slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. A seasonal high water table is at a depth of 12 to 24 inches in spring and summer. This soil is occasionally flooded for brief periods in spring and summer. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for crops and grazing and as habitat for wildlife. In a few areas it is used for community development.

The native vegetation is mainly western wheatgrass, sedge, switchgrass, and alkali sacaton. The average annual production of air-dry vegetation ranges from 1,000 to 3,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Wetness limits the choice of plants on this soil. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and deterioration of the native plants.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by wetness and flooding. Plants that tolerate wetness should be selected. Drainage and structures to divert water may be needed.

The McClave soil is severely limited for homesites and for roads and streets by wetness and flooding. Drainage and structures to divert runoff are needed where roads and building foundations are constructed. Special sewage systems must be installed because of wetness. Some areas can be maintained as greenbelts and parks.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration. Tile drainage and open drainage ditches are needed to lower the water table and minimize wetness. Intensive management is required to maintain soil productivity.

On nonirrigated cropland, the main concerns in management are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the soil are needed to reduce erosion, improve tilth, and conserve moisture. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IIIw, irrigated and nonirrigated, in the Salt Meadow range site, and in plant adaptability group PF-2.

98—Midway clay loam, 9 to 30 percent slopes. This is a shallow, well drained soil on hill slopes and ridges. This soil formed in calcareous, clayey material derived from shale and mudstone. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, olive brown clay loam about 3 inches thick. The layer below that is mildly alkaline, light olive brown clay loam about 7 inches thick. The underlying material to a depth of 14 inches is moderately alkaline, light yellowish brown clay. Soft shale is at a depth of 14 inches.

Included in mapping are small areas of Primen soils on cobbly and gravelly ridges, Renohill soils on hill slopes, Standley and Nunn soils on fans, and soils on hill slopes that have cobbles on the surface. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Midway soil is slow. The available water capacity is low. The effective rooting depth is 6 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The depth to soft bedrock ranges from 6 to 20 inches. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used for grazing, as habitat for wildlife, and as recreation areas. In a few places it is used as homesites.

The native vegetation is mainly western wheatgrass, green needlegrass, sideoats grama, and needleandthread. The average annual production of air-dry vegetation ranges from 300 to 600 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic

deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds revegetation in areas depleted by heavy grazing or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

On this soil, grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the shallowness to rock and the slope. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Supplemental watering is needed at the time of planting and in dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the slope, the shallowness to rock, and the shrink-swell potential. The deep cuts needed to provide a sufficiently level building site expose bedrock. Structures to divert runoff are needed to protect buildings and roads. The effects of shrinking and swelling can be minimized by proper engineering designs and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Cuts and fills should be seeded or mulched. Effluent from an absorption field can surface downslope and create a health hazard. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Shaly Foothill range site, and in plant adaptability group F-2.

99—Midway stony clay loam, 15 to 40 percent slopes. This is a shallow, well drained soil on hill slopes and ridges. This soil formed in calcareous, stony, clayey material derived from shale and mudstone. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Typically, the surface layer is neutral, olive brown stony clay loam about 3 inches thick. The layer below that is mildly alkaline, light olive brown clay loam about 7 inches thick. The underlying material to a depth of 14 inches is moderately alkaline, light yellowish brown clay. Soft shale is at a depth of 14 inches.

Included in mapping are small areas of Primen soils on ridges, Leyden soils on hill slopes, Standley soils on fans, and soils that have cobbles on the surface and are on hill slopes. The included soils make up about 15 percent of the total acreage.

Permeability of this Midway soil is slow. The available water capacity is low. The effective rooting depth is 6 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 6 to 20 inches. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used for grazing, as habitat for wildlife, and as recreation areas.

The native vegetation is mainly western wheatgrass, green needlegrass, sideoats grama, and needleandthread. The average annual production of air-dry vegetation ranges from 300 to 600 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. The use of machinery is not practical because the surface is stony and the slopes are steep. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

On this soil, grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the shallowness to rock, the slope, and large stones. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Rock fragments should be removed from the surface in disturbed areas for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and in dry periods.

The main limitations to use of this Midway soil for homesite development are the slope, the shallowness to rock, and the shrink-swell potential. The deep cuts needed to provide a sufficiently level building site expose bedrock. Structures to divert runoff are needed where buildings and roads are constructed. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly

installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Cuts and fills should be seeded or mulched. Effluent from absorption fields can surface downslope and create a health hazard. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as open space and parks planted with native vegetation and other adapted plants.

This soil is in capability subclass VIIe, in the Shaly Foothill range site, and in plant adaptability group F-2.

100—Nederland very cobbly sandy loam, 15 to 50 percent slopes. This is a deep, well drained soil on shoulders and back slopes of terrace escarpments. This soil formed in cobbly, gravelly, and loamy alluvium derived from mixed sources. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Typically, the surface layer is mildly alkaline, dark brown and brown very cobbly sandy loam about 10 inches thick. The subsoil is neutral, dark brown and strong brown very cobbly sandy clay loam about 50 inches thick.

Included in mapping are small areas of Willowman soils on terrace escarpments, Flatirons and Veldkamp soils on terraces, Primen and Leyden soils on hill slopes at the lower edge of the mapped areas, and wet areas below springs. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Nederland soil is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 35 to 75 percent of the volume.

In most areas this soil is used for grazing, as pasture, and as habitat for wildlife. In a few areas it is used for community development.

The native vegetation is mainly big bluestem, little bluestem, blue grama, mountain muhly, and, on north-facing slopes, mountainmahogany. The average annual production of air-dry vegetation ranges from 1,000 to 2,300 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Proper grazing use is needed to prevent depletion because this soil is difficult to revegetate. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. The use of machinery is not practical because the surface is stony and the slopes are steep. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope and large stones. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the slope and large stones. The hazard of erosion increases if the soil is left exposed during site development. Structures to divert runoff from buildings and roads are needed. The steepness of the slope is a limitation for septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIIe, in the Cobbly Foothill range site, and in plant adaptability group F-5.

101—Nederland Variant very cobbly sandy loam, 30 to 50 percent slopes. This is a deep, well drained soil on hill slopes and ridges of Green Mountain. This soil formed in cobbly, gravelly, and loamy alluvium derived from mixed sources. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 6,200 to 6,900 feet.

Typically, the surface layer is medium acid, brown to dark brown very cobbly sandy loam about 3 inches thick. The subsoil in the upper 5 inches is medium acid, brown to dark brown very cobbly sandy loam. In the lower 9 inches it is neutral, brown to dark brown very cobbly sandy loam. The substratum to a depth of 60 inches is neutral, yellowish brown very cobbly loamy sand.

Included in mapping are small areas of Veldkamp soils on stable summits, Nederland soils on terraces, Rooney soils on hill slopes at the lower edge of some mapped areas, and Leyden and Primen soils on hill slopes. Also included are small areas of Urban land. The included

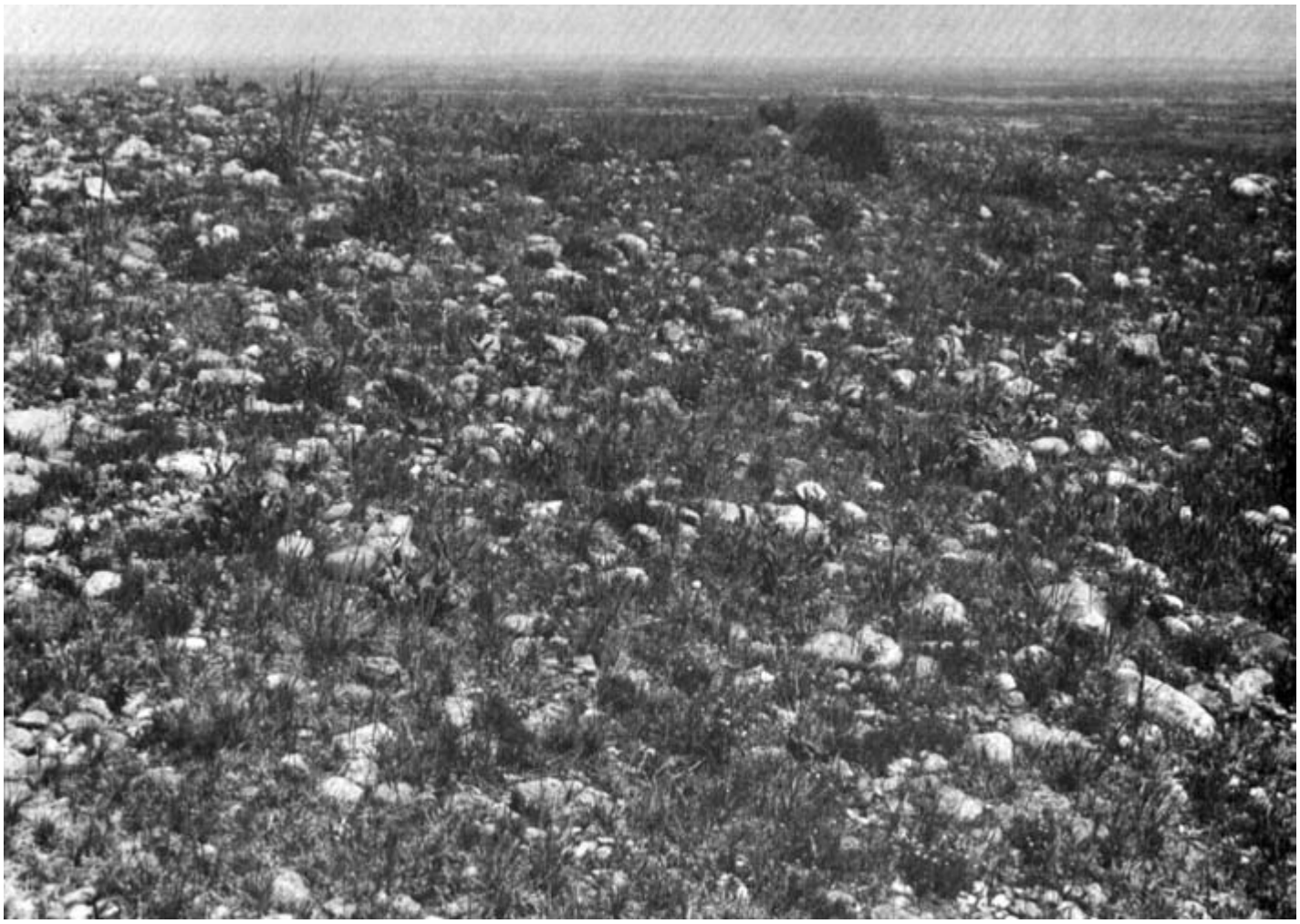


Figure 4.—This area near the top of Green Mountain is in the Cobbly Foothill range site. The soil is Nederland Variant very cobbly sandy loam, 30 to 50 percent slopes.

soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Nederland Variant soil is moderately rapid to rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 35 to 65 percent of the volume.

This soil is used mainly for grazing (fig. 4) and as pasture, as habitat for wildlife, and as recreation areas. In a few places this soil is used for community development.

The native vegetation is mainly big bluestem, little bluestem, blue grama, mountain muhly, and, on north-facing slopes, mountainmahogany. The average annual production of air-dry vegetation ranges from 1,000 to 2,300 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Proper grazing use is needed to prevent depletion because this soil is difficult to revegetate. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. The use of machinery is not practical because of the stony surface and steep slopes. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope and large stones. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the slope and large stones. The hazard of erosion increases if the soil is left exposed during site development. Structures to divert runoff are needed to protect buildings and roads. The steep slopes are a limitation for septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIIe, in the Cobbly Foothill range site, and in plant adaptability group F-5.

102—Nunn clay loam, 0 to 2 percent slopes. This is a deep, well drained soil on high terraces, tablelands, and fans. This soil formed in calcareous, clayey material derived from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer and the upper part of the subsoil are neutral, dark grayish brown clay loam about 6 inches thick. The subsoil in the next 17 inches is neutral and mildly alkaline, brown clay loam and clay. In the lower 12 inches it is moderately alkaline, pale brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown and very pale brown clay loam.

Included in mapping are small areas of Englewood soils in small drainageways, Denver soil on terraces and fans, Standley soils on gravelly terraces, and Ulm soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Nunn soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are slight hazards. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

In most places this soil is used for grazing, as pasture and as recreation areas, and for crops. In a few places it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and increased runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. A mulch of plant residue reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration

and improve tilth. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration. Land leveling is needed in some areas to achieve uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the soil are essential in protecting the soil from erosion, improving tilth, and conserving moisture. Soil blowing can be reduced by planting crops in alternate strips at right angles to the prevailing wind. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1.

103—Nunn clay loam, 2 to 5 percent slopes. This is a deep, well drained soil on high terraces, tablelands, and fans. This soil formed in calcareous, clayey material derived from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer and the upper part of the subsoil are neutral, dark grayish brown clay loam about 6 inches thick. The subsoil in the next 17 inches is neutral and mildly alkaline, brown clay loam and clay. In the lower 12 inches it is moderately alkaline, pale brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown and very pale brown clay loam.

Included in mapping are small areas of Englewood soils in small drainageways, Denver soils on terraces and fans, Standley soils on gravelly terraces, and Ulm soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Nunn soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

In most places this soil is used for grazing, as pasture and as recreation areas, and for crops. In a few places it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. A mulch of plant residue reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil helps maintain the content of organic matter, increase water infiltration, and improve tilth. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration. Light, frequent applications of irrigation water are needed to prevent soil loss because of the slope. Land leveling is needed in some areas for the uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the soil are essential in protecting the soil from erosion, improving tilth, and

conserving moisture. Soil blowing can be reduced by planting crops in alternate strips at right angles to the prevailing wind. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IIIe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1.

104—Nunn clay loam, 5 to 9 percent slopes. This is a deep, well drained soil on high terraces, hill slopes, and fans. This soil formed in calcareous, clayey material derived from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer and the upper part of the subsoil are neutral, dark grayish brown clay loam about 6 inches thick. The subsoil in the next 17 inches is neutral and mildly alkaline, brown clay loam and clay. In the lower 12 inches it is moderately alkaline, pale brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown and very pale brown clay loam.

Included in mapping are small areas of Kutch soils on hill slopes and shoulders, Denver soils on terraces and fans, Standley soils on gravelly terraces, and Ulm soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Nunn soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

In most places this soil is used for grazing, as pasture and as recreation areas, and for crops. In a few places it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. A mulch of plant residue reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration. Land leveling is needed for the uniform distribution of water. Light, frequent applications of irrigation water are needed to prevent soil loss because of the slope.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the soil are essential in protecting the soil from erosion, improving tilth, and conserving moisture. Terracing and contour tillage are needed to reduce erosion. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IVe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1.

105—Nunn-Urban land complex, 0 to 2 percent slopes. The areas of this complex are on high terraces,

tablelands, and fans. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Nunn soil makes up 65 percent of the complex, and Urban land makes up 20 percent. The areas of the Nunn soil and of Urban land are so intricately intermingled that it was not practical to map them separately at the scale used in mapping.

Included in mapping are small areas of Englewood soils in drainageways, Denver soils on terraces and fans, and Standley soils on gravelly terraces. Urban land makes up more than 20 percent of some mapped areas. Also included are small areas that are less than 20 percent Urban land and are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Nunn soil is deep and well drained. It formed in calcareous, clayey material derived from mudstone and shale.

Typically, the surface layer and the upper part of the subsoil are neutral, dark grayish brown clay loam about 6 inches thick. The subsoil in the next 17 inches is neutral and mildly alkaline, brown clay loam and clay. In the lower 12 inches it is moderately alkaline, pale brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown and very pale brown clay loam.

Permeability of this Nunn soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are slight hazards. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

Urban land is mainly covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

The areas of this complex are used mainly for community development. In a few areas the Nunn soil is used as pasture and for grazing.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding hastens revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and increased runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. A mulch of plant residue reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and of commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at the time of planting and in dry periods.

The main limitations to use of the Nunn soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help to prevent seepage into basements and to minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the Nunn soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff from Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

The Nunn soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

106—Nunn-Urban land complex, 2 to 5 percent slopes. The areas of this complex are on high terraces, tablelands, and fans. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Nunn soil makes up 65 percent of this complex, and Urban land makes up 20 percent. The areas of this Nunn soil and of Urban land are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Englewood soils in drainageways, Denver soils on terraces and fans, and Standley soils on gravelly terraces. Urban land makes up more than 20 percent of some mapped areas. Also included are small areas that are less than 20 percent Urban land; these are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Nunn soil is deep and well drained. It formed in calcareous, clayey material derived from mudstone and shale.

Typically, the surface layer and the upper part of the subsoil are neutral, dark grayish brown clay loam about 6

inches thick. The subsoil in the next 17 inches is neutral and mildly alkaline, brown clay loam and clay. In the lower 12 inches it is moderately alkaline, pale brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown and very pale brown clay loam.

Permeability of this Nunn soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

Urban land is mainly covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

The areas of this complex are used mainly for community development. In a few areas the Nunn soil is used as pasture and for grazing.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. A mulch of plant residue reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental watering is needed at the time of planting and in dry periods. Light, frequent applications of irrigation water are needed to prevent soil loss because of the slope.

The main limitations to use of the Nunn soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the Nunn soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff from Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

The Nunn soil is in capability subclass IIIe, irrigated and nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

107—Nunn-Urban land complex, 5 to 9 percent slopes. The areas of this complex are on high terraces, hill slopes, and fans. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Nunn soil makes up 65 percent of the complex, and Urban land makes up 20 percent. The areas of Nunn soil and of Urban land are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Kutch soils on hill slopes and shoulders, Denver soils on terraces and fans, and Standley soils on gravelly terraces. Urban land makes up more than 20 percent of some mapped areas. Also included are small areas that are less than 20 percent Urban land; these are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Nunn soil is deep and well drained. It formed in calcareous, clayey material derived from mudstone and shale.

Typically, the surface layer and the upper part of the subsoil are neutral, dark grayish brown clay loam about 6 inches thick. The middle part of the subsoil is neutral and mildly alkaline, brown clay loam and clay 17 inches thick. The lower part is moderately alkaline, pale brown clay loam 12 inches thick. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown and very pale brown clay loam.

Permeability of this Nunn soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

Urban land is mainly covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

The areas of this complex are used mainly for community development. In a few areas the Nunn soil is used as pasture and for grazing.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. A mulch of plant residue reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at the time of planting and in dry periods. Irrigation water should be applied lightly and frequently to prevent soil loss because of the slope and the slow permeability.

The main limitations to use of the Nunn soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the Nunn soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff from Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

The Nunn soil is in capability subclass IVe, irrigated and nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

108—Nunn Variant-Urban land complex, 0 to 3 percent slopes. The areas of this complex are on terraces, flood plains, and alluvial fans. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Nunn Variant soil makes up 65 percent of this complex, and Urban land makes up 20 percent. The areas of Nunn Variant soil and Urban land are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Nunn soils on high terraces, wet Englewood soils in drainageways, and Loveland Variant soils on low terraces. Also included are small areas that are less than 20 percent Urban land; these are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Nunn Variant soil is deep and is somewhat poorly drained or moderately well drained. It formed in calcareous alluvium derived from mixed sources.

Typically, the surface layer and the upper part of the subsoil are neutral, grayish brown clay loam about 12 inches thick. The subsoil in the next 17 inches is mildly alkaline, grayish brown clay loam, and in the lower 14 inches it is moderately alkaline, grayish brown clay loam that has strong brown mottles. The substratum to a depth of 60 inches is moderately alkaline, light gray clay loam that has strong brown mottles.

Permeability of the Nunn Variant soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are slight hazards. A seasonal high water table is at a depth of 24 to 72 inches in spring and summer. However, in some areas this soil has been artificially drained by domestic wells. It is subject to rare flooding in spring and summer. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

Urban land is mainly covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

The areas of this complex are used mainly for community development and as pasture. In a few areas the Nunn Variant soil is used for grazing and crops.

The native vegetation is mainly western wheatgrass, switchgrass, inland saltgrass, and sedges. The average annual production of air-dry vegetation ranges from 1,000 to 3,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the slow permeability and by the clay loam surface layer and subsoil, which make tillage difficult. A mulch of plant residue helps to reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at planting time and in dry periods.

The main limitations to use of the Nunn Variant soil for homesite development are flooding, the shrink-swell potential, low strength, and wetness. Structures to divert runoff are needed to protect buildings and roads from flooding. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Special sealing methods are needed to prevent excessive seepage. Buildings and roads should be designed to offset the limited ability of the Nunn Variant soil to support a load. Drainage is needed for roads and building foundations. Dwellings without basements can be built on a fill or pad of suitable soil material to compensate for wetness. Special sewage systems must be installed because of the slow permeability and wetness. Because runoff on Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, maintaining or improving fertility, and reducing wetness. Incorporating crop residue into the soil helps maintain the content of organic matter, increase water infiltration, and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen andphosphorus are needed to maintain fertility. A tillage pan forms easily if the Nunn Variant soil is tilled when it is wet. Tillage should be kept to a minimum. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the surface layer are essential in protecting the soil from erosion and in improving tilth and conserving moisture. A tillage pan forms easily if the Nunn Variant soil is tilled when it is wet. Tillage should be kept to a minimum.

The Nunn Variant soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated; in the Salt Meadow range site; and in plant adaptability group PF-2. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

109—Paymaster sandy loam, 0 to 3 percent slopes. This is a deep, well drained soil on low terraces. It formed in gravelly, sandy, and loamy alluvium derived from mixed sources. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Typically, the surface layer is neutral, grayish brown and dark grayish brown sandy loam about 36 inches thick. The underlying material to a depth of 60 inches is neutral, grayish brown, stratified gravelly loamy sand and gravelly sandy loam.

Included in mapping are small areas of Haverson soils and the somewhat poorly drained McClave soils on low terraces, riverwash in stream courses, and Nunn soils on fans and higher terraces. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

Permeability of this Paymaster soil is moderately rapid in the surface layer and rapid below that. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. This soil is subject to rare flooding in spring and summer. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume in the surface layer and 15 to 60 percent in the underlying material.

This soil is used for grazing, as pasture, for crops, and for community development.

The native vegetation is mainly big bluestem, prairie sandreed, needleandthread, and blue grama. The average annual production of air-dry vegetation ranges from 1,000 to 1,400 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

This soil is well suited to grasses, shrubs, trees, and garden plants. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and in dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm

drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this soil for homesite development are flooding and seepage. Structures to divert runoff are needed to protect buildings and roads from flooding. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas that are planted with native vegetation and other adapted plants can be used as greenbelts and parks.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. A sprinkler irrigation system works best on this soil because the soil takes in water rapidly. If furrow irrigation is used, land leveling is needed in some areas for the uniform distribution of water. Applications of manure and of commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Tillage should be kept to a minimum.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Maintaining crop residue on or near the surface reduces runoff and soil blowing and helps maintain tilth and the content of organic matter. Soil blowing can be reduced by planting crops in alternate strips at right angles to the prevailing wind.

This soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated; in the Sandy Foothill range site; and in plant adaptability group F-4.

110—Pits, clayey. This map unit consists mostly of borrow areas and cut areas resulting from mining operations or extensive leveling. In these areas, the substratum of the soils, shale, or mudstone is exposed. The side slopes commonly are steep or nearly vertical. At the bottom of the pits, slopes generally are complex and range from nearly level to moderately steep. The average annual precipitation is 13 to 17 inches, the average annual temperature is 47° F, and the frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Included in mapping are small areas of Ustic Torriorthents, clayey; Rock outcrop, sedimentary; and areas of undisturbed clayey soils. The included areas make up about 15 percent of the map unit.

Permeability of Pits, clayey, is slow. The available water capacity is low to moderate. Runoff is slow to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a slight to moderate hazard. The shrink-swell potential is moderate to high.

These pits are used as a source of clay and fill material. Some abandoned pits are used as recreation areas.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, the depth to rock, and the clayey texture of the soils. Reshaping before planting is necessary to stabilize the steep cut slopes. The areas should be covered with a layer of topsoil. Mulches are essential in establishing good stands of plantings on steep cut and fill slopes. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed. Planting on the contour helps conserve soil moisture and reduce erosion. Supplemental irrigation is needed at the time of planting and in dry periods.

The main limitations for homesite development are depth to rock, slope, the shrink-swell potential, low strength, and slippage. The deep cuts needed to provide a sufficiently level building site can expose bedrock. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential. Buildings and roads should be designed to offset the limited ability of these soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Effluent from a septic tank absorption field can surface downslope and create a health hazard. Structures to divert runoff are needed where buildings and roads are constructed. Topsoil should be used to reclaim areas disturbed by cutting. Steep cut slopes should be reshaped to reduce the slope and minimize the potential for slippage.

Onsite investigation is needed to determine the potential and limitations of specific sites for proposed uses.

This map unit is in capability subclass VIIs.

111—Pits, gravel. This map unit consists mainly of cut areas and borrow areas resulting from the mining of alluvial gravel and crushed rock or from extensive cutting and filling. The side slopes commonly range from steep to nearly vertical. At the bottom of the pits, slopes generally are complex and range from nearly level to moderately steep. The average annual precipitation is 13 to 20 inches, the average annual temperature ranges from 41° to 47° F, and the frost-free season ranges from 55 to 142 days. Elevation is 5,200 to 9,500 feet.

Included in mapping are small areas of Ustic Torriorthents, clayey; Rock outcrop; and undisturbed soils. The included areas make up about 15 percent of the map unit.

Permeability of Pits, gravel, is moderate to very rapid. The available water capacity generally is low. Runoff is slow to rapid, and water erosion is a moderate to severe

hazard. Soil blowing is a slight hazard. The shrink-swell potential commonly is low.

Pits, gravel, are used as a source of sand and gravel and crushed aggregate. Some abandoned pits are used as recreation areas.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, depth to rock, and small and large stones. Before planting, reshaping is necessary to stabilize the steep cut slopes. The areas should be covered with a layer of topsoil. A mulch is indispensable in establishing good stands of plantings on steep cut and fill slopes. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitations to use of these areas for homesite development are depth to rock, slope, large and small stones, seepage, and slippage. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. In some areas a water table has formed because of seepage from perennial streams, and drainage is needed before roads and building foundations are constructed. Topsoil can be used to reclaim areas disturbed by cutting. Steep cut slopes should be reshaped to reduce the slope and minimize the risk of slippage.

Onsite investigation is needed to determine the potential and limitations of a specific site for a proposed use.

This map unit is in capability subclass VIIs.

112—Platner loam, 3 to 5 percent slopes. This is a deep, well drained soil on high terraces, tablelands, and hill slopes. This soil formed in calcareous alluvial and eolian material derived from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,000 feet.

Typically, the surface layer is neutral, grayish brown loam about 8 inches thick. The subsoil in the upper 10 inches is neutral, dark grayish brown clay. In the lower 7 inches it is moderately alkaline, yellowish brown clay loam. The substratum in the upper 20 inches is moderately alkaline, light yellowish brown clay loam. Below that to a depth of 60 inches it is moderately alkaline, pink loam.

Included in mapping are small areas of Denver and Nunn soils on fans and Englewood soils in drainageways. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Platner soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium. Water erosion and soil blowing are moderate hazards. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used for grazing, crops, and community development.

The native vegetation is mainly blue grama, buffalograss, western wheatgrass, and green needlegrass. The average annual production of air-dry vegetation ranges from 900 to 1,500 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Contour furrowing and pitting improve water infiltration and reduce runoff; they are especially effective in depleted areas. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

This soil is well suited to grasses, shrubs, trees, and garden plants. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Tillage is difficult because of the clayey subsoil. Supplemental irrigation is needed at the time of planting and in dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the Platner soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage

systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Land leveling is needed to achieve uniform distribution of water. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the soil are essential in protecting soil from erosion and in improving tilth and conserving moisture. After row crops are harvested, a cover crop or an adequate amount of crop residue on the surface is needed to protect the soil from blowing. Terraces and diversions help reduce runoff and conserve moisture. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IIIe, irrigated and nonirrigated, in the Loamy Foothill range site, and in plant adaptability group F-3.

113—Platner-Urban land complex, 0 to 3 percent slopes. The areas of this complex are on high terraces and tablelands. The average annual precipitation is 13 to 15 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 5,600 feet.

Platner soil makes up 65 percent of this complex, and Urban land makes up 20 percent. The areas of this Platner soil and of Urban land are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Denver and Nunn soils on fans and Englewood soils in drainageways. Also included are small areas that are less than 20 percent Urban land; these are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Platner soil is deep and well drained. It formed in calcareous alluvial and eolian material derived from mudstone and shale.

Typically, the surface layer is neutral, grayish brown loam about 8 inches thick. The upper part of the subsoil is neutral, dark grayish brown clay 10 inches thick. The lower part is moderately alkaline, yellowish brown clay loam 7 inches thick. The upper part of the substratum is moderately alkaline, light yellowish brown clay loam 20 inches thick. The lower part to a depth of 60 inches is moderately alkaline, pink loam.

Permeability of this Platner soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

Urban land is covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

The areas of this complex are used mainly for community development. In a few places the Platner soil is used as pasture and for grazing.

The native vegetation is mainly blue grama, western wheatgrass, needleandthread, and buffalograss. The average annual production of air-dry vegetation ranges from 500 to 1,500 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The Platner soil is well suited to grasses, shrubs, trees, and garden plants. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Tillage may be difficult because of the clayey subsoil. Supplemental irrigation is needed at the time of planting and in dry periods.

The main limitations to use of the Platner soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the Platner soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff on Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding

downslope in areas that would not normally be subject to flooding. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

The Platner soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated; in the Loamy Plains range site; and in plant adaptability group F-3. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

114—Raleigh very gravelly sandy loam, 9 to 15 percent slopes. This is a shallow, somewhat excessively drained soil on mountain side slopes and summits. The slopes most commonly face north. This soil formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 45° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,200 to 10,000 feet.

Typically, the surface layer is neutral, grayish brown very gravelly sandy loam about 1 inch thick. The subsoil in the upper 4 inches is neutral, brown very gravelly sandy loam. In the lower 3 inches it is neutral, light brownish gray very gravelly sandy loam. The substratum is neutral, brown extremely gravelly sandy loam about 6 inches thick. It overlies fractured Pikes Peak Granite.

Included in mapping are small areas of Earcree Variant soils on toe slopes and fans and in drainageways, soils that do not have a dark surface layer and that are on eroded shoulders and back slopes, Rock outcrop on shoulders and ridges, and soils that have stones on the surface and are on side slopes. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage of the map unit.

Permeability of this Raleigh soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

This soil is used mainly as woodland, as habitat for wildlife, and as recreation areas. In a few places it is used for community development and as a source of roadfill.

The native vegetation is mainly an overstory of Douglas-fir and some lodgepole pine and ponderosa pine and an understory of kinnikinnick, common juniper, and a variety of scattered grasses and forbs. The wooded areas are managed mainly as habitat for wildlife and watershed and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the small stones, the slope, droughtiness, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface in disturbed areas for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this soil for homesite development are shallowness to rock, seepage, and slope. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. In constructing roads and streets in residential communities, the practices needed to control erosion are the same as those used in wooded areas. Structures to divert runoff from buildings and roads are needed. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Douglas-fir—Lodgepole Pine woodland group, and in plant adaptability group M-7.

115—Raleigh very gravelly sandy loam, 15 to 30 percent slopes. This is a shallow, somewhat excessively drained soil on mainly north-facing mountain side slopes. This soil formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 45° F, and the

average frost-free season ranges from 55 to 75 days. Elevation is 7,200 to 10,000 feet.

Typically, the surface is covered by a mat of partly decomposed needles and twigs that is about 1 inch thick. The surface layer is neutral, grayish brown very gravelly sandy loam about 1 inch thick. The subsoil in the upper 4 inches is neutral, brown very gravelly sandy loam. In the lower 3 inches it is neutral, light brownish gray very gravelly sandy loam. The substratum is neutral, brown extremely gravelly sandy loam about 6 inches thick. It overlies fractured Pikes Peak Granite.

Included in mapping are small areas of Earcree Variant soils on toe slopes and fans and in drainageways, soils that do not have a dark surface layer and that are on eroded shoulders and back slopes, Rock outcrop on shoulders and ridges, and soils, on side slopes, that have stones on the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage of the map unit.

Permeability of this Raleigh soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

This soil is used mainly as woodland, habitat for wildlife, and recreation areas. In a few places it is used for community development and as a source of roadfill.

The native vegetation is mainly an overstory of Douglas-fir and some lodgepole pine and ponderosa pine and an understory of kinnikinnick, common juniper, and a variety of scattered grasses and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on this soil because of the small stones, the slope, droughtiness, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface in disturbed areas for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this Raleigh soil for homesite development are shallowness to rock, slope, and seepage. Extensive excavation is required to provide level building sites because of the slope, but the deep cuts needed can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Structures to divert runoff from buildings and roads are needed. In constructing roads and streets in residential communities, the practices needed to control erosion are the same as those used in wooded areas. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Douglas-fir—Lodgepole Pine woodland group, and in plant adaptability group M-7.

116—Raleigh very gravelly sandy loam, 30 to 50 percent slopes. This is a shallow, somewhat excessively drained soil that is mainly on north-facing mountain side slopes. This soil formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 45° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,200 to 10,000 feet.

Typically, the surface is covered by a mat about 1 inch thick of partly decomposed twigs and needles. The surface layer is neutral and slightly acid, very dark grayish brown very gravelly sandy loam about 2 inches thick. The subsoil in the upper 3 inches is slightly acid, dark brown very gravelly sandy loam. In the lower 3 inches it is slightly acid, brown very gravelly sandy loam. The substratum is slightly acid, dark yellowish brown very gravelly sandy loam about 8 inches thick. It overlies weathered granite.

Included in mapping are small areas of Earcree Variant soils on toe slopes and fans and in drainageways, soils that do not have a dark surface layer and that are on eroded shoulders and back slopes, Rock outcrop on shoulders and ridges, and soils, on side slopes, that have stones on the surface. The included

areas make up about 15 percent of the total acreage of the map unit.

Permeability of this Raleigh soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

This soil is used mainly as woodland, as habitat for wildlife, and as recreation areas. In a few places it is used as homesites and as a source of roadfill.

The native vegetation is mainly an overstory of Douglas-fir and some lodgepole pine and ponderosa pine and an understory of kinnikinnick, common juniper, and a variety of scattered grasses and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas include or are adjacent to homesites; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on this soil because of the small stones, the slope, droughtiness, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitations to use of this Raleigh soil for homesite development are shallowness to rock, slope, and seepage. Because of the slope, extensive excavation is required to provide level building sites. The necessary deep cuts can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Structures to divert runoff from buildings and roads are needed. In constructing roads and streets in residential communities, the practices needed to control erosion are the same as those used in wooded areas. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIIe, in the Douglas-fir—Lodgepole Pine woodland group, and in plant adaptability group M-7.

117—Raleigh very gravelly sandy loam, 2 to 9 percent south slopes. This is a shallow, somewhat excessively drained soil on mountain side slopes and summits. This soil formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite. The average annual precipitation is 17 to 20 inches, the average air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 8,000 to 10,000 feet.

Typically, the surface layer is neutral, grayish brown very gravelly sandy loam about 1 inch thick. The subsoil in the upper 4 inches is neutral, brown very gravelly sandy loam. In the lower 3 inches it is neutral, light brownish gray very gravelly sandy loam. The substratum is neutral, brown extremely gravelly sandy loam about 6 inches thick. It overlies fractured Pikes Peak Granite.

Included in mapping are small areas of Earcree Variant soils on toe slopes and fans and in drainageways, soils that do not have a dark surface layer and that are on eroded shoulders and back slopes, Rock outcrop on shoulders and ridges, and soils, on side slopes, that have stones on the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage of the map unit.

Permeability of this Raleigh soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is slow to medium. Water erosion is a slight to moderate hazard, and soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

This soil is used mainly as woodland, habitat for wildlife, recreation areas, and pasture or for grazing. In a few areas it is used for community development and as a source of roadfill.

The native vegetation is mainly an overstory of ponderosa pine and Douglas-fir and an understory of Arizona fescue, kinnikinnick, and forbs. The wooded areas are managed mainly as habitat for wildlife and watershed and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. This soil is difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Seeding speeds revegetation in areas depleted by heavy grazing or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on this soil because of the small stones, droughtiness, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this Raleigh soil for homesite development are shallowness to rock and seepage. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Effluent from absorption fields can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. In constructing roads and streets in residential communities, the practices needed to control erosion are the same as those used in wooded areas. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIs, in the Mixed Conifer woodland group, and in plant adaptability group M-6.

118—Raleigh very gravelly sandy loam, 9 to 15 percent south slopes. This is a shallow, somewhat excessively drained soil on mountain side slopes and summits. The slopes most commonly face south. The soil formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 8,000 to 10,000 feet.

Typically, the surface layer is neutral, grayish brown very gravelly sandy loam about 1 inch thick. The subsoil in the upper 4 inches is neutral, brown very gravelly sandy loam. In the lower 3 inches it is neutral, light brownish gray very gravelly sandy loam. The substratum is neutral, brown extremely gravelly sandy loam about 6 inches thick. It overlies fractured Pikes Peak Granite.

Included in mapping are small areas of Earcree Variant soils on toe slopes and fans and in drainageways, soils that do not have a dark surface layer and that are on eroded shoulders and back slopes, Rock outcrop on shoulders and ridges, and soils, on side slopes, that have stones on the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage of the map unit.

Permeability of this Raleigh soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid. Water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

This soil is used mainly as woodland, as habitat for wildlife, as recreation areas, for grazing, and as pasture. In a few areas it is used for community development and as a source of roadfill.

The native vegetation is mainly an overstory of ponderosa pine and Douglas-fir and an understory of Arizona fescue, kinnikinnick, and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. This soil is difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Seeding speeds revegetation in areas depleted by heavy grazing or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The

rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on this soil because of the small stones, the slope, droughtiness, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and of commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this Raleigh soil for homesite development are shallowness to rock, seepage, and slope. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Effluent from absorption fields can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. In constructing roads and streets in residential areas, the practices needed to control erosion are the same as those used for roads in wooded areas. Structures to divert runoff from buildings and roads are needed. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Mixed Conifer woodland group, and in plant adaptability group M-6.

119—Raleigh very gravelly sandy loam, 15 to 30 percent south slopes. This is a shallow, somewhat excessively drained soil on mountain side slopes, mainly slopes that face south. This soil formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite. The average annual precipitation is 17 to 20 inches. The average annual temperature is 41° to 43° F, and the frost-free season ranges from 55 to 75 days. Elevation is 8,000 to 10,000 feet.

Typically, the surface layer is neutral, grayish brown very gravelly sandy loam about 1 inch thick. The subsoil in the upper 4 inches is neutral, brown very gravelly sandy loam. In the lower 3 inches it is neutral, light brownish gray very gravelly sandy loam. The substratum is neutral, brown extremely gravelly sandy loam about 6 inches thick. It overlies fractured Pikes Peak Granite.

Included in mapping are small areas of Earcree Variant soils on toe slopes and fans and in drainageways, soils that do not have a dark surface layer and that are on eroded shoulders and back slopes, Rock outcrop on shoulders and ridges, and soils that are on side slopes and have stones on the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage of the map unit.

Permeability of this Raleigh soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

This soil is used mainly as woodland, habitat for wildlife, recreation areas, and pasture or for grazing. In a few areas it is used for community development and as a source of roadfill.

The native vegetation is mainly an overstory of ponderosa pine and Douglas-fir and an understory of Arizona fescue, kinnikinnick, and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. This soil is difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Seeding speeds revegetation in areas depleted by heavy grazing or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on this soil because of the small stones, the slope, droughtiness, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and of commercial fertilizers that contain

nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this Raleigh soil for homesite development are the shallowness to rock, the slope, and seepage. Extensive excavation is required to provide level building sites because of the slope, but the deep cuts needed can expose bedrock. Effluent from absorption fields can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. In constructing roads and streets in residential communities, the practices needed to control erosion are the same as those used for roads in wooded areas. Structures to divert runoff are needed to protect buildings and roads. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Mixed Conifer woodland group, and in plant adaptability group M-6.

120—Raleigh stony sandy loam, 30 to 50 percent south slopes. This is a shallow, somewhat excessively drained soil on mountain side slopes. The slopes most commonly face south. This soil formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 8,000 to 10,000 feet.

Typically, the surface layer is neutral, grayish brown stony sandy loam about 1 inch thick. The subsoil in the upper 4 inches is neutral, brown very gravelly sandy loam. In the lower 3 inches it is neutral, light brownish gray very gravelly sandy loam. The substratum is neutral, brown extremely gravelly sandy loam about 6 inches thick. It overlies fractured Pikes Peak Granite.

Included in mapping are small areas of Earcree Variant soils on toe slopes and fans and in drainageways, soils that do not have a dark surface layer and that are on eroded shoulders and back slopes, and Rock outcrop on shoulders and ridges. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage of the map unit.

Permeability of this Raleigh soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

This soil is used mainly as woodland, as habitat for wildlife, and as recreation areas. In a few places it is used for community development and as a source of roadfill.

The native vegetation is mainly an overstory of ponderosa pine and Douglas-fir and an understory of Arizona fescue, kinnikinnick, and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on this soil because of the small stones, the slope, droughtiness, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and of commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitations to use of this Raleigh soil for homesite development are shallowness to rock, slope, and seepage. Because of slope, extensive excavation is required to provide level building sites. The deep cuts that are necessary can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. In constructing roads and streets in residential communities, the practices needed to control erosion are the same as those used for roads in wooded areas. Structures to divert runoff from buildings and roads are

needed. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIIe, in the Mixed Conifer woodland group, and in plant adaptability group M-6.

121—Raleigh-Rock outcrop complex, 50 to 70 percent slopes. The areas of this complex are on mountain side slopes and ridges. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 45° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 6,500 to 10,000 feet.

Raleigh soil makes up 60 percent of this complex, and Rock outcrop makes up 20 percent. The Raleigh soil is on side slopes, and Rock outcrop is on the crest of slopes and ridges. The areas of Raleigh soil and of Rock outcrop are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of soils that do not have a dark surface layer and are on ridge crests and other soils that have stones on the surface and are on side slopes. The included soils make up about 20 percent of the total acreage.

The Raleigh soil is shallow and somewhat excessively well drained. It formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite.

Typically, the surface layer is neutral, grayish brown very gravelly sandy loam about 1 inch thick. The subsoil in the upper 4 inches is neutral, brown very gravelly sandy loam. In the lower 3 inches it is neutral, light brownish gray very gravelly sandy loam. The substratum is neutral, brown extremely gravelly sandy loam about 6 inches thick. It overlies weathered Pikes Peak Granite.

Permeability of the Raleigh soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

Rock outcrop consists of exposures of hard Pikes Peak Granite, large boulders, and talus.

The Raleigh soil is used as habitat for wildlife, as recreation areas, and for limited grazing.

The native vegetation is mainly an overstory of Douglas-fir, ponderosa pine, and lodgepole pine and an understory of common juniper, kinnikinnick, and sparse stands of grasses, mainly Arizona fescue. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on the Raleigh soil because of the slope, the shallowness to rock, and the short growing season. Selecting adapted plants is essential in establishing grasses, shrubs, and trees.

The Raleigh soil in this complex is poorly suited to homesite development. The main limitations are the slope and shallowness to rock. These limitations can be overcome only by intensive and costly engineering methods and design.

This complex is in capability subclass VIIe. The Raleigh soil is in the Douglas-fir woodland group and in plant adaptability group M-7.

122—Ratake-Cathedral very stony sandy loams, 25 to 60 percent slopes. These soils are on mountain side slopes and ridges that have an east, west, or south aspect. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Ratake soil makes up 50 percent of this map unit, and Cathedral soil makes up 35 percent. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Curecanti soils on foot slopes, Lininger and Trag soils on stable summits and toe slopes, Rock outcrop on shoulders and back slopes, and Breece soils on toe slopes and in drainageways. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Ratake soil is shallow and well drained. It formed in stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark brown very stony sandy loam about 3 inches thick. The subsoil is neutral, dark brown very gravelly sandy loam about 9 inches thick. It overlies soft bedrock.

Permeability of the Ratake soil is moderate. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Cathedral soil is shallow and well drained. It formed in stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark grayish brown very stony sandy loam about 3 inches thick. The subsoil is neutral, dark grayish brown very gravelly sandy loam about 8 inches thick. It overlies hard bedrock.

Permeability of the Cathedral soil is rapid. The available water capacity is low. The effective rooting

depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

In most places, the soils are used as wildlife habitat, as woodland, as recreation areas, and for grazing. In a few places they are used for community development.

The native vegetation is mainly Arizona fescue, mountain muhly, and Parry oatgrass. The average annual production of air-dry vegetation ranges from 500 to 900 pounds per acre. Gambel oak is common in the mountains in the southern part of the area. Scattered ponderosa pine and Rocky Mountain juniper are common. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The soils are difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The wooded areas are managed mainly as habitat for wildlife and watershed and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

On these soils, grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, depth to rock, large stones, and the low available water capacity. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitations to use of the soils for homesite development are the slope, shallowness to rock, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Special sewage systems are needed because of the shallowness to rock and the slope. Effluent from an absorption field can surface downslope and create a health hazard. In constructing roads and streets, the same practices needed to control erosion in wooded areas are needed in residential communities. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIIe, in the Rocky Loam range site, and in plant adaptability group M-8.

123—Ratake-Cathedral-Rock outcrop complex, 25 to 60 percent slopes. The areas of this complex are on mountain side slopes and ridges that face east, west, or south. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° degrees F, and the average frost-free season is 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Ratake soil makes up 35 percent of this complex, Cathedral soil makes up 30 percent, and Rock outcrop makes up 20 percent. The areas are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Curecanti soils on foot slopes, Lininger and Trag soils on stable summits and toe slopes, and Breece soils on toe slopes and in drainageways. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Ratake soil is shallow and well drained. It formed in stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark brown very stony sandy loam about 3 inches thick. The subsoil is neutral, dark brown very gravelly sandy loam about 9 inches thick. It overlies soft bedrock.

Permeability of the Ratake soil is moderate. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Cathedral soil is shallow and well drained. It formed in stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark grayish brown very stony sandy loam about 3 inches thick. The subsoil is neutral, dark grayish brown very gravelly sandy loam about 8 inches thick. It overlies hard bedrock.

Permeability of the Cathedral soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

Rock outcrop consists of exposures of igneous and metamorphic rocks, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, and water erosion is only a slight hazard on most rock surfaces.

In most places the soils are used as habitat for wildlife, as woodland, as recreation areas, and for grazing. In a few places they are used for community development.

The native vegetation is mainly Arizona fescue, mountain muhly, and Parry oatgrass. The average annual production of air-dry vegetation ranges from 500 to 900 pounds per acre. Gambel oak is common in the mountains in the southern part of the survey area. Scattered ponderosa pine and Rocky Mountain juniper are common. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The soils are difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The wooded areas are managed mainly as watershed and habitat for wildlife and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

On these soils, grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, depth to rock, large stones, and the low available water capacity. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitations to use of the soils for community development are the slope, shallowness to rock, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Special sewage systems must be installed because of the shallowness to rock and the slope. Effluent from an absorption field can surface downslope and create a health hazard. In constructing roads and streets, the same practices needed to control erosion in wooded areas are needed in residential communities. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This complex is in capability subclass VIIe. The Ratake and Cathedral soils are in the Rocky Loam range site and in plant adaptability group M-8.

124—Ratake-Cathedral-Rock outcrop complex, 25 to 60 percent north slopes. The areas of this complex are on north-facing mountain side slopes and ridges. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season is 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Ratake soil makes up 35 percent of this complex, Cathedral soil makes up 30 percent, and Rock outcrop makes up 20 percent. The areas are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Curecanti soils on foot slopes, Lininger and Trag soils on stable summits and toe slopes, and Breece soils on toe slopes and in drainageways. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Ratake soil is shallow and well drained. It formed in stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark brown very stony sandy loam about 3 inches thick. The subsoil is neutral, dark brown very gravelly sandy loam about 9 inches thick. It overlies soft bedrock.

Permeability of the Ratake soil is moderate. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Cathedral soil is shallow and well drained. It formed in stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark grayish brown very stony sandy loam about 3 inches thick. The subsoil is neutral, dark grayish brown very gravelly sandy loam about 8 inches thick. It overlies hard bedrock.

Permeability of the Cathedral soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

Rock outcrop consists of exposures of igneous and metamorphic rocks, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces.

In most places, the soils in this complex are used as wildlife habitat, woodland, and recreation areas and for grazing. In a few places they are used for community development.

The native vegetation is mainly mountainmahogany, Parry oatgrass, mountain muhly, and Arizona fescue. There are also scattered ponderosa pine and Rocky Mountain juniper. The average annual production of air-dry vegetation ranges from 500 to 900 pounds. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Proper grazing use is needed to prevent depletion because the soils are difficult to revegetate. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

On these soils, grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, depth to rock, large stones, and the low available water capacity. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain soil fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface in disturbed areas for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitations to use of these soils for homesite development are the slope, shallowness to rock, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. In constructing roads and streets, the same practices are needed to control erosion that are needed in wooded areas. Special sewage systems must be installed because of the shallowness to rock and the slope. Effluent from an absorption field can surface downslope and create a health hazard. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This complex is in capability subclass VIIe. The Ratake and Cathedral soils are in the Rocky Loam range site and in plant adaptability group M-8.

125—Ratake-Lininger stony sandy loams, 30 to 60 percent slopes. These soils are on mountain side slopes and ridges that face south, east, or west. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Ratake soil makes up 55 percent of this map unit, and Lininger soil makes up 30 percent. The Ratake soil is on side slopes and ridges, and the Lininger soil is on side slopes. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Trag and Breece soils on toe slopes and in drainageways, Cathedral soils on ridges and side slopes, and Rock outcrop on shoulders and in places where quartzitic dikes reach the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Ratake soil is shallow and well drained. It formed in stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark brown stony sandy loam about 3 inches thick. The subsoil is neutral, dark brown very gravelly sandy loam about 9 inches thick. It overlies soft bedrock.

Permeability of the Ratake soil is moderate. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Lininger soil is moderately deep and well drained. It formed in stony, gravelly, and loamy material derived from igneous and metamorphic rocks.

Typically, the surface layer and the upper part of the subsoil are neutral, dark grayish brown stony sandy loam about 8 inches thick. The lower part of the subsoil is slightly acid, brown gravelly sandy clay loam about 28 inches thick. Soft schist is at a depth of 36 inches.

Permeability of the Lininger soil is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water

erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

The soils are used mainly for grazing and as pasture, woodland, habitat for wildlife, and recreation areas. In a few places they are used for community development.

The native vegetation is mainly needleandthread, mountainmahogany, Arizona fescue, and mountain muhly and an overstory of ponderosa pine. The average annual production of air-dry understory vegetation ranges from 400 to 550 pounds per acre on the Ratake soil and from 1,100 to 1,800 pounds per acre on the Lininger soil. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The soils are difficult to revegetate; consequently, proper grazing use is needed to prevent depletion. Seeding speeds revegetation in areas depleted by heavy grazing or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the short growing season, the slope, and large stones. Selecting climatically adapted plants is essential in establishing plantings. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles should be removed from the surface for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the soils for homesite development are the depth to rock, slope, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. In constructing roads and streets, the same practices needed to control erosion in wooded areas are needed in residential communities. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIIe, in the Ponderosa Pine woodland group, and in plant adaptability group M-5.

126—Razor-Heldt clay loams, 9 to 25 percent slopes. These soils are on hill slopes and ridges. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Razor soil makes up 45 percent of this map unit, and Heldt soil makes up 40 percent. The Razor soil is on hill slopes and ridges, and the Heldt soil is on hill slopes. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Denver soils on hill slopes, Nunn and Ulm soils on hill slopes and fans, Renohill soils on ridges, and Manzanola soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Razor soil is moderately deep and well drained. It formed in calcareous, clayey material derived from mudstone and shale.

Typically, the surface layer is neutral, dark grayish brown clay loam about 3 inches thick. The subsoil in the upper 8 inches is mildly alkaline, grayish brown clay. In the lower 20 inches it is mildly alkaline, light brownish gray and light yellowish brown clay. Soft, weathered shale is at a depth of 31 inches.

Permeability of the Razor soil is slow. The available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Runoff is rapid. Water erosion is a severe hazard. Soil blowing is a moderate hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

The Heldt soil is deep and well drained. It formed in calcareous, clayey material derived dominantly from mudstone and shale.

Typically, the surface layer is moderately alkaline and mildly alkaline, grayish brown and light olive brown clay loam about 6 inches thick. The subsoil is moderately alkaline and mildly alkaline, light yellowish brown clay 36 inches thick. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Permeability of the Heldt soil is slow. The available water capacity is high. The effective rooting depth is 60

inches or more. Runoff is rapid. Water erosion is a severe hazard, and soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

The soils are used mainly for grazing and as pasture. In a few areas they are used for community development and for crops.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing or other disturbances. These soils are difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope and the clayey subsoil, which make tillage difficult. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to the use of these soils for homesite development are the shrink-swell potential, the slope, low strength, the slow permeability, and, on the Razor soil, the moderate depth to rock. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. On the Razor soil, the deep cuts needed to provide a sufficiently level building site can expose bedrock. Buildings and roads should be designed to offset the limited ability of the soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slope and slow permeability. Effluent from absorption fields can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched.

On these soils, nonirrigated cropland commonly is severely eroded. Seeding it to grass helps control erosion.

These soils are in capability subclass VIe, in the Clayey Foothill range site, and in plant adaptability group F-1.

127—Razor-Heldt-Midway cobbly clay loams, 15 to 30 percent slopes. These soils are on hill slopes and ridges. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Razor soil makes up 35 percent of this map unit, Heldt soil makes up 30 percent, and Midway soil makes up 20 percent. The Razor soil is on hill slopes and ridges, the Heldt soil is on hill slopes, and the Midway soil is on ridges. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Leyden, Primen, and Standley soils on ridges and hill slopes, Nunn and Ulm soils on hill slopes and fans, Renohill and Kutch soils on hill slopes, and soils, on hill slopes, that do not have cobbles on the surface. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Razor soil is moderately deep and well drained. It formed in calcareous, cobbly, clayey material derived from mudstone and shale.

Typically, the surface layer is neutral, dark grayish brown cobbly clay loam about 3 inches thick. The subsoil in the upper 8 inches is mildly alkaline, grayish brown clay. In the lower 20 inches it is mildly alkaline, light brownish gray and light yellowish brown clay. Soft, weathered shale is at a depth of 31 inches.

Permeability of the Razor soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume, and there are cobbles on the surface.

The Heldt soil is deep and well drained. It formed in calcareous, cobbly, clayey material derived dominantly from mudstone and shale.

Typically, the surface layer is moderately alkaline and mildly alkaline, grayish brown and light olive brown cobbly clay loam about 6 inches thick. The subsoil is moderately alkaline and mildly alkaline, light yellowish brown clay 36 inches thick. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown clay.

Permeability of the Heldt soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid. Water erosion is a severe hazard, and soil blowing is a slight hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume, and there are cobbles on the surface.

The Midway soil is shallow and well drained. It formed in calcareous, cobbly, clayey material derived dominantly from mudstone and shale.

Typically, the surface layer is neutral, olive brown cobbly clay loam about 3 inches thick. The layer below that is mildly alkaline, light olive brown clay loam 7 inches thick. The underlying material to a depth of 14 inches is moderately alkaline, light yellowish brown clay. Soft shale is at a depth of 14 inches.

Permeability of the Midway soil is slow. The available water capacity is low. The effective rooting depth is 6 to 20 inches. Runoff is rapid. Water erosion is a severe hazard, and soil blowing is a slight hazard. The depth to soft bedrock ranges from 6 to 20 inches. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume, and there are cobbles on the surface.

The soils are used mainly for grazing and as pasture and habitat for wildlife. In a few places, they are used for community development and for crops.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre on the Razor and Heldt soils and 300 to 600 pounds per acre on the Midway soil. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing or other disturbances. The use of machinery is not practical because of the stony surface and steep slopes. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on these soils because of the slope, large stones, and clayey subsoil and, on the Midway soil, because of its shallowness to rock. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and of commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps to conserve moisture and reduce erosion. Tillage is difficult on these soils because of the clay loam surface layer and clayey subsoil. Cobbles should be removed from the surface for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to the use of the soils for homesite development are the slope, the shrink-swell potential, low strength, depth to rock, and slow permeability. On the Midway soil, the deep cuts needed to provide a sufficiently level building site expose bedrock. Buildings and roads should be designed to offset the limited ability of the soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. The effects of shrinking and swelling can be minimized by proper engineering designs and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help control seepage into basements and minimize the effects of shrinking and swelling. The steepness of the slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from absorption fields can surface downslope and create a health hazard. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On these soils, nonirrigated cropland commonly is severely eroded. Seeding it to grass helps control erosion.

These soils are in capability subclass VIe. The Razor and Heldt soils are in the Clayey Foothill range site and in plant adaptability group F-1. The Midway soil is in the Shaly Foothill range site and in plant adaptability group F-2.

128—Rednun clay loam, 0 to 3 percent slopes. This is a deep, well drained soil on high terraces and fans. This soil formed in calcareous, reddish, clayey material derived from sandstone and shale. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,500 to 6,500 feet.

Typically, the surface layer is slightly acid, grayish brown clay loam about 4 inches thick. The subsoil in the upper 23 inches is slightly acid, brown clay and neutral, reddish brown clay. In the lower 12 inches it is mildly alkaline, light reddish brown sandy clay loam. The substratum to a depth of 60 inches is mildly alkaline, light reddish brown sandy clay loam.

Included in mapping are small areas of Nunn soils in positions similar to those of the Rednun soil, Lavate and Chapin Variant soils on fans, and Critchell soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Rednun soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are slight hazards. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, as pasture, as recreation areas, and for crops. In a few areas it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer and poor tilth.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the clay loam surface layer and clayey subsoil, which make tillage difficult. A mulch of plant residue helps maintain tilth and the content of organic matter. Applications of manure and of commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff on Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The Rednun soil is limited for homesite development by the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and of commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration. Land leveling is needed in some areas for the uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the surface layer are essential in protecting the soil from erosion, improving tilth, and conserving moisture. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1.

129—Rednun clay loam, 3 to 9 percent slopes. This is a deep, well drained soil on high terraces, hill slopes, and fans. This soil formed in calcareous, reddish, clayey material derived from sandstone and shale. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,500 to 6,500 feet.

Typically, the surface layer is slightly acid, grayish brown clay loam about 4 inches thick. The subsoil in the upper 23 inches is slightly acid, brown clay and neutral, reddish brown clay. In the lower 12 inches it is mildly alkaline, light reddish brown sandy clay loam. The substratum to a depth of 60 inches is mildly alkaline, light reddish brown sandy clay loam.

Included in mapping are small areas of Nunn soils in positions similar to those of the Rednun soil, Lavate and Chapin Variant soils on fans, and Critchell soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Rednun soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, as pasture and as recreation areas, and for crops. In a few areas it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the clay loam surface layer and clayey subsoil, which make tillage difficult. Planting on the contour helps conserve moisture and reduce erosion. A mulch of plant residue reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at the time of planting and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

This soil is limited for homesite development by the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help reduce seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

In areas of irrigated cropland the main concerns in management are proper use of irrigation water, controlling soil erosion, and maintaining or improving fertility. Incorporating crop residue into the soil helps maintain the content of organic matter, increase water infiltration, and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Frequent light applications of irrigation water are needed to prevent soil loss because of the slope. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration. Land leveling is needed in some areas for the uniform distribution of water.

Management concerns in areas of nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the surface layer are essential in protecting the soil from erosion and in improving tilth and conserving moisture. Terraces and diversions also help reduce runoff and conserve moisture. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IVe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1.

130—Rednun clay loam, 9 to 15 percent slopes. This is a deep, well drained soil on hill slopes and fans. This soil formed in calcareous, reddish, clayey material derived from sandstone and shale. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,500 to 6,500 feet.

Typically, the surface layer is slightly acid, grayish brown clay loam about 4 inches thick. The subsoil in the upper 23 inches is slightly acid, brown clay and neutral, reddish brown clay. In the lower 12 inches it is mildly alkaline, light reddish brown sandy clay loam. The substratum to a depth of 60 inches is mildly alkaline, light reddish brown sandy clay loam.

Included in mapping are small areas of Nunn soils in positions similar to those of the Rednun soil, Lavate and Chapin Variant soils on fans, and Critchell soils on hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Rednun soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, as pasture, and as recreation areas. In a few places it is used for community development and for crops.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the slope and by the clay loam surface layer and clayey subsoil, which make tillage difficult. Planting on the contour helps to conserve moisture and reduce erosion. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this soil for homesite development are the slope, the shrink-swell potential, low strength, and slow permeability. The steepness of the slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from absorption fields can surface downslope and create a health hazard. Special sewage systems must be installed because of the slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling.

Areas of this soil that are used for crops commonly are severely eroded. Seeding these areas to grass helps check erosion.

This soil is in capability subclass VIe, in the Clayey Foothill range site, and in plant adaptability group F-1.

131—Rednun-Chapin Variant clay loams, 9 to 15 percent slopes. These soils are on hill slopes and fans. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Rednun soil makes up 50 percent of the map unit, and Chapin Variant soil makes up 35 percent. These soils are on hill slopes and fans. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Ascalon and Lavate soils on fans, Bernal soils on ridges, Nunn soils on high terraces, and Rock outcrop on shoulders. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Rednun soil is deep and well drained. It formed in calcareous, reddish, clayey material derived from sandstone and shale.

Typically, the surface layer is slightly acid, grayish brown clay loam about 4 inches thick. The subsoil in the upper 23 inches is slightly acid, brown clay over neutral, reddish brown clay. In the lower 12 inches it is mildly alkaline, light reddish brown sandy clay loam. The substratum to a depth of 60 inches is mildly alkaline, light reddish brown sandy clay loam.

Permeability of the Rednun soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

The Chapin Variant soil is moderately deep and well drained. It formed in noncalcareous, reddish, clayey material derived from reddish sedimentary rocks.

Typically, the surface layer is neutral and slightly acid, brown to dark brown clay loam about 9 inches thick. The subsoil is slightly acid, reddish brown sandy clay 17 inches thick. It overlies a layer of soft sandstone that is 4 inches thick. Hard sandstone is at a depth of 30 inches.

Permeability of the Chapin Variant soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard sandstone ranges from 20 to 40 inches. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

The soils are used mainly for grazing and as pasture, habitat for wildlife, and recreation areas. In a few places they are used for community development and for crops.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Proper grazing use is needed to prevent depletion because the soils are difficult to revegetate. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the slope and the clayey subsoil. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Planting on the contour helps conserve moisture and reduce erosion. Tillage is difficult on these soils because of the clay loam surface layer and clayey subsoil. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the shrink-swell potential, slope, low strength, slow permeability, and, on the Chapin Variant soil, the depth to rock. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. In areas of the Chapin Variant soil, the deep cuts needed to provide a sufficiently level building site can expose bedrock. Buildings and roads should be designed to offset the limited ability of the soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slope and the slow permeability. Effluent from an absorption field can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched.

Areas of these soils that are used for nonirrigated crops commonly are severely eroded. Seeding them to grass helps check erosion.

These soils are in capability subclass VIe, in the Clayey Foothill range site, and in plant adaptability group F-1.

132—Renohill loam, 5 to 9 percent slopes. This is a moderately deep, well drained soil on hill slopes and ridges. It formed in calcareous, clayey material derived from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, grayish brown loam about 3 inches thick. The subsoil in the upper 7 inches is neutral and mildly alkaline, dark grayish brown and grayish brown clay loam. In the lower 6 inches it is moderately alkaline, light brownish gray clay loam. The substratum is moderately alkaline, pale yellow clay loam 16 inches thick. Soft, weathered shale is at a depth of 32 inches.

Included in mapping are small areas of Manzanola and Ulm soils on hill slopes, Stoneham soils on knobs, Midway soils on ridges, and Kutch soils in positions similar to those of the Renohill soil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Renohill soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, as pasture, and as recreation areas. In a few places it is used for crops and for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Proper grazing use is needed to prevent depletion because the soil is difficult to revegetate. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the clay loam subsoil, which makes tillage difficult, and by the low available water capacity. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

This soil is limited for community development by the shrink-swell potential, depth to rock, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains

near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability and depth to rock. Effluent from absorption fields can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil erosion, and maintaining or improving fertility. Incorporating crop residue into the soil helps maintain the content of organic matter, increase water infiltration, and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration. Land leveling is needed for the uniform distribution of water. Frequent light applications of irrigation water are needed to prevent soil loss because of the slope.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and the incorporation of crop residue into the surface layer are essential in protecting soil from erosion, improving tilth, and conserving moisture. Terracing and contour tillage are essential in reducing soil erosion. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IVe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1.

133—Renohill-Manzanola clay loams, 9 to 15 percent slopes. These soils are on hill slopes and ridges. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Renohill soil makes up 55 percent of this map unit, and Manzanola soil makes up 30 percent. Renohill soil is on ridges, and Manzanola soil is on hill slopes. The areas of these soils are so intricately intermingled that it was not practical to map the soils separately.

Included in mapping are small areas of Ulm and Nunn soils on hill slopes, Kutch soils in positions similar to those of the Renohill soil, Leyden and Primen soils on cobbly hill slopes, and Midway soils on ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Renohill soil is moderately deep and well drained. It formed in calcareous, clayey material derived from mudstone and shale.

Typically, the surface layer is neutral, grayish brown clay loam about 3 inches thick. The subsoil in the upper 7 inches is neutral and mildly alkaline, dark grayish brown and grayish brown clay loam. In the lower 6 inches it is moderately alkaline, light brownish gray clay loam. The substratum to a depth of 32 inches is moderately alkaline, pale yellow clay loam. Soft, weathered shale is at a depth of 32 inches.

Permeability of the Renohill soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

The Manzanola soil is deep and well drained. It formed in calcareous, clayey material derived from mudstone and shale.

Typically, the surface layer is mildly alkaline, dark grayish brown clay loam about 5 inches thick. The subsoil in the upper 7 inches is mildly alkaline, brown clay loam. In the lower 17 inches it is moderately alkaline, pale brown and light yellowish brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, light yellowish brown clay loam.

Permeability of the Manzanola soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

The soils are used mainly for grazing, as pasture, and as recreation areas. In a few places they are used for community development and for crops.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the depth to rock and the slope. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the slope, the shrink-swell potential, and the slow permeability. Also, on the Renohill soil, the deep cuts needed to provide a sufficiently level building site can expose bedrock. Structures to divert runoff from buildings and roads are needed. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help reduce seepage into basements and minimize the effects of shrinking and swelling. Cuts and fills should be seeded or mulched. Special sewage systems must be installed because of the depth to rock, slope, and slow permeability. Effluent from absorption fields can surface downslope and create a health hazard. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On these soils, nonirrigated cropland generally is severely eroded. Seeding it to grass helps control erosion.

These soils are in capability subclass VIe, in the Clayey Foothill range site, and in plant adaptability group F-1.

134—Renohill-Midway complex, 9 to 15 percent slopes. The soils in this complex are on hill slopes and ridges. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Renohill soil makes up 55 percent of this complex, and Midway soil makes up 30 percent. The Renohill soil is on hill slopes, and the Midway soil is on ridges. The areas of these soils are so intricately intermingled that it was not practical to map the soils separately.

Included in mapping are small areas of Ulm, Nunn, and Manzanola soils on hill slopes, Kutch soils in positions similar to those of the Renohill soil, and Leyden and Primen soils on cobbly hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Renohill soil is moderately deep and well drained. It formed in calcareous, clayey material derived from mudstone and shale.

Typically, the surface layer is neutral, grayish brown loam about 3 inches thick. The subsoil in the upper 7 inches is neutral and mildly alkaline, dark grayish brown and grayish brown clay loam. In the lower 6 inches it is moderately alkaline, light brownish gray clay loam. The substratum to a depth of 32 inches is moderately alkaline, pale yellow clay loam. Soft, weathered shale is at a depth of 32 inches.

Permeability of this Renohill soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

The Midway soil is shallow and well drained. It formed in calcareous, clayey material derived from mudstone and shale.

Typically, the surface layer is neutral, olive brown clay loam about 3 inches thick. The layer below that is mildly alkaline, light olive brown clay loam about 7 inches thick. The underlying material to a depth of 14 inches is moderately alkaline, light yellowish brown clay. Soft shale is at a depth of 14 inches.

Permeability of this Midway soil is slow. The available water capacity is low. The effective rooting depth is 6 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The depth to soft bedrock ranges from 6 to 20 inches. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

The soils are used mainly for grazing and as pasture and recreation areas. In a few places they are used for community development and for crops.

The native vegetation is mainly western wheatgrass, green needlegrass, sideoats grama, and needleandthread. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre on the Renohill soil and 300 to 600 pounds per acre on the Midway soil. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Grazing when the soil is wet results in

compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on these soils because of the depth to rock and the slope. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the slope, depth to rock, the shrink-swell potential, and the slow permeability. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Structures to divert runoff from buildings and roads are needed. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help reduce seepage into basements and minimize the effects of shrinking and swelling. Cuts and fills should be seeded or mulched. Special sewage systems must be installed because of the depth to rock, slope, and slow permeability. Effluent from absorption fields can surface downslope and create a health hazard. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On these soils, nonirrigated cropland generally is severely eroded. Seeding it to grass helps check erosion.

These soils are in capability subclass VIe. The Renohill soil is in the Clayey Foothill range site and in plant adaptability group F-1. The Midway soil is in the Shaly Foothill range site and in plant adaptability group F-2.

135—Resort-Sphinx very gravelly sandy loams, 9 to 15 percent slopes. These soils are on mountain side slopes, ridges, and summits. The slopes most commonly face south, east, or west. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Resort soil makes up 50 percent of this map unit, and Sphinx soil makes up 35 percent. The Resort soil is on summits and side slopes, and the Sphinx soil is on side slopes and ridges. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Garber Variant soils on toe slopes and fans, Rock outcrop on shoulders and ridge crests, and soils, on side slopes, that have stones on the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Resort soil is shallow and somewhat excessively drained. It formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite.

Typically, the surface layer is neutral, brown very gravelly sandy loam about 3 inches thick. The subsoil is slightly acid, brown to dark brown very gravelly sandy loam about 5 inches thick. The substratum is neutral, brown to dark brown very gravelly loamy sand about 7 inches thick. It overlies fractured granite.

Permeability of the Resort soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Sphinx soil is shallow and somewhat excessively drained. It formed in gravelly, sandy material derived from grus of the Pikes Peak Granite.

Typically, the surface layer is neutral, brown to dark brown very gravelly sandy loam about 2 inches thick. The layer below that is slightly acid, yellowish brown very gravelly loamy coarse sand about 8 inches thick. Fractured granite is at a depth of 10 inches.

Permeability of the Sphinx soil is rapid. The available water capacity is low. The effective rooting depth is 8 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 8 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The soils are used mainly as woodland, as habitat for wildlife, and as recreation areas. In a few places they are used for community development, for grazing, as pasture, and as a source of roadfill.

The native vegetation is mainly an overstory of ponderosa pine and an understory of mountainmahogany, pine dropseed, and mountain muhly. The average annual production of air-dry understory vegetation ranges from 400 to 650 pounds per acre. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded

areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Where these soils are used for grazing, proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The soils are difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Seeding speeds revegetation in areas depleted by heavy grazing or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on these soils because of the depth to rock, the slope, droughtiness, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at the time of planting and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are shallowness to rock, seepage, and slope. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Structures to divert runoff from buildings and roads are needed. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Effluent from an absorption field can surface downslope and create a health hazard. In constructing roads and streets, the practices needed to control erosion are the same as those used for roads in wooded areas. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIe, in the Ponderosa Pine woodland group, and in plant adaptability group M-5.

136—Resort-Sphinx very gravelly sandy loams, 15 to 30 percent slopes. These soils are on mountain side slopes, ridges, and summits. The slopes most commonly face south, east, or west. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Resort soil makes up 50 percent of this map unit, and Sphinx soil makes up 35 percent. The Resort soil is on summits and side slopes, and the Sphinx soil is on side slopes and ridges. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Raleigh soils on north-facing side slopes, Garber Variant soils on toe slopes and fans, Rock outcrop on shoulders and ridge crests, and soils, on side slopes, that have stones on the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage of the map unit.

The Resort soil is shallow and somewhat excessively drained. It formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite.

Typically, the surface layer is neutral, brown very gravelly sandy loam about 3 inches thick. The subsoil is slightly acid, brown to dark brown very gravelly sandy loam about 5 inches thick. The substratum is neutral, brown to dark brown very gravelly loamy sand about 7 inches thick. It overlies fractured soft granite.

Permeability of the Resort soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Sphinx soil is shallow and somewhat excessively drained. It formed in gravelly, sandy material derived from grus of the Pikes Peak Granite.

Typically, the surface layer is neutral, brown to dark brown very gravelly sandy loam about 2 inches thick. The layer below that is slightly acid, yellowish brown very gravelly loamy coarse sand about 8 inches thick. Fractured granite is at a depth of 10 inches.

Permeability of the Sphinx soil is rapid. The available water capacity is low. The effective rooting depth is 8 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 8 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The soils are used mainly as woodland, as habitat for wildlife, and as recreation areas. In a few places they are used for community development, for grazing, as pasture, and as a source of roadfill.

The native vegetation is mainly an overstory of ponderosa pine and an understory of mountainmahogany, pine dropseed, and mountain muhly. The average annual production of air-dry understory vegetation ranges from 400 to 650 pounds per acre. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The soils are difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Seeding speeds revegetation in areas depleted by heavy grazing or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on these soils because of the shallowness to rock, the slope, droughtiness, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at the time of planting and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the slope, shallowness to rock, and seepage. Extensive excavation is required to provide level building sites because of the slope, but the deep cuts needed can expose bedrock. Structures to divert runoff from buildings and roads are needed. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Effluent from an absorption field can surface downslope and create a health hazard. In constructing roads and streets in residential areas, the practices needed to control erosion are the same as those used for roads in wooded areas. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIe, in the Ponderosa Pine woodland group, and in plant adaptability group M-5.

137—Resort-Sphinx very gravelly sandy loams, 30 to 50 percent slopes. These soils are on mountain side slopes and ridges. The slopes most commonly face south, east, or west. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Resort soil makes up 50 percent of this map unit, and Sphinx soil makes up 35 percent. The Resort soil is on side slopes, and the Sphinx soil is on side slopes and ridges. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Raleigh soils on north-facing side slopes, Garber Variant soils on toe slopes and fans, Rock outcrop on shoulders and ridge crests, and soils, on side slopes, that have stones on the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Resort soil is shallow and somewhat excessively drained. It formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite.

Typically, the surface layer is neutral, brown very gravelly sandy loam about 3 inches thick. The subsoil is slightly acid, brown to dark brown very gravelly sandy loam about 5 inches thick. The substratum is neutral, brown to dark brown very gravelly loamy sand about 7 inches thick. It overlies fractured granite.

Permeability of the Resort soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Sphinx soil is shallow and somewhat excessively drained. It formed in gravelly, sandy material derived from grus of the Pikes Peak Granite.

Typically, the surface layer is neutral, brown to dark brown very gravelly sandy loam about 2 inches thick.

The layer below that is slightly acid, yellowish brown very gravelly loamy coarse sand about 8 inches thick. Fractured granite is at a depth of 10 inches.

Permeability of the Sphinx soil is rapid. The available water capacity is low. The effective rooting depth is 8 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 8 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The soils are used mainly as woodland, habitat for wildlife, and recreation areas. In a few places they are used for community development, for grazing, and as a source of roadfill.

The native vegetation is mainly an overstory of ponderosa pine and an understory of mountainmahogany, pine dropseed, and mountain muhly. The average annual production of air-dry understory vegetation ranges from 400 to 650 pounds per acre. The wooded areas are managed mainly as watershed and as habitat for wildlife and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on these soils because of the depth to rock, slope, droughtiness, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitations to use of the soils for homesite development are the slope, depth to rock, and seepage. Because of the slope, extensive excavation is required to provide level building sites. The deep cuts that are necessary can expose bedrock. Structures to divert runoff from buildings and roads are needed. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Effluent from absorption fields can surface downslope and create a health hazard. In constructing roads and streets, the practices needed to control erosion are the same as those used for roads in wooded areas. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIIe, in the Ponderosa Pine woodland group, and in plant adaptability group M-5.

138—Rock outcrop, igneous and metamorphic. Rock outcrop, igneous and metamorphic, consists of exposed bedrock, talus, and large boulders on back slopes, shoulders, and convex summits. It commonly is gneiss, schist, phyllite, quartz monzonite, granite, pegmatite, or latite. The slope is 15 to 100 percent.

Included in mapping are small areas of shallow soils in cracks and in small concave fills.

Plants can grow only in cracks and fissures in the rock and on the included shallow soils. Vegetation is sparse. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces.

The areas of this map unit are used mainly as habitat for wildlife, as recreation areas, and, in some places, as a source of crushed aggregate and roadfill. A few areas are used for community development.

The areas of this map unit are poorly suited to community development. However, in some places that offer panoramic views for homesites, the limitations of slope, bedrock, and large stones have been overcome by expensive engineering and excavation techniques. Special sewage systems must be installed because of the exposed bedrock and the slope. Some areas are esthetically valuable for use as parks.

Rock outcrop, igneous and metamorphic, is in capability class VIII.

139—Rock outcrop, sedimentary. Rock outcrop, sedimentary, consists of exposed sedimentary rocks, talus, and large boulders on back slopes, shoulders, hogbacks, and terrace escarpments. The rock commonly is sandstone, but in some places it is mudstone, shale, or conglomerate. The slope is 15 to 100 percent.

Included in mapping are small areas of shallow soils in cracks and in small concave fills.

Rock outcrop, sedimentary, is very slowly permeable or is impermeable. Runoff is rapid. Water erosion is a slight hazard on most sandstones and a severe hazard on most shales. The shrink-swell potential generally is low, but in some shales it is high.

The areas of this map unit are used mainly as habitat for wildlife and as recreation areas and, in some places, as a source of decorative rock or of clay for porcelain and brick. A few areas are used for community development.

Vegetation generally is sparse. Plants grow only in cracks and fissures and on the included shallow soils.

The areas of this map unit are poorly suited to community development. However, in some places that offer panoramic views for homesites, the limitations of slope, bedrock, and large stones have been overcome

by expensive engineering and excavation techniques. Special sewage systems must be installed because of the exposed bedrock and the slope. Some areas are esthetically valuable for use as parks.

Rock outcrop, sedimentary, is in capability class VIII.

140—Rock outcrop-Cathedral-Ratake complex, 50 to 100 percent slopes. The areas of this complex are on mountain side slopes, ridges, and canyon walls. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Rock outcrop makes up 45 percent of this complex, Cathedral soil makes up 25 percent, and Ratake soil makes up 20 percent. These soils and Rock outcrop are in areas so intricately intermingled that it was not practical to map them separately. Rock outcrop is on canyon walls, the Cathedral soil is on side slopes and ridges, and the Ratake soil is on side slopes.

Included in mapping are small areas of Curecanti soils on foot slopes and fans, Lininger soils on stable summits, Trag soils on toe slopes, and Tolvar and Legault soils on north-facing side slopes. The included soils make up about 15 percent of the total acreage.

Rock outcrop consists of exposures of igneous and metamorphic rocks, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces.

The Cathedral soil is shallow and well drained. It formed in stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark grayish brown very stony sandy loam about 3 inches thick. The subsoil is neutral, dark grayish brown very gravelly sandy loam about 8 inches thick. It overlies hard bedrock.

Permeability of the Cathedral soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Ratake soil is shallow and well drained. It formed in stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark brown very stony sandy loam about 3 inches thick. The subsoil is neutral, dark brown very gravelly sandy loam about 9 inches thick. It overlies soft bedrock.

Permeability of the Ratake soil is moderate. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The soils in this complex are used as wildlife habitat, as recreation areas, and as limited woodland.

The native vegetation is mainly Arizona fescue, mountain muhly, and Parry oatgrass. The average annual production of air-dry vegetation on the soils in this complex ranges from 500 to 900 pounds per acre. Gambel oak is common in the mountains in the southern part of the survey area. Scattered ponderosa pine and Rocky Mountain juniper are common. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. Proper grazing use is needed because the soils are shallow, highly erodible, and difficult to revegetate. Periodic deferment of grazing during the growing season helps maintain or improve the range conditon.

The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Sufficient ground cover should be maintained to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on the soils because of the slope, shallowness to rock, large stones, and the low available water capacity. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping. Supplemental irrigation is needed at the time of planting and during dry periods.

The main limitations to use of the soils for homesite development are the slope, shallowness to rock, and large stones. These limitations can be overcome only by very expensive engineering and excavation techniques. The deep cuts needed to provide a sufficiently level building site expose bedrock. Special sewage systems must be installed because of the shallowness to rock and the slope. Effluent from an absorption field can surface downslope and create a health hazard. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as open space planted with native vegetation and other adapted plants.

This complex is in capability class VIII. The Cathedral and Ratake soils are in the Rocky Loam range site and in plant adaptability group M-8.

141—Rogert-Herbman-Rock outcrop complex, 30 to 70 percent slopes. The areas of this complex are on mountain side slopes and ridges. The slopes generally face south, east, or west. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free

season ranges from 55 to 75 days. Elevation is 7,600 to 10,000 feet.

Rogert soil makes up 35 percent of this complex, Herbman soil makes up 30 percent, and Rock outcrop makes up 20 percent. The areas of these soils and of Rock outcrop are so intricately intermingled that it was not practical to map them separately. The Rogert and Herbman soils are on side slopes, and Rock outcrop is on ridges and side slopes.

Included in mapping are small areas of Troutdale soils on side slopes, Sprucedale soils on side slopes and toe slopes, and Kittredge and Earcree soils on toe slopes and in drainageways. Rock outcrop makes up less than 20 percent of some mapped areas. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Rogert soil is shallow and well drained. It formed in noncalcareous, stony, gravelly, and loamy material derived from igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark grayish brown very stony sandy loam about 4 inches thick. The lower part of the surface layer is neutral, brown to dark brown very gravelly sandy loam about 9 inches thick. Pegmatite is at a depth of 13 inches.

Permeability of the Rogert soil is moderately rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to hard bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Herbman soil is shallow and well drained. It formed in noncalcareous, stony, gravelly, and loamy material derived from igneous and metamorphic rocks.

Typically, the surface layer is slightly acid, dark grayish brown very stony sandy loam about 4 inches thick. The layer below that is neutral, brown to dark brown very gravelly sandy loam about 9 inches thick. Soft schist is at a depth of 13 inches.

Permeability of the Herbman soil is moderately rapid. The available water capacity is low. The effective rooting depth is 7 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 7 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

Rock outcrop consists of exposures of igneous and metamorphic rocks, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard on most rock surfaces.

In most places, the soils are used as woodland, habitat for wildlife, and recreation areas. In a few places they are used as pasture, for grazing, and for community development.

The native vegetation is mainly an overstory of ponderosa pine and Douglas-fir and an understory of Arizona fescue, wheatgrass, junegrass, forbs, and shrubs. The wooded areas are managed mainly as watershed and habitat for wildlife and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion. Proper grazing use is needed for maximum quality of forage. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, large stones, shallowness to rock, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the soils for homesite development are the slope, shallowness to rock, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Structures to divert runoff from buildings and roads are needed. In constructing roads and streets in residential areas, the practices needed to control erosion are the same as those used for roads in wooded areas. Effluent from an absorption field can surface downslope and create a health hazard. Cuts and fills should be seeded or mulched.

This complex is in capability subclass VIIe. The Rogert and Herbman soils are in the Mixed Conifer woodland group and in plant adaptability group M-6.

142—Rooney very cobbly sandy loam, 15 to 50 percent slopes. This is a shallow, well drained soil on convex hill slopes and ridges. It formed in cobbly and gravelly colluvium and in residuum of conglomerate and sandstone. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season ranges from 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Typically, the surface layer is neutral, olive brown very cobbly sandy loam about 3 inches thick. The layer below that is neutral, light olive brown very gravelly sandy loam 5 inches thick. Soft, stratified conglomerate and sandstone are at a depth of 8 inches.

Included in mapping are small areas of Primen soils at the lower edge of the mapped areas on hill slopes, Leyden soils on hill slopes, Rock outcrop on shoulders, and Kutch and Denver soils on ridges and fans. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

Permeability of this Rooney soil is moderately rapid. The available water capacity is low. The effective rooting depth is 4 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 4 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

This soil is used mainly for grazing, as wildlife habitat, and as recreation areas. In a few places it is used for community development.

The native vegetation is mainly big bluestem, little bluestem, sideoats grama, and needleandthread. The average annual production of air-dry vegetation ranges from 300 to 700 pounds per acre. This soil is difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. Mechanical treatment is not practical because the surface is stony and the slopes are steep. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, large stones, shallowness to rock, and the low available water capacity. A mulch of plant residue reduces runoff, improves tilth, and conserves moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Some areas need to be covered with a layer of topsoil before planting. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate the runoff to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the Rooney soil for homesite development are shallowness to rock, slope, large stones, and seepage. The deep cuts needed to provide a sufficently level building site can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. A community sewage system is needed to prevent seepage from contaminating the water supply. Structures to divert runoff are needed where buildings and roads are constructed. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as open space planted with native vegetation and other adapted plants.

This soil is in capability subclass VIIe, in the Shallow Foothill range site, and in plant adaptability group F-7.

143—Rooney-Primen-Leyden complex, 15 to 50 percent slopes. These soils are on hill slopes and ridges. The average annual precipitation is 15 to 17 inches. The average annual air temperature is 47° F, and the average frost-free season ranges from 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Rooney soil makes up 35 percent of this complex, Primen soil makes up 25 percent, and Leyden soil makes up 20 percent. The Rooney soil is on ridges where the bedrock is sandstone and conglomerate, the Primen soil is on hill slopes where shale is near the surface, and the Leyden soil is on hill slopes. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Haverson soils on flood plains and low terraces, Standley and Nunn soils on fans, and Rock outcrop on eroded shoulders and on escarpments where slippage has taken place. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Rooney soil is shallow and well drained. It formed in cobbly and gravelly colluvium and in residuum of sandstone and conglomerate.

Typically, the surface layer is neutral, grayish brown extremely cobbly sandy loam about 2 inches thick. The underlying material to a depth of 10 inches is neutral, pale brown very gravelly sandy loam. Sandstone and conglomerate are at a depth of 10 inches.

Permeability of the Rooney soil is moderately rapid. The available water capacity is low. The effective rooting depth is 4 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to sandstone and conglomerate ranges from 4 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Primen soil is shallow and well drained. It formed in cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer and the upper part of the subsoil are neutral, dark grayish brown cobbly clay loam about 9 inches thick. The lower part of the subsoil is

neutral, dark grayish brown gravelly clay loam about 9 inches thick. It overlies soft shale.

Permeability of the Primen soil is slow. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is moderate to high. Rock fragments make up 15 to 35 percent of the volume.

The Leyden soil is moderately deep and well drained. It formed in calcareous, cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is neutral, very dark grayish brown cobbly clay loam about 3 inches thick. The subsoil in the upper 5 inches is neutral, dark grayish brown gravelly clay loam. In the lower 27 inches it is neutral, brown to dark brown, brown, and light yellowish brown gravelly clay and gravelly clay loam. It overlies soft shale at a depth of 35 inches.

Permeability of the Leyden soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is high. Rock fragments make up 15 to 35 percent of the volume.

These soils are used mainly for grazing and as wildlife habitat, pasture, and recreation areas. In a few places they are used for community development.

The native vegetation is mainly Gambel oak, mountainmahogany, sideoats grama, little bluestem, and a few scattered ponderosa pines. The average annual production of air-dry vegetation ranges from 300 to 700 pounds per acre on the Rooney soil and 600 to 1,200 pounds on the Primen and Leyden soils. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. These soils are difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. The use of machinery is not practical because the surface is stony and the slopes are steep. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, large stones, and depth to rock. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. The removal of pebbles and cobbles in disturbed areas is required for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the slope, depth to rock, soil slippage, the shrink-swell potential, and large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Where the underlying rock is shale or mudstone, landslides are a hazard when the soil mass is loaded, excavated, or wet. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from absorption fields can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as greenbelts and parks planted with native vegetation and other adapted plants.

These soils are in capability subclass VIIe. The Rooney soil is in the Shallow Foothill range site and in plant adaptability group F-7. The Primen and Leyden soils are in the Clayey Foothill range site and in plant adaptability group F-1.

144—Rooney-Rock outcrop complex, 50 to 70 percent slopes. The areas of this complex are on hill slopes and ridges. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Rooney soil makes up 50 percent of this complex, and Rock outcrop makes up 30 percent. The areas of the Rooney soil and of Rock outcrop are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Primen soils on hill slopes, Leyden and Standley soils on hill slopes and fans, Haverson soils on low terraces, and Nunn soils on

stable summits. The included soils make up about 20 percent of the total acreage.

The Rooney soil is shallow and well drained. It formed in cobbly and gravelly colluvium and in residuum of sandstone and conglomerate.

Typically, the surface layer is neutral, grayish brown extremely cobbly sandy loam about 2 inches thick. The underlying material is neutral, pale brown very gravelly sandy loam about 8 inches thick. Soft sandstone and conglomerate are at a depth of 10 inches.

Permeability of the Rooney soil is moderately rapid. The available water capacity is low. The effective rooting depth is 4 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 4 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

Rock outcrop consists of exposures of sedimentary rocks, talus, and large boulders. In those areas, plants can take root only in cracks and fissures. Runoff is rapid, but water erosion is only a slight hazard.

The areas of this complex are used as habitat for wildlife and as recreation areas.

The native vegetation is mainly mountainmahogany, Gambel oak, big bluestem, and sideoats grama and some scattered ponderosa pine. The average annual production of air-dry vegetation on the Rooney soil ranges from 300 to 700 pounds per acre. Proper grazing use is needed to prevent depletion because the soil is difficult to revegetate. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Mechanical treatment is not practical because the surface is stony and the slopes are steep.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, large stones, depth to rock, and the low available water capacity. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps to conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Some areas need to be covered with a layer of topsoil before planting. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the Rooney soil for homesite development are shallowness to rock, slope, large stones, and seepage. The deep cuts needed to provide a sufficiently level building site expose bedrock. Effluent from absorption fields can surface downslope and create a health hazard. A community sewage system is needed to prevent seepage from contaminating the water supply. Structures to divert runoff are needed where buildings and roads are constructed. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas that can be planted with native vegetation and other adapted plants can be used as open space.

This complex is in capability subclass VIIe. The Rooney soil is in the Shallow Foothill range site and in plant adaptability group F-7.

145—Rosane sandy loam, 0 to 3 percent slopes. This is a deep, poorly drained soil on alluvial valley floors, low terraces, and flood plains along large perennial streams in the mountains. It formed in loamy alluvium underlain by sand and gravel. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 45° F, and the average frost-free season ranges from 55 to 125 days. Elevation is 6,500 to 8,000 feet.

Typically, the surface layer is neutral, dark grayish brown sandy loam about 12 inches thick. It has strong brown mottles in the lower 7 inches. The layer below that is neutral, brown sandy loam 11 inches thick; it has strong brown mottles throughout. The underlying material to a depth of 60 inches is neutral, pale brown very gravelly loamy sand.

Included in mapping are small areas of Venable soils and Cumulic Cryoborolls on low terraces. Also included are marshes and bogs on abandoned meander scars and areas of riverwash in stream courses. There are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

Permeability of this Rosane soil is moderately rapid to a depth of 20 to 40 inches and rapid below that. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. A seasonal high water table is at a depth of 6 to 24 inches in spring and summer. In some areas the soil has been drained by artificial means or by gullies. This soil is subject to brief periods of flooding in spring and summer. The depth to contrasting sand and gravel ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume in the solum and 35 to 70 percent in the underlying material.

This soil is used mainly for grazing and as hayland, as habitat for wildlife, and as recreation areas. In a few places it is used for community development.

The native vegetation is mainly tufted hairgrass, sedges, Baltic rush, and willows. The average annual production of air-dry vegetation ranges from 2,000 to 4,000 pounds per acre.

Wetness, flooding, and the short growing season are the main limitations to use of the soil as hayland and pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is wet results in

compaction of the surface layer, poor tilth, and increased runoff. Wetness limits the choice of plants and the period of cutting or grazing. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Where the soil has been drained, irrigation water can be applied by the contour furrow and sprinkler methods.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by wetness, flooding, and the short growing season. Plants that tolerate wetness are best adapted to survive and become established on this soil. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Deep cuts made in land grading should be covered with a layer of topsoil. In drained areas, supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Storm drains, natural drainageways, and land grading must accommodate the rapid runoff to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of this soil for homesite development are wetness, flooding, and seepage. Drainage and structures to divert runoff are needed where buildings and roads are constructed. Special sewage systems must be installed because of wetness, flooding, and seepage. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas planted with native vegetation and other adapted plants can be used as greenbelts and parks.

This soil is in capability subclass Vc, irrigated and nonirrigated, in the Mountain Meadow range site, and in plant adaptability group M-2.

146—Rosane-Venable fine sandy loams, 0 to 3 percent slopes. These soils are on alluvial valley floors, low terraces, and flood plains along perennial streams in the mountains (fig. 5). The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,200 to 9,500 feet.

Rosane soil makes up 45 percent of this map unit, and Venable soil makes up 40 percent. The Rosane soil is on flood plains near the stream course, and the Venable soil is on low terraces. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Cumulic Cryoborolls on low terraces, marshes and bogs on abandoned meander scars, riverwash in stream courses, and Kittredge and Earcree soils on adjacent toe slopes and fans. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Rosane soil is deep and poorly drained. It formed in loamy alluvium underlain by sand and gravel.

Typically, the surface layer is neutral, dark grayish brown fine sandy loam about 12 inches thick. It has strong brown mottles in the lower 7 inches. The layer below that is neutral, brown sandy loam about 11 inches thick. It has strong brown mottles throughout. The underlying material to a depth of 60 inches is neutral, pale brown very gravelly loamy sand.

Permeability of the Rosane soil is moderately rapid to a depth of 20 to 40 inches and rapid below that. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. A seasonal high water table is at a depth of 6 to 24 inches in spring and summer. In some areas the soil has been drained by artificial means or by gullies. This soil is subject to brief periods of flooding in spring and summer. The depth to contrasting sand and gravel ranges from 20 to 40 inches. The depth to bedrock is more than 60 inches. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume in the solum and 35 to 70 percent in the underlying material.

The Venable soil is deep and poorly drained. It formed in loamy alluvium derived from igneous and metamorphic rocks.

Typically, the surface layer is neutral, very dark grayish brown fine sandy loam about 5 inches thick. In the upper 9 inches the subsoil is neutral, very dark grayish brown sandy clay loam. In the lower 29 inches it is neutral, dark grayish brown clay loam that has mottles throughout. The substratum to a depth of 60 inches is neutral, grayish brown sandy loam that has mottles throughout.

Permeability of this Venable soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion and soil blowing are only slight hazards. A seasonal high water table is at a depth of 6 to 30 inches in spring and summer. This soil is subject to very brief periods of flooding in spring and early in summer. The depth to bedrock is more than 60 inches. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

In most places the soils are used for grazing and hay crops, as habitat for wildlife, and as recreation areas. In a few places they are used for community development.

The native vegetation is mainly tufted hairgrass, sedges, Baltic rush, and willows. The average annual production of air-dry vegetation ranges from 2,000 to 4,000 pounds per acre.

Figure 5.—Hay has been harvested in this area of Rosane-Venable fine sandy loams, 0 to 3 percent slopes (foreground and center). The present stream course is marked by a line of willows at the foot of the slope at right.

The main limitations to use of the soils for hay and as pasture are wetness, flooding, and the short growing season. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and increased runoff. Wetness limits the choice of plants and the period of cutting or grazing. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Where the soils have been drained, irrigation water can be applied by the contour furrow and sprinkler methods.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by wetness, flooding, and the short growing season. Plants that tolerate wetness should be selected. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Deep cuts made in land grading should be covered with a layer of topsoil. In drained areas, supplemental irrigation is needed at planting time and during dry periods thereafter.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are wetness, flooding, and seepage. Drainage and structures to divert runoff are needed to protect roads and building foundations. Special sewage systems must be installed because of wetness, flooding, and seepage. Where the density of housing is moderate

to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas planted with native vegetation and other adapted plants can be used as greenbelts and parks.

These soils are in capability subclass Vc, irrigated and nonirrigated, in the Mountain Meadow range site, and in plant adaptability group M-2.

147—Sphinx-Resort-Rock outcrop complex, 50 to 70 percent slopes. The areas of this complex are on mountain side slopes, which mainly face south, east, or west, and on ridges. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° degrees F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Sphinx soil makes up 35 percent of this complex, Resort soil makes up 30 percent, and Rock outcrop makes up 20 percent. The Sphinx soil is on side slopes and ridges, the Resort soil is on side slopes, and Rock outcrop is on shoulders and ridges. The areas are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Raleigh soils on north-facing side slopes, Garber Variant soils on toe slopes and fans, and soils, on side slopes, that have stones on the surface. The included soils make up about 15 percent of the acreage.

The Sphinx soil is shallow and somewhat excessively drained. It formed in gravelly, sandy material derived from grus of the Pikes Peak Granite.

Typically, the surface layer is neutral, brown to dark brown very gravelly sandy loam about 2 inches thick. The layer below that is slightly acid, yellowish brown very gravelly loamy coarse sand about 8 inches thick. Fractured granite is at a depth of 10 inches.

Permeability of the Sphinx soil is rapid. The available water capacity is low. The effective rooting depth is 8 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 8 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Resort soil is shallow and somewhat excessively drained. It formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite.

Typically, the surface layer is neutral, brown very gravelly sandy loam about 3 inches thick. The subsoil is slightly acid, brown to dark brown very gravelly sandy loam about 5 inches thick. The substratum is neutral, brown to dark brown very gravelly loamy sand about 7 inches thick. It overlies fractured granite.

Permeability of the Resort soil is rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

Rock outcrop consists of exposures of Pikes Peak Granite, talus, and large boulders. In areas of Rock outcrop, plants can take root only in cracks and fissures. Runoff is rapid. Water erosion is a slight hazard on most rock surfaces.

The soils are used as woodland, as habitat for wildlife, and as recreation areas.

The native vegetation is mainly an overstory of ponderosa pine and an understory of mountainmahogany, pine dropseed, and mountain muhly. The wooded areas are managed mainly as watershed and as habitat for wildlife and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the shallowness to rock, the slope, droughtiness, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and during dry periods.

The soils in this complex are poorly suited to homesite development. The main limitations are the slope, shallowness to rock, and seepage. The deep cuts needed to provide a sufficiently level building site commonly expose bedrock. Structures to divert runoff from buildings and roads are needed. In constructing roads and streets, the practices needed to control erosion are the same as those used for roads in wooded areas. Effluent from an absorption field can surface downslope and create a health hazard. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as open space and parks planted with native vegetation and other adapted plants.

This complex is in capability subclass VIIe. The Sphinx and Resort soils are in the Ponderosa Pine woodland group and in plant adaptability group M-5.

148—Standley-Leyden-Primen very stony clay loams, 15 to 30 percent slopes. These soils are on hill slopes below volcanic mesa tops. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Standley soil makes up 35 percent of this map unit, Leyden soil makes up 30 percent, and Primen soil makes up 20 percent. The Standley soil is on fans, the Leyden soil is on hill slopes, and the Primen soil is on ridges and hill slopes. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of soils that are more than 35 percent rock fragments, Englewood and Denver soils on fans and in drainageways, and Midway soils on ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Standley soil is deep and well drained. It formed in calcareous, stony, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is mildly alkaline, dark grayish brown very stony clay loam about 9 inches thick. The subsoil in the upper 8 inches is mildly alkaline, brown gravelly clay; in the lower 5 inches it is moderately alkaline, pale brown gravelly clay loam. The substratum in the upper 15 inches is moderately alkaline, very pale brown gravelly clay loam. In the lower part to a depth of 60 inches it is moderately alkaline, very pale brown gravelly loam.

Permeability of the Standley soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is moderate to high. Rock fragments make up 15 to 35 percent of the volume. They originated in rockfall from the edge of the mesa.

The Leyden soil is moderately deep and well drained. It formed in calcareous, stony, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is neutral, very dark grayish brown very stony clay loam about 3 inches thick. The subsoil in the upper 5 inches is neutral, dark grayish brown gravelly clay loam. In the lower 27 inches it is neutral, brown to dark brown, brown, and light yellowish brown gravelly clay and gravelly clay loam. It overlies soft mudstone at a depth of 35 inches.

Permeability of the Leyden soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is high. Rock fragments make up 15 to 35 percent of the volume. They originated in rockfall from the edge of the mesa.

The Primen soil is shallow and well drained. It formed in stony, cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer and the upper part of the subsoil are mildly alkaline, dark grayish brown very stony clay loam about 9 inches thick. The subsoil in the next 5 inches is mildly alkaline, dark grayish brown cobbly clay loam. In the lower 4 inches it is mildly alkaline, dark grayish brown gravelly clay loam. Soft mudstone is at a depth of 18 inches.

Permeability of the Primen soil is slow. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is moderate to high. Rock fragments make up 15 to 35 percent of the volume. They originated in rockfall from the edge of the mesa.

These soils are used as wildlife habitat and recreation areas and for community development.

The native vegetation is mainly big bluestem, little bluestem, western wheatgrass, and blue grama. The average annual production of air-dry vegetation ranges from 900 to 1,500 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Mechanical treatment is not practical because the surface is stony.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope and large stones and because of the shallowness to bedrock of the Primen soil. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the slope, depth to rock, soil slippage, rockfall, the shrink-swell potential, large stones, and low strength. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Landslides are a hazard when the soil mass is loaded, excavated, or wet. Rockfall from the mesa tops is a hazard to structures. The effects of shrinking and swelling can be minimized

by proper engineering design and by backfilling with material that has a low shrink-swell potential. The steepness of slopes, large stones, and depth to rock are concerns in installing septic tank absorption fields. Effluent from absorption fields can surface downslope and create a health hazard. Buildings and roads should be designed to offset the limited ability of the soils to support a load. Existing vegetation should be protected as much as possible during construction. Some areas can be used as open space and parks.

These soils are in capability subclass VIe, in the Rocky Foothill range site, and in plant adaptability group F-6.

149—Standley-Nunn gravelly clay loams, 0 to 5 percent slopes. These soils are on high terraces and ridges. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Standley soil makes up 45 percent of this map unit, and Nunn soil makes up 40 percent. Nunn and Standley soils are in similar positions on the landscape. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Nunn soils that have a clay loam surface layer on tablelands, Valmont soils on terraces, Denver soils on higher terraces and fans, and Kutch soils on ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Standley soil is deep and well drained. It formed in calcareous, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is mildly alkaline, dark grayish brown gravelly clay loam about 9 inches thick. The subsoil in the upper 8 inches is mildly alkaline, brown gravelly clay. In the lower 5 inches it is moderately alkaline, pale brown gravelly clay loam. The substratum in the upper 15 inches is moderately alkaline, very pale brown gravelly clay loam. Below that to a depth of 60 inches it is moderately alkaline, very pale brown gravelly loam.

Permeability of the Standley soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow to medium, and water erosion is a slight to moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is moderate to high. Rock fragments make up 15 to 35 percent of the volume.

The Nunn soil is deep and well drained. It formed in calcareous, clayey, and gravelly material derived from mudstone and shale.

The surface layer is neutral, dark grayish brown gravelly clay loam about 5 inches thick. The subsoil in the upper 12 inches is neutral, grayish brown clay. In the lower 10 inches it is mildly alkaline, pale brown clay. The substratum to a depth of 60 inches is moderately alkaline, very pale brown clay loam.

Permeability of the Nunn soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is moderate to high. Rock fragments make up 15 to 35 percent of the volume in the surface layer and less than 15 percent below that.

In most places the soils are used for grazing. In a few places they are used for crops and for community development.

The native vegetation is mainly western wheatgrass, blue grama, buffalograss, and needleandthread. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by small stones and by the clay loam surface layer and the clayey subsoil, which make tillage difficult. Pebbles on the surface should be removed for best results in landscaping, particularly for lawns. A mulch of plant residue reduces runoff and soil blowing and helps maintain tilth and the content of organic matter. Supplemental irrigation is needed at the time of planting and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soils to support a load. Special sewage systems are needed because of the slow permeability.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and

phosphorus are needed to maintain fertility. A tillage pan forms easily if these soils are tilled when they are wet. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration. Land leveling is needed in some areas for the uniform distribution of water.

On nonirrigated cropland, the main concerns in management are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Maintaining crop residue on or near the surface reduces runoff and soil blowing and helps to maintain tilth and the content of organic matter. A tillage pan forms easily if these soils are tilled when they are wet. Chiseling or subsoiling can break up the tillage pan. Small stones on the surface may make the use of special equipment necessary.

These soils are in capability subclass IIIe, irrigated and nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1.

150—Tolvar very gravelly loamy sand, 15 to 30 percent slopes. This is a deep, well drained soil on mountain side slopes, which most commonly face north. It formed in stony, gravelly, and loamy material derived from igneous and metamorphic rocks. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 6,500 to 10,000 feet.

Typically, the surface is covered by a mat of partly decomposed needles, twigs, and leaves that is about 2 inches thick. The surface layer is slightly acid, grayish brown very gravelly loamy sand about 1 inch thick. The subsurface layer is strongly acid, white very gravelly loamy sand about 20 inches thick. The layer below that is strongly acid, light brown very gravelly sandy loam about 8 inches thick. The subsoil is strongly acid, light brown very gravelly sandy clay loam about 31 inches thick.

Included in mapping are small areas of Peeler and Grimstone soils on side slopes and Legault and Hiwan soils on side slopes and ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Tolvar soil is moderate. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

This soil is used mainly as woodland, habitat for wildlife, and recreation areas. In a few places it is used for community development.

The native vegetation is mainly an overstory of Douglas-fir and some lodgepole and ponderosa pine and an understory of common juniper, kinnikinnick, and scattered grasses and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope, droughtiness, and the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles should be removed for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The main limitation to use of the soil for homesite development is the slope. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. Structures to divert runoff are needed when buildings and roads are constructed. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Douglas-fir—Lodgepole Pine woodland group, and in plant adaptability group M-7.

151—Torrifluvents, very gravelly, 0 to 3 percent slopes. Torrifluvents, very gravelly, are deep, somewhat excessively drained soils on flood plains and low terraces. These soils formed in stratified sandy and gravelly alluvium derived from mixed sources. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Torrifluvents, very gravelly, are stratified very gravelly loamy sand and very gravelly sand about 60 inches deep.

Included in mapping are small areas of riverwash in stream channels, Fluvaquents in low-lying, poorly drained areas, Paymaster soils on low terraces, and Haverson soils on higher terraces. The included areas make up about 15 percent of the total acreage.

Permeability of Torrifluvents, very gravelly, is rapid. The available water capacity is low. Runoff is slow, and water erosion is a severe hazard. These soils are subject to occasional brief periods of flooding in spring and summer. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

These soils are used mainly as habitat for wildlife and as recreation areas. In a few places they are used for grazing.

The native vegetation is mainly scattered stands of western wheatgrass, blue grama, green needlegrass, and switchgrass. The average annual production of air-dry vegetation ranges from 1,000 to 2,000 pounds per acre. Because these soils are difficult to revegetate, proper grazing use is needed to prevent depletion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on these soils because of flooding, the low available water capacity, small stones, and sand. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Mulching and irrigation in dry periods are needed to establish seeded grasses and other small plants. Pebbles and cobbles should be removed for best results in landscaping, particularly for lawns. Structures to protect plantings from flooding are needed.

The main limitations to use of the soils for homesite development are flooding and seepage. Structures to divert runoff are needed to protect buildings and roads. Special sewage systems must be installed because of seepage. Effluent from absorption fields can surface downstream and create a health hazard. Special sealing methods are needed to control seepage. Some areas planted with native vegetation and other adapted plants can be used as greenbelts and parks.

Torrifluvents, very gravelly, are in capability subclass VIw, in the Overflow range site, and in plant adaptability group PF-1.

152—Trag sandy loam, 3 to 9 percent slopes. This is a deep, well drained soil on fans and toe slopes and in drainageways in the mountains. This soil formed in loamy alluvial and colluvial material derived from igneous and metamorphic rocks. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Typically, the surface layer is slightly acid, very dark grayish brown sandy loam about 11 inches thick. The subsoil in the upper 11 inches is neutral, dark grayish brown loam. In the lower 38 inches it is slightly acid, grayish brown and light yellowish brown clay loam.

Included in mapping are small areas of Breece soils in positions similar to those of the Trag soil, Lininger soils on side slopes, and Venable soils on flood plains. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Trag soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing and as pasture, hayland, and habitat for wildlife. In a few areas it is used for community development.

The native vegetation is mainly Arizona fescue, mountain muhly, Parry oatgrass, and slender wheatgrass. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances.

The short growing season limits the use of this soil for hay and as pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Weed control and fertilizer are needed for maximum quality of forage. Irrigation water can be applied by a contour furrow or sprinkler system. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment of grasses, shrubs, trees, and garden plants is restricted by the short growing season. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The Trag soil is well suited to use as homesites. Effluent from an absorption field can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling.

Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as greenbelts and parks planted with native vegetation and other adapted plants.

Most areas are too small for field crops, but some crops can be grown in small gardens. The crops selected should be suited to the short growing season. In many areas, gullies have formed as a result of poor cropping practices. Planting on the contour, terraces, and diversions help to reduce erosion and to conserve moisture.

This soil is in capability subclass IVe, irrigated and nonirrigated, in the Loamy Park range site, and in plant adaptability group M-1.

153—Trag sandy loam, 9 to 25 percent slopes. This is a deep, well drained soil on fans and toe slopes and in drainageways in the mountains. This soil formed in loamy alluvial and colluvial material derived from igneous and metamorphic rocks. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Typically, the surface layer is slightly acid, very dark grayish brown sandy loam about 11 inches thick. The subsoil in the upper 11 inches is neutral, dark grayish brown loam. In the lower 38 inches it is slightly acid, grayish brown to light yellowish brown clay loam.

Included in mapping are small areas of Breece soils in positions similar to those of the Trag soil, Lininger soils on side slopes, and Venable soils on flood plains. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Trag soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing and as pasture, hayland, and habitat for wildlife. In a few areas it is used for community development and for crops.

The native vegetation is mainly Arizona fescue, mountain muhly, Parry oatgrass, and slender wheatgrass. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances.

This soil is limited for use as hayland and pasture by the short growing season and the slope. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Weed control and fertilizer are needed for maximum quality of forage. Irrigation water can be applied by a contour furrow or sprinkler system. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the short growing season and the slope. A mulch of plant residue helps reduce soil blowing and runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting climatically adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

If the Trag soil is used for homesite development, the main limitation is the slope. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Structures to divert runoff are needed where buildings and roads are constructed. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining adequate plant cover. Some areas can be used as greenbelts and parks planted with native vegetation and other adapted plants.

Most of the areas that are used for crops are severely eroded. Seeding them to grass helps control erosion.

This soil is in capability subclass VIe, in the Loamy Park range site, and in plant adaptability group M-1.

154—Troutdale gravelly sandy loam, 3 to 9 percent slopes. This is a moderately deep, well drained soil on stable mountain summits and side slopes. This soil formed in gravelly, loamy material derived dominantly from igneous and metamorphic rocks. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average

frost-free season ranges from 55 to 75 days. Elevation is 7,600 to 9,500 feet.

Typically, the surface layer is slightly acid and neutral, dark grayish brown gravelly sandy loam about 8 inches thick. The subsoil in the upper 10 inches is neutral, brown to dark brown gravelly sandy clay loam. In the lower 11 inches it is neutral, brown to dark brown gravelly sandy loam. Soft schist is at a depth of 29 inches.

Included in mapping are small areas of Sprucedale soils on summits and side slopes, Kittredge soils on toe slopes, Earcree soils on fans, and soils, on side slopes, that have stones and cobbles on the surface. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Troutdale soil is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is slow. Water erosion and soil blowing are only slight hazards. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

This soil is used mainly for grazing and as pasture, recreation areas, and wildlife habitat. In a few places it is used for community development.

The native vegetation is mainly Parry oatgrass, western wheatgrass, Arizona fescue, and mountain muhly and some ponderosa pine. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment of grasses, shrubs, trees, and garden plants is restricted by the short growing season. Selecting climatically adapted plants is essential in establishing plantings. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitation to use of the soil for homesite development is depth to rock. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Loamy Park range site, and in plant adaptability group M-1.

155—Troutdale-Kittredge sandy loams, 5 to 15 percent slopes. These soils are on mountain side slopes and toe slopes. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,200 to 9,500 feet.

Troutdale soil makes up 50 percent of this map unit, and Kittredge soil makes up 35 percent. The Troutdale soil is on side slopes, and the Kittredge soil is on toe slopes. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Sprucedale soils on summits and side slopes, Earcree soils on fans and toe slopes and in drainageways, Venable soils on wet flood plains, and soils that are on side slopes and have gravel and cobbles on the surface. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Troutdale soil is moderately deep and well drained. It formed in gravelly, loamy material derived dominantly from igneous and metamorphic rocks.

Typically, the surface layer is slightly acid and neutral, dark grayish brown sandy loam about 8 inches thick. The subsoil in the upper 10 inches is neutral, brown to dark brown sandy clay loam. In the lower 11 inches it is neutral, brown to dark brown sandy loam. Soft schist is at a depth of 29 inches.

Permeability of the Troutdale soil is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is medium. Water erosion and soil blowing are moderate hazards. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

The Kittredge soil is deep and well drained. It formed in loamy alluvium and colluvium derived from igneous and metamorphic rocks.

Typically, the surface layer and the upper part of the subsoil are neutral, grayish brown and brown sandy loam about 8 inches thick. The lower part of the subsoil is

neutral, brown sandy clay loam about 34 inches thick. The substratum to a depth of 60 inches is neutral, yellowish brown sandy clay loam.

Permeability of the Kittredge soil is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is medium. Water erosion and soil blowing are moderate hazards. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

These soils are used for grazing and as pasture, habitat for wildlife, and recreation areas. In a few places they are used for community development and hayland.

The native vegetation is mainly Parry oatgrass, western wheatgrass, Arizona fescue, and mountain muhly and some ponderosa pine. The average annual production of air-dry vegetation ranges from 800 to 1,800 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds revegetation in areas depleted by heavy grazing, cultivation, or other disturbances.

The main limitations to use of these soils for hay and as pasture are the short growing season and the slope. Proper grazing use, weed control, and fertilizer are needed for maximum quality of forage. Irrigation water can be applied by a contour furrow or sprinkler system. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used for exercise areas and very limited grazing.

The establishment of grasses, shrubs, trees, and garden plants is restricted by the short growing season and the slope. Selecting climatically adapted species is essential in establishing plantings. A mulch of plant residue reduces runoff, improves tilth, and conserves moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flow to prevent flooding dlownslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the moderate depth to rock of the Troutdale soil and the slope. On the Troutdale soil, the deep cuts needed to provide a sufficiently level building site can expose bedrock. The steepness of the slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIe, in the Loamy Park range site, and in plant adaptability group M-1.

156—Troutdale-Rogert-Kittredge complex, 15 to 30 percent slopes. The soils making up this complex are on mountain side slopes, ridge crests, and toe slopes. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,600 to 9,500 feet.

Troutdale soil makes up 40 percent of this complex, Rogert soil makes up 25 percent, and Kittredge soil makes up 20 percent. The Troutdale soil is on side slopes and ridge crests, the Rogert soil is on ridges, and the Kittredge soil is on toe slopes. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Sprucedale soils on summits and side slopes, Earcree soils on fans and toe slopes and in drainageways, Venable soils on wet flood plains, and Rock outcrop on shoulders and in places where quartzitic dikes reach the surface. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Troutdale soil is moderately deep and well drained. It formed in gravelly, loamy material derived dominantly from igneous and metamorphic rocks.

Typically, the surface layer is slightly acid to neutral, dark grayish brown gravelly sandy loam about 8 inches thick. The subsoil in the upper 10 inches is neutral, brown to dark brown gravelly sandy clay loam. In the lower 11 inches it is neutral, brown to dark brown gravelly sandy loam. Soft schist is at a depth of 29 inches.

Permeability of the Troutdale soil is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

The Rogert soil is shallow and well drained. It formed in noncalcareous, stony, gravelly, and loamy material derived from igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark grayish brown cobbly sandy loam about 4 inches thick. The lower part of the surface layer is neutral, brown to dark

brown very gravelly sandy loam about 8 inches thick. Hard pegmatite is at a depth of 12 inches.

Permeability of the Rogert soil is moderately rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is rapid, and water erosion is high. The hazard of soil blowing is slight. The depth to hard bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

The Kittredge soil is deep and well drained. It formed in loamy alluvium and colluvium derived from igneous and metamorphic rocks.

Typically, the surface layer and the upper part of the subsoil are neutral, grayish brown and brown sandy loam about 8 inches thick. The lower part of the subsoil is neutral, brown sandy clay loam about 34 inches thick. The substratum to a depth of 60 inches is neutral, yellowish brown sandy clay loam.

Permeability of the Kittredge soil is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

In most places the soils are used for grazing and as habitat for wildlife, as recreation areas, and as woodland. In a few places they are used for community development.

The native vegetation is mainly Parry oatgrass, western wheatgrass, Arizona fescue, and mountain muhly and an open overstory of ponderosa pine. The average annual production of air-dry understory vegetation ranges from 700 to 1,000 pounds per acre on the Troutdale soil, 500 to 900 pounds per acre on the Rogert soil, and 900 to 2,000 pounds per acre on the Kittredge soil. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range conditon. Seeding speeds the revegetation of areas depleted by heavy grazing or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock maintained in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The wooded areas are managed mainly as watershed and habitat for wildlife and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the short growing season and the slope and, on the Rogert soil, by shallowness to rock and large stones. Selecting climatically adapted plants is essential in establishing plantings. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus help maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles on the surface should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the depth to rock and the slope. On the Rogert and Troutdale soils, the deep cuts needed to provide a sufficiently level building site can expose bedrock. The steepness of the slopes is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. In constructing roads and streets, the same practices needed to control erosion in wooded areas are needed in residential communities. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIe, in the Ponderosa Pine woodland group, and in plant adaptability group M-3.

157—Troutdale-Sprucedale gravelly sandy loams, 3 to 15 percent slopes. These soils are on mountain side slopes and summits. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,600 to 9,500 feet.

Troutdale soil makes up 45 percent of this map unit, and Sprucedale soil makes up 40 percent. The Troutdale soil is on side slopes and stable summits, and the Sprucedale soil is on summits and side slopes. The areas are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Kittredge soils on toe slopes, Rogert soils on ridges, Rock outcrop on shoulders and exposures of quartzitic dikes, and Venable

soils on wet flood plains. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

The Troutdale soil is moderately deep and well drained. It formed in gravelly, loamy material derived dominantly from igneous and metamorphic rocks.

Typically, the surface layer is slightly acid and neutral, dark grayish brown gravelly sandy loam about 8 inches thick. The subsoil in the upper 10 inches is neutral, brown to dark brown gravelly sandy clay loam. In the lower 11 inches it is neutral, brown to dark brown gravelly sandy loam. Soft schist is at a depth of 29 inches.

Permeability of the Troutdale soil is moderate. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

The Sprucedale soil is shallow and well drained. It formed in noncalcareous, micaceous, gravelly, and loamy alluvial and colluvial material derived from igneous and metamorphic rocks.

Typically, the surface layer is neutral, dark grayish brown gravelly sandy loam about 6 inches thick. The subsoil is neutral, brown to dark brown sandy loam 6 inches thick. Soft schist is at a depth of 12 inches.

Permeability of the Sprucedale soil is moderately rapid. The available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 10 to 20 inches. The shrink-swell potential is low. Rock fragments make up 0 to 35 percent of the volume.

In most places the soils are used for grazing and as habitat for wildlife, as recreation areas, and as woodland. In a few places they are used for community development.

The native vegetation is mainly needleandthread, western wheatgrass, Arizona fescue, and mountain muhly and an open overstory of ponderosa pine. The average annual production of air-dry understory vegetation ranges from 500 to 1,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the short growing season, depth to rock, and the slope. Selecting climatically adapted plants is essential in establishing plantings. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and of nitrogen and phosphate fertilizers are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles should be removed for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the depth to rock and the slope. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Effluent from an absorption field can surface downslope and create a health hazard. In constructing roads and streets, the same practices needed to control erosion in wooded areas are needed in residential communities. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIe, in the Ponderosa Pine woodland group, and in plant adaptability group M-3.

158—Truckton sandy loam, 0 to 3 percent slopes. This is a deep, well drained soil on high terraces and tablelands. It formed in noncalcareous, sandy eolian material. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,400 to 6,500 feet.

Typically, the surface layer is slightly acid, grayish brown to dark grayish brown sandy loam about 7 inches thick. The subsoil in the upper 6 inches is slightly acid, brown sandy loam. In the next 6 inches it is slightly acid, yellowish brown sandy loam. The lower part of the subsoil and the substratum to a depth of 60 inches are neutral, light yellowish brown and very pale brown loamy sand.

Included in mapping are small areas of Blakeland and Bresser soils in positions similar to those of the Truckton soil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Truckton soil is moderately rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, as pasture, for crops, and as habitat for wildlife. In a few areas it is used for community development.

The native vegetation is mainly big bluestem, needleandthread, sand reedgrass, and blue grama. The average annual production of air-dry vegetation ranges from 1,000 to 1,400 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment of grasses, shrubs, trees, and garden plants is limited by droughtiness because of the sandy texture. A mulch of plant residue helps reduce soil blowing, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Supplemental irrigation is needed at planting time and throughout the growing season.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitation to use of the soil for homesite development is seepage. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Revegetating the disturbed area around a construction site as soon as possible helps control soil blowing. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil blowing, and maintaining or improving fertility. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Sprinkler irrigation is best suited to this soil because of the rapid intake rate.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Maintaining crop residue on or near the surface reduces soil blowing and runoff and helps maintain tilth and the content of organic matter. Soil blowing can be reduced by planting crops in alternate strips at right angles to the prevailing wind.

This soil is in capability subclasses IIe, irrigated, and IIIs, nonirrigated; in the Sandy Foothill range site; and in plant adaptability group F-4.

159—Truckton sandy loam, 3 to 9 percent slopes. This is a deep, well drained soil on high terraces and tablelands. It formed in noncalcareous, sandy eolian material. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,400 to 6,500 feet.

Typically, the surface layer is slightly acid, grayish brown to dark grayish brown sandy loam about 7 inches thick. The subsoil in the upper 6 inches is slightly acid, brown sandy loam. In the next 6 inches it is slightly acid, yellowish brown sandy loam. The lower part of the subsoil and the substratum to a depth of 60 inches are neutral, light yellowish brown and very pale brown loamy sand.

Included in mapping are small areas of Blakeland and Bresser soils in positions similar to those of the Truckton soil. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Truckton soil is moderately rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, as pasture, for crops, and as habitat for wildlife. In a few areas it is used for community development.

The native vegetation is mainly big bluestem, needleandthread, sand reedgrass, and blue grama. The average annual production of air-dry vegetation ranges

from 1,000 to 1,400 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Seeding speeds the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment of grasses, shrubs, trees, and garden plants is limited by droughtiness because of the sandy texture. A mulch of plant residue helps reduce soil blowing, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and throughout the growing season.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitation to use of the soil for homesite development is seepage. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent seepage from contaminating the water supply. Revegetating the disturbed area around a construction site as soon as possible helps control soil blowing. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling soil blowing, and maintaining or improving fertility. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Sprinkler irrigation is best suited to this soil because of the rapid intake rate.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Maintaining crop residue on or near the surface reduces soil blowing and runoff and helps maintain tilth and the content of organic matter. Soil blowing can be reduced by planting crops in alternate strips at right angles to the prevailing wind. Terraces and diversions help to reduce runoff and to conserve moisture.

This soil is in capability subclass IIIe, irrigated and nonirrigated; in the Sandy Foothill range site; and in plant adaptability group F-4.

160—Ulm clay loam, 5 to 9 percent slopes. This is a deep, well drained soil on hill slopes and high terraces. It formed in calcareous, clayey material derived from mudstone and shale. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, brown clay loam about 6 inches thick. The subsoil in the upper 23 inches is neutral and mildly alkaline, yellowish brown clay. In the lower 21 inches it is moderately alkaline, light yellowish brown and pale brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, very pale brown clay loam.

Included in mapping are small areas of Englewood soils in drainageways, Nunn and Denver soils in positions similar to those of the Ulm soil, and Manzanola and Renohill soils on convex ridges and hill slopes. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Ulm soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing, as pasture, as recreation areas, and for crops. In a few places it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding hastens the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. Maintaining plant residue on or near the surface reduces runoff and helps to maintain or improve tilth and the content of organic matter. Because the natural fertility is low, applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed. Planting on the contour helps to conserve moisture and reduce erosion. Supplemental

irrigation is needed at the time of planting and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help to prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A tillage pan forms easily if the Ulm soil is tilled when it is wet. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration. Land leveling is needed for the uniform distribution of water. Light, frequent applications of irrigation water are needed to prevent soil loss because of the slope.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue into the soil are essential in protecting the soil from erosion, improving tilth, and conserving moisture. Terracing and contour tillage are needed to reduce erosion. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclass IVe, irrigated and nonirrigated, in the Clayey Foothill range site, and in plant adaptability group F-1.

161—Ulm-Urban land complex, 0 to 3 percent slopes. The areas of this complex are on tablelands and high terraces. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Ulm soil makes up 65 percent of this complex, and Urban land makes up 20 percent. The areas of Ulm soil and of Urban land are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Englewood soils in drainageways, Nunn and Denver soils in positions similar to those of the Ulm soil, and Manzanola soils on convex ridges and hill slopes. Urban land makes up more than 20 percent of some mapped areas. Also included are small areas that are less than 20 percent Urban land; these are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Ulm soil is deep and well drained. It formed in calcareous, clayey material derived from shale and mudstone.

Typically, the surface layer is neutral, brown clay loam about 6 inches thick. The subsoil in the upper 23 inches is neutral and mildly alkaline, yellowish brown clay. In the lower 21 inches it is moderately alkaline, light yellowish brown and pale brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, very pale brown clay loam.

Permeability of the Ulm soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion and soil blowing are slight hazards. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

Urban land is mainly covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

Most areas of this complex are used for community development. A few areas are used as pasture or for grazing.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,000 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens; the rest of the pasture can be used as exercise areas and for very limited grazing. Seeding hastens the revegetation of areas depleted by heavy grazing or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. Maintaining plant residue on or near the surface reduces runoff and helps maintain tilth and the content of organic matter. The natural fertility is low;

therefore, applications of manure and of nitrogen and phosphate fertilizers are needed. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the Ulm soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the Ulm soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff on Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that are not normally subject to flooding. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

The Ulm soil is in subclasses IIe, irrigated, and IIIc, nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

162—Ulm-Urban land complex, 3 to 5 percent slopes. The areas of this complex are on tablelands and high terraces. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Ulm soil makes up 65 percent of this complex, and Urban land makes up 20 percent. The areas of Ulm soil and of Urban land are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Englewood soils in drainageways, Nunn and Denver soils in positions similar to those of the Ulm soil, and Manzanola soil on convex ridges and hill slopes. Urban land makes up more than 20 percent of some mapped areas. Also included are small areas that are less than 20 percent Urban land; these are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Ulm soil is deep and well drained. It formed in calcareous, clayey material derived from shale and mudstone.

Typically, the surface layer is neutral, brown clay loam about 6 inches thick. The subsoil in the upper 23 inches is neutral and mildly alkaline, yellowish brown clay. In the lower 21 inches it is moderately alkaline, light yellowish brown and pale brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, very pale brown clay loam.

Permeability of the Ulm soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

Urban land is mainly covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

Most areas of this complex are used for community development. A few areas are used as pasture or for grazing.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding hastens the revegetation of areas depleted by heavy grazing or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. Maintaining plant residue on or near the surface reduces runoff and helps to maintain tilth and the content of organic matter. The natural fertility is low; therefore, applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the Ulm soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the Ulm soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff on Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that are not normally subject to flooding. Special sewage systems must be installed because of the slow

permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

The Ulm soil is in capability subclass IIIe, irrigated and nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

163—Ulm-Urban land complex, 5 to 9 percent slopes. The areas of this complex are on hill slopes and high terraces. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Ulm soil makes up 65 percent of this complex, and Urban land makes up 20 percent. The areas of Ulm soil and of Urban land are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Englewood soils in drainageways, Nunn and Denver soils in positions similar to those of the Ulm soil, and Manzanola and Renohill soils on convex ridges and hill slopes. Urban land makes up more than 20 percent of some mapped areas. Also included are small areas that are less than 20 percent Urban land; these are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included areas make up about 15 percent of the total acreage.

The Ulm soil is deep and well drained. It formed in calcareous, clayey material derived from shale and mudstone.

Typically, the surface layer is neutral, brown clay loam about 6 inches thick. The subsoil in the upper 23 inches is neutral and mildly alkaline, yellowish brown clay. In the lower 21 inches it is moderately alkaline, light yellowish brown and pale brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, very pale brown clay loam.

Permeability of the Ulm soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and water erosion is a moderate hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. Rock fragments make up 0 to 15 percent of the volume.

Urban land is mainly covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

Most areas of this complex are used for community development. A few areas are used as pasture or for grazing.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding hastens the revegetation of areas depleted by heavy grazing or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. Maintaining plant residue on or near the surface reduces runoff and helps to maintain soil tilth and organic matter The natural fertility is low; therefore, applications of manure and of nitrogen and phosphate fertilizers are needed. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the Ulm soil for homesite development are the shrink-swell potential, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the Ulm soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff on Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that are not normally subject to flooding. Special sewage systems must be installed because of the slow permeability. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

The Ulm soil is in capability subclass IVe, irrigated and nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1. Urban land is in capability class VIII. It is not assigned to a range site or to a plant adaptability group.

164—Ulm-Urban land complex, 9 to 18 percent slopes. The areas of this complex are on hill slopes. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Ulm soil makes up 65 percent of this complex, and Urban land makes up 20 percent. The areas of Ulm soil and of Urban land are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Englewood soils in drainageways, Nunn and Denver soils on hill

slopes and terraces, Midway soils on ridge crests, and Renohill and Manzanola soils on convex ridges and hill slopes. Also included are small areas that are less than 20 percent Urban land; these are mainly parks, playgrounds, vacant lots, and small fields and pastures. The included soils make up about 15 percent of the total acreage.

The Ulm soil is deep and well drained. It formed in calcareous, clayey material derived from shale and mudstone.

Typically, the surface layer is neutral, brown clay loam about 6 inches thick. The subsoil in the upper 23 inches is neutral and mildly alkaline, yellowish brown clay. In the lower 21 inches it is moderately alkaline, light yellowish brown and pale brown clay loam. The substratum to a depth of 60 inches is moderately alkaline, very pale brown clay loam.

Permeability of the Ulm soil is slow. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is high. Rock fragments make up from 0 to 15 percent of the volume.

Urban land is mainly covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because Urban land is very slowly permeable or is impermeable, runoff is rapid.

Most areas of this complex are used for community development. A few areas are used as pasture or for grazing.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding hastens the revegetation of areas depleted by heavy grazing or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the slope and because the clay loam surface layer and clayey subsoil make tillage difficult. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

The main limitations to use of the Ulm soil for homesite development are the shrink-swell potential, the slope, low strength, and slow permeability. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the Ulm soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Because runoff on Urban land is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that are not normally subject to flooding. Special sewage systems must be installed because of the slope and the slow permeability. Effluent from an absorption field can surface downslope and create a health hazard. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Cuts and fills should be seeded or mulched.

The Ulm soil is in capability subclass VIe, in the Clayey Foothill range site, and in plant adaptability group F-1. Urban land is in capability class VIII. It is not assigned to a range site or a plant adaptability group.

165—Ustic Torriorthents, loamy, 15 to 50 percent slopes. These are shallow to deep, well drained soils on eroded, active hill slopes adjacent to drainageways. The soils formed in loamy material that eroded from interbedded sandstone and shale. The average annual precipitation is 13 to 17 inches, the average annual temperature is 47° F, and the frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Ustic Torriorthents, loamy, are highly variable. They differ in depth to bedrock, in color, and in thickness of soil layers. However, they commonly are clay loam, loam, or sandy clay loam.

Included in mapping are small areas of Midway and Primen soils on ridges, Kutch and Leyden soils on hill slopes, Ascalon, Nunn, and Denver soils on fans, and Haverson soils on low terraces. Also included are small areas of Urban land. The included soils and Urban land make up about 20 percent of the total acreage of the map unit.

Permeability of Ustic Torriorthents, loamy, is moderate to slow. The available water capacity is low to high. The effective rooting depth ranges from 10 to 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate to severe hazard. The depth to soft bedrock ranges from 10 to 60 inches or more. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 35 percent of the volume.

In most places these soils are used for grazing and as habitat for wildlife. In a few places they are used for community development.

The native vegetation is mainly needleandthread, western wheatgrass, sideoats grama, and big bluestem.

The average annual production of air-dry vegetation ranges from 300 to 1,200 pounds per acre. These soils are difficult to revegetate; consequently, proper grazing use is needed to prevent depletion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The steepness of the slopes limits access by livestock and promotes overgrazing of the less sloping areas. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain on these soils because of the slope and, in some areas, because of the clayey texture and the depth to rock. A mulch of plant residue helps to reduce runoff and soil blowing, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and during dry periods. Deep cuts made in land grading should be covered with topsoil.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the slope, depth to rock, and slippage. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Structures to divert runoff are needed where buildings and roads are constructed. Effluent from an absorption field can surface downslope and create a health hazard. The soils are unstable and are subject to slippage when they are bearing a load, have been disturbed by excavation, or are wet. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas planted with native vegetation and other adapted plants can be used as open space and parks.

Onsite investigation is needed to determine the potentials and limitations of a specific site for a proposed use.

These soils are in capability subclass VIIe, in the Shallow Foothill and Clayey Foothill range sites, and in plant adaptability groups F-7 and F-1.

166—Ustic Torriorthents, clayey, 0 to 50 percent slopes. These soils consist mainly of clayey fill material that has been placed on various other soils. The fill originated from shale, mudstone, and the numerous clayey soils in the survey area. The fill areas were created mainly as sites for buildings, roads, and landfills. In some places they originated as dumps for spoil from claypit operations. The surface of these soils commonly is nearly level to gently sloping, but the adjacent cut slopes are moderately sloping to steep. The average annual precipitation is 13 to 17 inches, the average annual temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Ustic Torriorthents, clayey, are highly variable according to the source of the material and the mode of deposition. The soils commonly are clay loam, gravelly clay loam, clay, and gravelly clay. They are more than 20 inches thick.

Included in mapping are small cut areas and some undisturbed areas that have not been subjected to cutting and filling. Also included are small areas of Urban land. The included areas make up about 15 percent of the total acreage.

Permeability of Ustic Torriorthents, clayey, is slow. The available water capacity ranges from low to high. Runoff is slow to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a slight to moderate hazard. The shrink-swell potential is moderate to high.

These soils are used mainly for community development and as landfills.

Plantings are difficult to establish and maintain on these soils. A mulch of plant residue helps reduce runoff and soil blowing, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to improve fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Pebbles and cobbles should be removed for best results in landscaping. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate heavy flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of these soils for homesite development are slope, the shrink-swell potential, and low strength. Because the nearby cut slopes are moderately sloping to steep, structures to divert runoff from buildings and roads are needed. Buildings and roads should be designed to offset the limited ability of the soils to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface

drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help to control seepage into basements and minimize the effects of shrinking and swelling. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

Onsite investigation is needed to determine the potential and limitations of a specific site for a proposed use.

These soils are in capability subclass VIIs.

167—Ustorthents, cool-Rock outcrop complex, 15 to 50 percent slopes. The areas of this complex are on mountain slopes and ridges associated with the Fountain Formation. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 43° to 47° F, and the average frost-free season ranges from 76 to 125 days. Elevation is 6,500 to 7,800 feet.

Ustorthents make up 65 percent of this complex, and Rock outcrop makes up 20 percent. The areas of each are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of deep colluvial soils on toe slopes and areas of soils that are on stable summits and have slopes of less than 15 percent. The included soils make up about 15 percent of the total acreage.

Ustorthents are shallow to moderately deep, and they are well drained. They formed in noncalcareous, stony, gravelly, and sandy to loamy colluvium and in residuum dominantly of sandstone of the Fountain Formation.

These soils vary in depth, amount of rock fragments, and texture. They generally have a thin dark surface layer that ranges from stony sandy loam to extremely stony sandy loam and overlies very gravelly sandy loam. The hues are reddish, because red sandstone of the Fountain Formation is the main parent material of these soils.

Permeability of the Ustorthents is moderately rapid. The available water capacity is low to moderate. The effective rooting depth is 10 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to bedrock ranges from 10 to 40 inches. The shrink-swell potential is low. Rock fragments make up 35 to 80 percent of the volume.

Rock outcrop consists of exposures of sedimentary rock, talus, and large boulders. Runoff in areas of Rock outcrop is rapid, and water erosion is a moderate to severe hazard.

Ustorthents are used mainly as recreation areas, woodland, and habitat for wildlife. In some places they are used for community development.

The native vegetation is mainly an overstory of ponderosa pine and Douglas-fir and an understory of buffaloberry, some grasses, and forbs. The wooded areas are managed mainly as habitat for wildlife, as watershed, and for recreation uses. Some wooded areas are included in or are adjacent to residential communities; consequently, their esthetic value is of major importance. Thinning overcrowded stands and removing dead trees help to reduce susceptibility to insect attack and to keep the trees healthy and productive. In constructing access roads, the design of a road drainage system and the placement of culverts are critical in controlling erosion. Spoil from excavations must be protected to prevent rill and gully erosion and sloughing. Sufficient ground cover is needed to protect the soil from erosion.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the slope, depth to rock, and large stones. Planting on the contour helps conserve moisture and reduce erosion. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Pebbles and cobbles should be removed for best results in landscaping, particularly for lawns. Deep cuts made in land grading should be covered with a layer of topsoil. Supplemental irrigation is needed at planting time and during dry periods.

If areas of this complex are used for community development, the main limitations are slope, depth to rock, and, in some areas, large stones. The deep cuts needed to provide a sufficiently level building site can expose bedrock. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. In constructing roads and streets, the practices needed to control erosion are the same as those used for roads in wooded areas. Preserving the existing plant cover during construction helps to control erosion.

This complex is in capability subclass VIIe. Ustorthents, cool, are in the Mixed Conifer woodland group and in plant adaptability group M-6.

168—Valmont clay loam, 0 to 3 percent slopes. This is a deep, well drained soil on high terraces and alluvial fans. It formed in calcareous, clayey alluvium underlain by calcareous, very cobbly or very gravelly material. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, grayish brown clay loam about 4 inches thick. The subsoil in the upper 13 inches is neutral and moderately alkaline, dark grayish brown and brown clay. In the lower 14 inches it is moderately alkaline, pale brown clay and clay loam.

The substratum to a depth of 60 inches is moderately alkaline, light gray very gravelly sandy loam.

Included in mapping are small areas of Standley soils on lower terraces, Flatirons and Veldkamp soils on higher terraces, Valmont soils that have slopes of 3 to 5 percent, and Denver and Nunn soils on fans. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Valmont soil is slow to a depth of 20 to 40 inches and moderately rapid below that. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The depth to the contrasting very gravelly substratum ranges from 20 to 40 inches. The shrink-swell potential is high in the surface layer and subsoil and low in the substratum. Rock fragments make up 0 to 15 percent of the volume in the surface layer and subsoil and 35 percent or more in the substratum.

In most places this soil is used for grazing, as pasture, or for crops. In a few places it is used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, and blue grama. The average annual production of air-dry vegetation ranges from 600 to 1,200 pounds per acre. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing. Seeding hastens the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Heavy infestations of undesirable plants can be controlled by chemical or mechanical treatment. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and increased runoff.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by the clay loam surface layer and clayey subsoil, which make tillage difficult. A mulch of plant residue reduces runoff and helps maintain tilth and the content of organic matter. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed at planting time and during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are the shrink-swell potential and low strength. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Buildings and roads should be designed to offset the limited ability of the soil to support a load. The risk of settlement can be minimized by compacting the building site before construction begins. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, and maintaining or improving fertility. Incorporating crop residue into the soil and maintaining the content of organic matter increase water infiltration and improve tilth. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A tillage pan forms easily if this soil is tilled when it is wet. Chiseling or subsoiling breaks up the tillage pan and improves water infiltration. Land leveling is needed in some areas for the uniform distribution of water.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue into the soil are essential in protecting the soil from erosion, improving tilth, and conserving moisture. Soil blowing can be reduced by planting crops in alternate strips at right angles to the prevailing wind. A tillage pan forms easily if this soil is tilled when it is wet. Tillage should be kept to a minimum.

This soil is in capability subclasses IIIs, irrigated, and IIIc, nonirrigated; in the Clayey Foothill range site; and in plant adaptability group F-1.

169—Veldkamp-Nederland very cobbly sandy loams, 0 to 3 percent slopes. These soils are on piedmont fan terraces, alluvial terraces, and stable summits. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Veldkamp soil makes up 65 percent of this map unit, and Nederland soil makes up 20 percent. Veldkamp and Nederland soils are in similar positions on the landscape. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Valmont soils on high terraces, Willowman soils on terrace escarpments, and Standley soils on terraces and hill slopes. Standley soils have a lower percentage of rock fragments than Veldkamp and Nederland soils. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Veldkamp soil is deep and well drained. It formed in noncalcareous, stratified, cobbly, gravelly, and clayey alluvial material.

Typically, the surface layer is neutral, dark grayish brown very cobbly sandy loam about 3 inches thick. The subsoil in the upper 9 inches is neutral, dark grayish brown and brown to dark brown very cobbly clay loam and very cobbly clay. In the lower 9 inches it is neutral, dark yellowish brown very cobbly clay loam. The substratum to a depth of 60 inches is neutral, dark yellowish brown, stratified very cobbly sandy loam.

Permeability of the Veldkamp soil is moderately slow. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are slight hazards. The shrink-swell potential is moderate. Rock fragments make up 35 to 60 percent of the volume.

The Nederland soil is deep and well drained. It formed in cobbly, gravelly, and loamy alluvium derived from mixed sources.

Typically, the surface layer is mildly alkaline, dark brown to brown very cobbly sandy loam about 10 inches thick. The subsoil is neutral, dark brown and strong brown very cobbly sandy clay loam about 52 inches thick. The substratum below a depth of 62 inches is neutral, strong brown very stony sandy loam.

Permeability of the Nederland soil is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are slight hazards. The shrink-swell potential is low. Rock fragments make up 35 to 75 percent of the volume.

In most places the soils are used for grazing and as habitat for wildlife. In a few places they are used for community development.

The native vegetation is mainly big bluestem, little bluestem, blue grama, and mountain muhly. The average annual production of air-dry vegetation ranges from 1,000 to 2,300 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Large stones on the surface make seeding difficult and mechanical treatment impractical. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees and garden plants are limited by the large stones, which make tillage difficult. Pebbles and cobbles should be removed from the surface for best results in landscaping, particularly for lawns. Mulching, fertilizing, and irrigation are needed to establish grasses and other plants. Selecting adapted plants is essential in establishing plantings.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitation to use of the soils for homesite development is the large stones. Excavation of building sites and roads is difficult because of the large stones and may require the use of large equipment. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIIs, in the Cobbly Foothill range site, and in plant adaptability group F-5.

170—Venable loam, 0 to 3 percent slopes. This is a deep, poorly drained soil on alluvial valley floors, flood plains, and low terraces of mountain streams. The soil formed in loamy alluvium derived from igneous and metamorphic rocks. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,200 to 9,500 feet.

Typically, the surface layer is neutral, very dark grayish brown loam about 5 inches thick. The subsoil in the upper 9 inches is neutral, very dark grayish brown sandy clay loam. In the lower 29 inches it is neutral, dark grayish brown clay loam that has mottling throughout. The substratum to a depth of 60 inches is neutral, grayish brown sandy loam that has mottling throughout.

Included in mapping are small areas of Rosane soils on flood plains, Earcree soils on fans and slopes, and moderately well drained, loamy soils on higher terraces and abandoned natural levees. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Venable soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are only slight hazards. A seasonal high water table is at a depth of 6 to 30 inches in spring and summer. In some areas the soil has been drained artificially or by gullying. This soil is subject to very brief periods of flooding in spring and early in summer. The depth to bedrock is more than 60 inches. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing and hay crops and as habitat for wildlife. In a few areas it is used for community development.

The native vegetation is mainly tufted hairgrass, Canada sedge, slender wheatgrass, and Baltic rush. The average annual production of air-dry vegetation ranges from 2,000 to 4,000 pounds per acre. Some willows and other water-tolerant shrubs grow adjacent to stream

courses. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and increased runoff. Seeding hastens the revegetation of areas depleted by heavy grazing or other disturbances.

Wetness and the short growing season limit the use of this Venable soil for hay and pasture. Wetness limits the choice of plants and the period of cutting or grazing. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Where the soil has been drained, irrigation water can be applied by the contour furrow or sprinkler method. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by wetness and the short growing season. Species that tolerate wetness should be selected for planting. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Supplemental irrigation is needed during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the Venable soil for homesite development are wetness and flooding. Drainage and structures to divert runoff are needed where buildings and roads are constructed. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas that are planted with native vegetation and other adapted plants can be used as greenbelts and parks.

This soil is in capability subclass Vc, irrigated and nonirrigated; in the Mountain Meadow range site; and in plant adaptability group M-2.

171—Venable loam, 3 to 9 percent slopes. This is a deep, poorly drained soil on alluvial valley floors, flood plains, and low terraces of mountain streams. It formed in loamy alluvium derived from igneous and metamorphic rocks. The average annual precipitation is 17 to 20 inches, the average annual air temperature is 41° to 43° F, and the average frost-free season ranges from 55 to 75 days. Elevation is 7,200 to 9,500 feet.

Typically, the surface layer is neutral, very dark grayish brown loam about 5 inches thick. In the upper 9 inches the subsoil is neutral, very dark grayish brown sandy clay loam. In the lower 29 inches it is neutral, dark grayish brown clay loam that has mottling throughout. The substratum to a depth of 60 inches is neutral, grayish brown sandy loam that has mottling throughout.

Included in mapping are small areas of Rosane soils on flood plains, Earcree soils on fans and toe slopes, and moderately well drained, loamy soils on higher terraces and abandoned natural levees. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Venable soil is moderate. The available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow. Water erosion and soil blowing are only slight hazards. A seasonal high water table is at a depth of 6 to 30 inches in spring and summer. In some areas the soil has been drained artificially or by gullying. This soil is subject to very brief periods of flooding in spring and early in summer. The depth to bedrock is more than 60 inches. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly for grazing and hay crops and as habitat for wildlife. In a few areas it is used for community development.

The native vegetation is mainly tufted hairgrass, Nebraska sedge, slender wheatgrass, and Baltic rush. The average annual production of air-dry vegetation ranges from 2,000 to 4,000 pounds per acre. Some willows and other water-tolerant shrubs grow adjacent to stream courses. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and increased runoff. Seeding hastens the revegetation of areas depleted by heavy grazing or other disturbances.

Wetness and the short growing season limit the use of this Venable soil for hay and pasture. Wetness limits the choice of plants and the period of cutting or grazing. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and protect the soil from erosion. Where the soil has been drained, irrigation water can be applied by the contour furrow or sprinkler method. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are restricted by wetness and the short growing season. Species that tolerate wetness should be selected for planting. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed during dry periods.

The areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to the use of this Venable soil for homesite development are wetness and flooding. Drainage and structures to divert runoff are needed where buildings and roads are constructed. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply. Effluent from an absorption field can surface downslope and create a health hazard. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas can be used as greenbelts and parks.

This soil is in capability subclass VIe, in the Mountain Meadow range site, and in plant adaptability group M-2.

172—Wann fine sandy loam, 0 to 2 percent slopes. This is a deep, somewhat poorly drained soil on alluvial valley floors, flood plains, and low terraces. This soil formed in stratified, loamy alluvium derived from mixed sources. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, dark grayish brown fine sandy loam about 13 inches thick. The upper part of the underlying material is mildly alkaline, yellowish brown fine sandy loam 24 inches thick. The lower part to a depth of 60 inches is mildly alkaline, brownish yellow sandy clay loam.

Included in mapping are small areas of Alda soils in positions similar to those of the Wann soil, Nunn Variant soils on terraces and fans, and wet Englewood soils in drainageways. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Wann soil is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. A seasonal high water table is at a depth of 18 to 42 inches in spring and summer. This soil is subject to rare, brief periods of flooding in spring and summer. The shrink-swell potential is low. Rock fragments make up 0 to 15 percent of the volume.

This soil is used mainly as recreation areas, as habitat for wildlife, and for crops. In a few places it is used for community development.

The native vegetation is mainly switchgrass, indiangrass, big bluestem, and prairie cordgrass. The average annual production of air-dry vegetation ranges from 3,000 to 4,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Seeding hastens the revegetation of areas depleted by heavy grazing, cultivation, or other disturbances. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and increased runoff. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by wetness and flooding. Selecting plants that tolerate wetness is essential in establishing plantings. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. A mulch of plant residue helps improve tilth and conserve moisture. Supplemental irrigation is needed during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are wetness, flooding, and seepage. Drainage and structures to divert runoff are needed where buildings and roads are constructed. Effluent from an absorption field can surface downslope and create a health hazard. Special sealing methods are needed to prevent excessive seepage. Erosion and sedimentation can be controlled by maintaining an adequate plant cover. Some areas planted with native vegetation and other adapted plants can be used as greenbelts and parks.

On irrigated cropland, the main concerns in management are proper use of irrigation water, controlling erosion, maintaining or improving fertility, and reducing wetness. Tile drains and open drainage ditches are needed to lower the water table. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Land leveling is needed in some areas for the uniform

distribution of water. Tillage should be kept to a minimum.

Management concerns on nonirrigated cropland are conserving soil moisture, protecting the soil from erosion, and maintaining fertility. Stubble mulch tillage and incorporating crop residue into the soil are essential in protecting the soil from erosion, improving tilth, and conserving moisture. Tillage should be kept to a minimum.

This soil is in capability subclasses IIe, irrigated, and IIIc, nonirrigated; in the Wet Meadow range site; and in plant adaptability group PF-4.

173—Willowman cobbly sandy loam, 0 to 5 percent slopes. This is a deep, well drained soil on ridges, hill slopes, and knobs. It formed in calcareous, cobbly, gravelly, and loamy alluvium. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is mildly alkaline, dark grayish brown cobbly sandy loam about 6 inches thick. The subsoil in the upper 4 inches is mildly alkaline, dark grayish brown very gravelly clay loam. In the lower 5 inches it is mildly alkaline, light brownish gray very gravelly loam. The substratum in the upper 14 inches is moderately alkaline, white very gravelly loam. Below that to a depth of 60 inches it is moderately alkaline, very pale brown very gravelly sandy loam.

Included in mapping are small areas of Leyden and Primen soils on hill slopes and ridges, soils that have a thick accumulation of carbonates and are in similar positions, and Veldkamp soils on terraces. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Willowman soil is moderate. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and water erosion is a slight hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low to moderate. Rock fragments make up 35 to 70 percent of the volume.

This soil is used mainly for grazing, as pasture, and as recreation areas. In a few places it is used for community development.

The native vegetation is mainly big bluestem, little bluestem, switchgrass, and mountain muhly. The average annual production of air-dry vegetation ranges from 1,000 to 2,300 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. The main limitation for seeding is large stones. The use of equipment is not practical because the surface is stony. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the low available water capacity and by the large stones, which make tillage difficult. The removal of pebbles and cobbles is required for best results in landscaping, particularly for lawns. Mulching, fertilizing, and irrigation are needed to establish seeded grasses and other small plants. Selecting plants that tolerate droughty conditions helps in establishing plantings.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitation to use of the soil for homesite development is the large stones. Excavating this soil in constructing houses and roads is difficult because of the large stones and may require the use of large equipment. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIs, in the Cobbly Foothill range site, and in plant adaptability group F-5.

174—Willowman-Leyden cobbly loams, 9 to 30 percent slopes. These soils are on hill slopes, ridges, and terrace escarpments. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Willowman soil makes up 60 percent of this map unit, and Leyden soil makes up 25 percent. The Willowman soil is on hill slopes and terrace escarpments, and the Leyden soil is on hill slopes and ridges. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Primen soils on ridges, Veldkamp soils on terraces, and Standley, Nunn, and Denver soils on fans. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Willowman soil is deep and well drained. It formed in calcareous, cobbly, gravelly, and loamy alluvium.

Typically, the surface layer is mildly alkaline, dark grayish brown cobbly loam about 6 inches thick. The subsoil in the upper 4 inches is mildly alkaline, dark grayish brown very gravelly clay loam. In the lower 5 inches it is mildly alkaline, light brownish gray very gravelly loam. The substratum in the upper 14 inches is moderately alkaline, white very gravelly loam. Below that to a depth of 60 inches it is moderately alkaline, very pale brown very gravelly sandy loam.

Permeability of the Willowman soil is moderate. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The shrink-swell potential is low to moderate. Rock fragments make up 35 to 70 percent of the volume.

The Leyden soil is moderately deep and well drained. It formed in calcareous, cobbly, gravelly, and clayey material derived from mixed sources.

Typically, the surface layer is neutral, very dark grayish brown cobbly loam about 3 inches thick. The subsoil in the upper 5 inches is neutral, dark grayish brown gravelly clay loam. In the lower 27 inches it is neutral, brown to dark brown, brown, and light yellowish brown gravelly clay and gravelly clay loam. It overlies soft mudstone.

Permeability of the Leyden soil is slow. The available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The depth to soft bedrock ranges from 20 to 40 inches. The shrink-swell potential is high. Rock fragments make up 15 to 35 percent of the volume.

These soils are used mainly for grazing and as habitat for wildlife. In a few areas they are used for community development.

The native vegetation is mainly big bluestem, switchgrass, indiangrass, and mountain muhly. The average annual production of air-dry vegetation ranges from 1,000 to 2,300 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Mechanical treatment is not practical because of the large stones on the surface. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

The establishment and maintenance of grasses, shrubs, trees, and garden plants are limited by the slope and by the small and large stones. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Deep cuts made in land grading should be covered with a layer of topsoil. Pebbles and cobbles should be removed from the surface for best results in landscaping, particularly for lawns. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the slope, the large and small stones, and, on the Leyden soil, the depth to rock and the shrink-swell potential. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Topsoil can be stockpiled and used to reclaim areas disturbed by cutting and filling. Revegetating disturbed areas around construction sites as soon as possible helps to control soil blowing. The steepness of the slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from an absorption field can surface downslope and create a health hazard. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIe, in the Cobbly Foothill range site, and in plant adaptability group F-5.

175—Yoder Variant gravelly sandy loam, 9 to 30 percent slopes. This is a deep, somewhat excessively drained soil on alluvial fans, hill slopes, and ridges. It formed in noncalcareous, gravelly, sandy, reddish alluvium. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,200 to 6,500 feet.

Typically, the surface layer is neutral, dark brown gravelly sandy loam about 3 inches thick. The subsoil in the upper 5 inches is neutral, reddish brown gravelly sandy loam. In the lower 7 inches it is neutral, yellowish red gravelly sandy loam. The substratum to a depth of 60 inches is neutral, yellowish red very gravelly loamy sand.

Included in mapping are small areas of Critchell soils on fans, Lavate soils on fans, Rednun soils on terraces, and Midway soils on ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

Permeability of this Yoder Variant soil is moderately rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is medium to rapid, and water erosion is a moderate to severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 15 to 35 percent of the volume in the solum and 35 to 60 percent in the substratum.

In most places this soil is used for grazing and as pasture and habitat for wildlife. In a few places it is used for community development.

The native vegetation is mainly needleandthread, sideoats grama, little bluestem, and prairie sandreed.

The average annual production of air-dry vegetation ranges from 700 to 1,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. This soil is difficult to revegetate; therefore, proper grazing use is needed to prevent depletion. Seeding hastens the revegetation of areas depleted by heavy grazing or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the slope and small stones. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and during dry periods. The removal of pebbles and cobbles is required for best results in landscaping, particularly for lawns.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soil for homesite development are slope and seepage. Effluent from an absorption field can surface downslope and create a health hazard. Where the density of housing is moderate to high, a community sewage system is needed to prevent contamination of the water supply by seepage. Structures to divert runoff are needed where buildings and roads are constructed. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

This soil is in capability subclass VIe, in the Gravelly Foothill range site, and in plant adaptability group F-8.

176—Yoder Variant-Midway complex, 15 to 60 percent slopes. These soils are on hill slopes and ridges. The average annual precipitation is 13 to 17 inches, the average annual air temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation is 5,600 to 6,500 feet.

Yoder Variant soil makes up 45 percent of this complex, and Midway soil makes up 40 percent. Yoder Variant soil is on ridges, and Midway soil is on hill slopes. The areas of these soils are so intricately intermingled that it was not practical to map them separately.

Included in mapping are small areas of Nunn and Denver soils on fans, Heldt soils on hill slopes, Renohill, Kutch, and Leyden soils on hill slopes, and Primen soils on ridges. Also included are small areas of Urban land. The included soils and Urban land make up about 15 percent of the total acreage.

The Yoder Variant soil is deep and somewhat excessively drained. It formed in noncalcareous, gravelly, sandy, reddish alluvium.

Typically, the surface layer is neutral, dark brown gravelly sandy loam about 3 inches thick. The subsoil in the upper 5 inches is neutral, reddish brown gravelly sandy loam. In the lower 7 inches it is neutral, yellowish red gravelly sandy loam. The substratum to a depth of 60 inches is neutral, yellowish red very gravelly loamy sand.

Permeability of the Yoder Variant soil is moderately rapid. The available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a slight hazard. The shrink-swell potential is low. Rock fragments make up 15 to 35 percent of the volume in the solum and 35 to 60 percent in the substratum.

The Midway soil is shallow and well drained. It formed in calcareous, clayey material derived from shale and mudstone.

Typically, the surface layer is neutral, olive brown clay loam about 3 inches thick. The layer below that is mildly alkaline, light olive brown clay loam about 7 inches thick. The underlying material to a depth of 14 inches is moderately alkaline, light yellowish brown clay. Soft shale is at a depth of 14 inches.

Permeability of the Midway soil is slow. The available water capacity is low. The effective rooting depth is 6 to 20 inches. Runoff is rapid, and water erosion is a severe hazard. Soil blowing is a moderate hazard. The depth to soft bedrock ranges from 6 to 20 inches. The shrink-swell potential is moderate to high. Rock fragments make up 0 to 15 percent of the volume.

In most places the soils are used for grazing and as pasture and habitat for wildlife. In a few places they are used for community development.

The native vegetation is mainly western wheatgrass, green needlegrass, sideoats grama, and needleandthread. The average annual production of air-dry vegetation ranges from 700 to 1,000 pounds per acre. Proper grazing use and a planned grazing system are needed to maintain the quality and quantity of the desirable plants and to prevent erosion. Periodic deferment of grazing during the growing season helps maintain or improve the range condition. Proper grazing use is needed to prevent depletion because these soils are difficult to revegetate. Seeding hastens the revegetation of areas depleted by heavy grazing or other disturbances. Small pastures commonly are severely overgrazed and eroded. Livestock in small pastures

should be kept in pens. The rest of the pasture can be used as exercise areas and for very limited grazing.

Grasses, shrubs, trees, and garden plants are difficult to establish and maintain because of the shallowness to rock of the Midway soil and the slope. A mulch of plant residue helps reduce runoff, improve tilth, and conserve moisture. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Selecting adapted plants is essential in establishing plantings. Planting on the contour helps conserve moisture and reduce erosion. Supplemental irrigation is needed at planting time and during dry periods.

The small areas of Urban land are covered by streets, parking lots, sidewalks, buildings, and other impervious manmade structures. Because runoff is rapid, storm drains, natural drainageways, and land grading must accommodate increased flows to prevent flooding downslope in areas that normally would not be subject to flooding.

The main limitations to use of the soils for homesite development are the slope and, on the Midway soil, the shallowness to rock and the shrink-swell potential. The deep cuts needed to provide a sufficiently level building site can expose bedrock. Structures to divert runoff from buildings and roads are needed. The effects of shrinking and swelling can be minimized by proper engineering design and by backfilling with material that has a low shrink-swell potential and installing surface and subsurface drains near foundations. Properly installed tile drains below the foundation and minimal surface watering near the foundation help prevent seepage into basements and minimize the effects of shrinking and swelling. Cuts and fills should be seeded or mulched. Effluent from an absorption field can surface downslope and create a health hazard. Erosion and sedimentation can be controlled by maintaining an adequate plant cover.

These soils are in capability subclass VIe. The Yoder Variant soil is in the Gravelly Foothill range site and in plant adaptability group F-8. The Midway soil is in the Shaly Foothill range site and in plant adaptability group F-2.

Prime Farmland

In this section, prime farmland is defined and discussed, and the prime farmland soils in the survey area are listed.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources, and farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They either are used for producing food or fiber or are available for these uses. Urban or built-up land and water areas cannot be considered prime farmland.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not subject to frequent flooding during the growing season. The slope ranges mainly from 0 to 6 percent.

Soils that have a high water table, are subject to flooding, or are saline may qualify as prime farmland soils if the limitations or hazards are overcome by drainage, flood control, or leaching. Onsite evaluation is necessary to determine the effectiveness of corrective measures. More information on the criteria for prime farmland soils can be obtained at the local office of the Soil Conservation Service.

All of the prime farmland in the Golden Area is east of the mountain front. About 40,000 acres, or 9 percent of the survey area, qualifies as prime farmland if irrigated. Much of this land is being held for urban and homesite development or is within the boundary of incorporated towns. Since the end of World War II most of the prime farmland has been and is being converted to urban and built-up land such as streets, parking lots, homesites, and commercial and industrial sites.

The loss of prime farmland to other uses has put pressure on marginal lands, which generally are more erodible and difficult to cultivate and less productive than prime farmland.

The following map units, or soils, if irrigated make up prime farmland in the Golden Area. On some soils included in the list, appropriate measures have been applied to overcome a hazard or limitation, such as flooding, wetness, or salinity. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

1 Alda loam, 0 to 2 percent slopes
2 Alda-Niwot complex, 0 to 2 percent slopes
15 Bresser sandy loam, 0 to 5 percent slopes
17 Critchell gravelly sandy loam, 0 to 3 percent slopes
18 Critchell gravelly sandy loam, 3 to 9 percent slopes (only where the slope is less than 6 percent)
20 Critchell stony sandy loam, 0 to 5 percent slopes
24 Dacono Variant gravelly clay loam, 0 to 3 percent slopes
25 Denver clay loam, 0 to 2 percent slopes
26 Denver clay loam, 2 to 5 percent slopes
41 Englewood clay loam, 0 to 2 percent slopes
42 Englewood clay loam, 2 to 5 percent slopes
43 Englewood clay loam, wet, 0 to 3 percent slopes
51 Fondis loam, 0 to 3 percent slopes
60 Haverson loam, 0 to 3 percent slopes
61 Haverson loam, 3 to 9 percent slopes (only where the slope is less than 6 percent)
70 Lavate sandy loam, 3 to 9 percent slopes (only where the slope is less than 6 percent)

88 Loveland clay loam, 0 to 1 percent slopes (where artificially drained)
89 Loveland Variant gravelly sandy loam, 0 to 2 percent slopes (where artificially drained)
90 Manzano fine sandy loam, 0 to 2 percent slopes
91 Manzanola clay loam, 0 to 5 percent slopes
97 McClave clay loam, 0 to 3 percent slopes (where artificially drained)
102 Nunn clay loam, 0 to 2 percent slopes
103 Nunn clay loam, 2 to 5 percent slopes
109 Paymaster sandy loam, 0 to 3 percent slopes
112 Platner loam, 3 to 5 percent slopes
128 Rednun clay loam, 0 to 3 percent slopes
129 Rednun clay loam, 3 to 9 percent slopes (only where the slope is less than 6 percent)
149 Standley-Nunn gravelly clay loams, 0 to 5 percent slopes
158 Truckton sandy loam, 0 to 3 percent slopes
159 Truckton sandy loam, 3 to 9 percent slopes (only where the slope is less than 6 percent)
168 Valmont clay loam, 0 to 3 percent slopes
172 Wann fine sandy loam, 0 to 2 percent slopes (where artificially drained)

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

Roy Bell, district conservationist, Soil Conservation Service, assisted in preparing this section.

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 and the system of land capability classification used by the Soil Conservation Service is explained.

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.

About 5 percent (21,000 acres) of the survey area is used for crops and as pasture. About 3,000 acres is used for irrigated crops, 12,000 acres is used for nonirrigated crops, mainly wheat, and 6,000 acres is used as pasture. The acreage used for crops and as pasture is decreasing because of the dramatically increasing population of the area and the consequent conversion of agricultural land to community development. The cropland commonly is less sloping, and the soils are deep and relatively free of rock fragments; therefore, conversion to homesites is much easier than on adjacent steeper, shallower, and stonier soils.

The kinds of irrigated crops grown in the area vary according to the location. East of the front range, the irrigated crops and products commonly grown are alfalfa, small grains, vegetables and fruits in small truck gardens, and ornamental plants in nurseries. The primary management concerns on irrigated cropland are maintaining soil fertility and tilth, using water efficiently, and controlling erosion. Applications of manure and of nitrogen and phosphate fertilizers are important in maintaining fertility. A soil test can determine fertility levels and the amount of fertilizer needed. Crop residue on the surface improves the content of organic matter, tilth, and the water intake rate. In most areas, land leveling is needed for the uniform distribution of irrigation water and to reduce runoff and erosion. Tillage should be kept to a minimum to prevent compaction and the formation of a tillage pan. Clayey soils, such as the Denver, Nunn, and Englewood soils, are particularly susceptible to compaction, especially if they are tilled when wet. Chiseling or subsoiling breaks up a tillage pan and improves water infiltration. Sprinkler irrigation systems are suitable for most soils.

Drainage is needed on some soils that are used for irrigated crops. Soils on low terraces and flood plains, such as the Alda, Wann, and McClave soils, have a naturally fluctuating water table. Some areas of these soils cannot be drained because no outlet is available. Therefore, water-tolerant crops must be selected, and

the water table must be maintained at a nearly constant level by controlled irrigation.

The irrigated crops grown in the mountains generally are limited to native and introduced grass hay. Most areas used for irrigated hay are along drainageways and in open parks. If introduced grasses are planted, cool season grasses need to be selected. Management concerns include controlling erosion, timely and efficient use of irrigation water, and the addition of manure and commercial fertilizers that contain nitrogen and phosphorus. The Kittredge, Earcree, Breece, and Trag soils commonly are severely gullied. These soils can be stabilized and further erosion can be prevented if the soils are used for irrigated hay. The Venable and Rosane soils have a naturally fluctuating water table. Wetness limits the choice of plants and the period when hay can be cut. Irrigation water can be applied by means of contour furrows or by sprinklers.

The major nonirrigated crop grown east of the front range is small grains, mainly wheat. The main management concerns on nonirrigated cropland are controlling wind and water erosion, conserving soil moisture, and maintaining fertility. Because precipitation is limited, a crop-fallow system is used in which crops are grown only in alternate years. Chemical fallow—the use of herbicides to control unwanted vegetation on fallow land—is useful to conserve soil moisture for the growth of crops the following year. With chemical fallow, the stubble can be left on the land throughout the fallow year to help control erosion. Tillage for the control of unwanted vegetation is reduced, thus saving energy. Stubble mulch tillage and incorporating crop residue in adequate amounts help protect fallowed soils from soil blowing and water erosion and allow the soils to readily absorb and retain moisture. Soil blowing on nearly level soils can be controlled by stripcropping at right angles to the prevailing wind. On sloping soils, contour stripcropping, terracing, and contour tillage help control water and wind erosion. Severely eroded areas that are presently in nonirrigated crops should be seeded to grass to prevent further erosion.

In the mountains, nonirrigated crops are limited primarily to grass hay and, in a few areas, to small grains. Most of the areas that are used for nonirrigated crops are along drainageways and in open parks. The primary management concerns are controlling water erosion and maintaining fertility. Many areas that were used for crops other than hay are severely gullied. Care must be taken to protect the soil if the native vegetation is removed. Stubble mulch tillage and contour tillage help reduce erosion. Early maturing varieties of small grains are needed because of the short growing season. Applications of manure and commercial fertilizers that contain nitrogen and phosphorus are needed to maintain fertility. Severely eroded areas can be seeded to grass to check gullying and further erosion.

Pasture in the survey area is used primarily for grazing horses. Many pastures are too small to support the grazing demands and are severely overgrazed. Overgrazing results in excessive erosion and runoff of animal wastes and sediment. Livestock in pastures that are too small to supply their total grazing needs should be maintained in pens or corrals. The rest of the pasture can be used for exercising the animals and for limited grazing. Supplemental feeding is needed. In grazed pasture, care should be taken to maintain enough of the leaf area and roots to support regrowth and maximum production. The minimum grazing height for most grasses is 4 inches. Irrigation and fertilization increase forage production on most pasture.

Specific recommendations on management practices for crops and pasture can be obtained from the local office of the Soil Conservation Service.

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 (*9*). Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

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

Class I soils have few limitations that restrict their use.

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

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

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

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

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

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

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

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

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

Rangeland

Harvey Sprock, area range conservationist, Soil Conservation Service, assisted in preparing this section.

About 29 percent of the Golden Area is rangeland. This rangeland, besides being used for grazing, is also used for community development, as woodland, and as recreation areas. Grazing by horses is the main use. The rangeland is also grazed to a limited extent by cattle and is also used by wildlife.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

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 of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. 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. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

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 optimum production of vegetation, reduction of undesirable brush species, 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 (*3*).

To reestablish and maintain the desired vegetation in a natural plant community, 50 percent of the seasonal growth should remain at the end of the grazing period. Because horses can graze plants close to the ground and can damage them extensively by trampling, extreme care is needed when horses are allowed to graze an area.

Deferment of grazing favors the improvement or maintenance of the condition of a natural plant community (fig. 6). Deferment is the postponement of grazing during the growing season of key forage plants. If deferment is worked into a planned grazing system on a recurring basis, the key forage plants in each grazing area are allowed periodically to produce seed and to develop a healthy root system. Total deferment during the growing season should be allowed every 2 or 3 years.

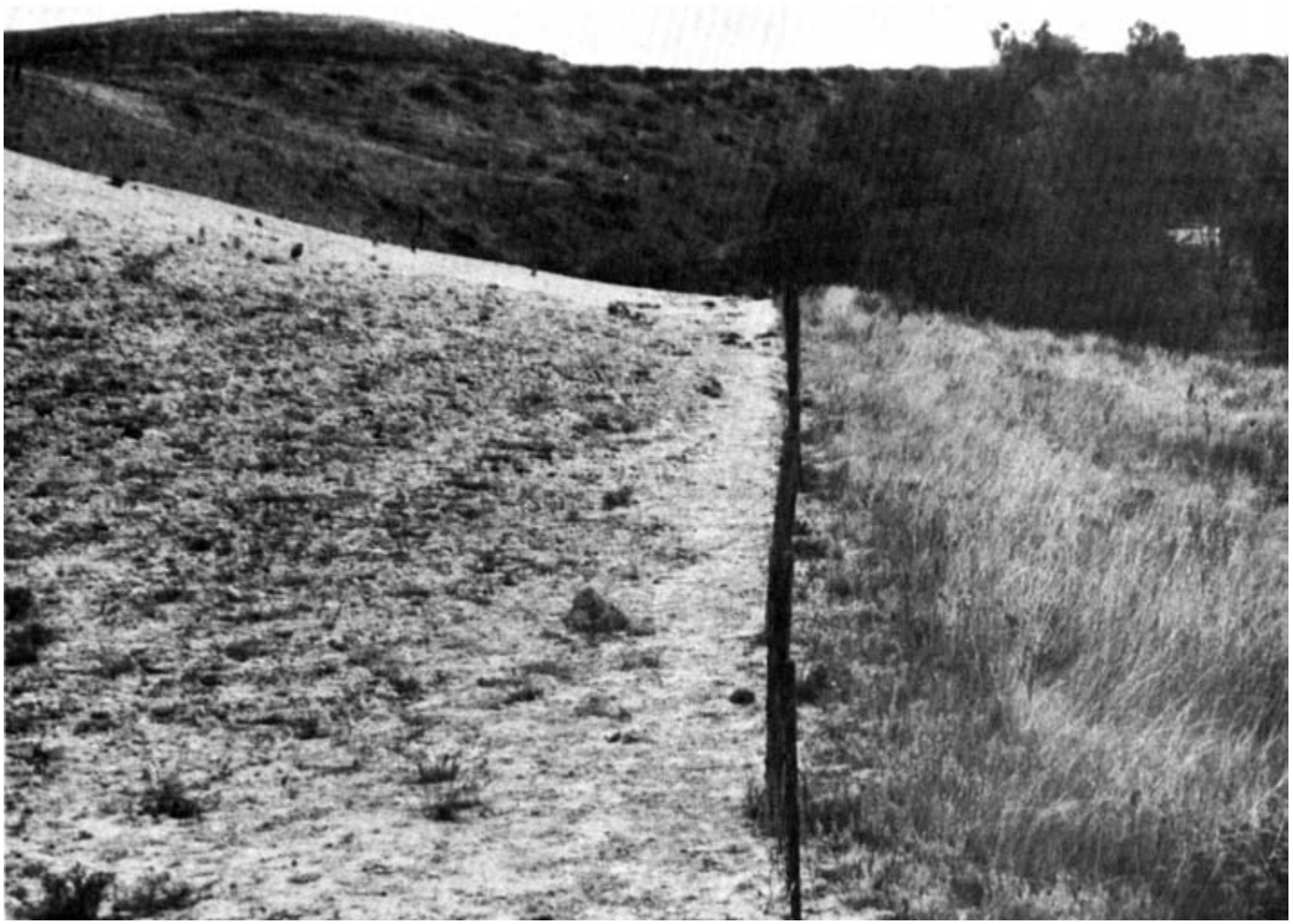


Figure 6.—The area on the left is overgrazed. Grazing has been deferred in the area on the right. The soil is Manzanola clay loam, 0 to 5 percent slopes.

Fencing and the proper location of watering places and salt are important management tools in obtaining more uniform grazing distribution. Seeding may be necessary to reestablish vegetation in depleted areas. The plants selected should protect the soil from wind and water erosion and meet the seasonal requirements of the grazing animals. The prepared seedbed should be clean and firm, and, where the soils are suitable, a good grassland drill should be used. Applying mulch after seeding is advisable. Supplemental watering greatly enhances the chance of a successful seeding. Early spring seedings have proved most successful. Total deferment of grazing in the seeded area is required for a minimum of 1 to 2 years. It may need to be extended to 3 to 5 years to establish the stand. Weeds should be controlled to prevent competition with the seeded species. Specific recommendations on plant species, mulch, weed control, and irrigation can be obtained at the local office of the Soil Conservation Service.

There are three major land resource areas in the Golden Area. The mountain area is in the western part of the survey area along the front range. It is at a higher elevation, has cooler temperatures and a shorter growing season, and receives more precipitation than the other two areas. This combination favors cool-season mid grasses. The foothill area is at the base of the front range or mountain area. It forms a transition zone between the mountain area and the plains area. It generally has a longer growing season, less precipitation, and warmer temperatures than the mountain area. These conditions favor warm-season tall and mid grasses as well as cool-season mid grasses. The plains area is in

the northeastern part of the survey area. Generally there is less precipitation than in the foothill area; the growing season lengthens, and temperatures increase. These conditions favor warm-season short grasses. Almost all of the plains area is now used for community development.

Each detailed map unit is assigned to a specific range site or combination of range sites, which are listed at the end of the detailed map unit description.

Woodland Management and Productivity

Eugene S. Anderson, woodland conservationist, Soil Conservation Service, assisted in preparing this section.

About 35 percent (156,000 acres) of the survey area is forested land. In years past, from the days of the early settlers to recent times, these areas have been harvested for wood products, such as building materials, railroad ties, firewood, and mine props.

In the Golden Area, woodland use and management have undergone a change of purpose in recent years. Much of the forested area is either subdivided or waiting to be subdivided, or it is held in the public trust as open space. The concern in management now is with conserving and maintaining scenic and watershed values rather than with exploiting the forested land for its wood products.

Native forest cover types in the survey area vary from juniper at low elevations to lodgepole pine at high elevations. The cover types are in a puzzlelike mosaic that is determined as much by aspect as by elevation. For example, some ridges have a sparse juniper cover on the south-facing slope and a Douglas-fir—lodgepole pine cover on the north-facing slope.

The following forest cover types are found in the survey area:

Pinyon-Juniper—This plant community is a variant of the recognized plant community because there is no pinyon in this survey area. Therefore, the plant community consists of scattered juniper, shrubs, and sparse grasses. Baller-Rock outcrop complex, 15 to 50 percent slopes, is a detailed map unit that characteristically has this plant community.

Interior Ponderosa Pine—Ponderosa pine grows in pure stands or is predominant. This cover type is found in the survey area on southern aspects at mid elevations. It may have a canopy of mature ponderosa pine and both ponderosa pine and Douglas-fir reproduction in the understory. Ratake-Lininger stony sandy loams, 30 to 60 percent slopes, and Resort-Sphinx very gravelly sandy loams, 15 to 30 percent slopes, have this plant community.

Blue Spruce—This type is not prominent in the survey area, but in some places it forms a thin belt along streams and in meadows. This plant community commonly is an inclusion in other plant communities.

Interior Douglas-fir—Douglas-fir grows in pure stands in some places, but most commonly it grows in mixed stands with ponderosa pine, aspen, and lodgepole pine. This type grows on both north- and south-facing slopes at middle elevations. On south-facing slopes, this type takes over from the Interior ponderosa pine type in areas where more water is available and summer temperatures are cooler. Grimstone-Hiwan-Rock outcrop complex, 30 to 60 percent slopes, and Raleigh very gravelly sandy loam, 30 to 50 percent slopes, have this plant community.

Lodgepole Pine—This type is found at mid and high elevations; generally, it is pure. The stands of lodgepole pine commonly cover wide areas, having apparently originated after widespread fires at about the turn of the century. Late successional stages of this type exist in the survey area and are sometimes classified as the Interior Douglas-fir type. This plant community is common on Legault-Hiwan stony loamy sands, 15 to 30 percent slopes.

Aspen—Aspen is of limited extent in the survey area, but it is found around meadows and depressions at mid and upper elevations and on subirrigated slopes. This plant community commonly is an inclusion in other plant communities.

The wooded areas generally are characterized by low productivity and fragile plant communities. Grazing of domestic animals is not recommended in most areas, and only light grazing can be tolerated in others.

Most of the forest types permit periodic harvest of wood products. Although most productivity rates and ownership goals will not support management for commercial timber production, proper tree spacing and removal of dead or dying material can provide a healthy stand and some product for the landowner. Information on tree spacing can be obtained from the local office of the Soil Conservation Service.

Table 5 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol (woodland suitability) for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; 5, moderately low; 6, low; and 7, very low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are

insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 5, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

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

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

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

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

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

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.

Table 6 shows, for each soil suitable for woodland use, the potential for producing understory vegetation. The total production of understory vegetation includes the herbaceous plants and the leaves, twigs, and fruit of woody plants up to a height of 4 1/2 feet. It is expressed in pounds per acre of air-dry vegetation in favorable, normal, and unfavorable years. In a favorable year, soil moisture is above average during the optimum part of the growing season; in a normal year, soil moisture is average; and in an unfavorable year, it is below average.

Table 6 also lists the common names of the characteristic vegetation on each soil and the percentage composition, by air-dry weight, of each kind of plant. The table shows the kind and percentage of understory plants expected under a canopy density that is most nearly typical of woodland in which the production of wood crops is highest.

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 tall-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.

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.

Recreation

Eldie W. Mustard, Jr., biologist, Soil Conservation Service, assisted in preparing this section.

The survey area is characterized by a variety of diverse landforms including plains or grasslands, foothills, and mountains. This amalgamation of landforms, as well as a growing tourist and resident population, fosters a tremendous variety of outdoor activities. Outdoor recreation activities range from fox hunting to hounds on one large ranch to hang gliding from a precipitous mountain slope.

Wildlife and opportunities to observe wildlife abound in the multitude of varied habitats supported by the streams and reservoirs that dot the landscape, as well as the many wildlife niches allowed by a range in elevation from 5,200 to 10,000 feet.

The soils of the survey area are rated in table 7 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 7, 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 7 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

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

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

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

Paths and trails for hiking and horseback riding 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.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

Eldie W. Mustard, Jr., biologist, Soil Conservation Service, assisted in preparing this section.

The diversity of wildlife is high in the Golden Area because of the natural diversity of habitat types fostered by the range in elevation that encompasses plains, foothills, and mountains. Also, reservoirs, artificial ponds, changes in vegetation, and other works of man have created new habitats by altering, sometimes markedly, the natural habitat.

The most drastic changes in the natural habitat have taken place in that part of the survey area that comprises the Nunn-Denver and Denver-Kutch general map units. Urban land—specifically, houses, streets, schools, and shopping centers—has largely replaced the natural environment, except in a few enclaves along creeks and streams. Many of the native wildlife species that inhabit plains or grassland have disappeared; for example, the prairie sharp-tailed grouse, bison, and antelope. They have been replaced by man-tolerant species that are attracted to urbanized areas by backyard plantings, bird feeders, reservoirs, and parks.

Figure 7.—The undeveloped flood plains in the Alda-Torrifluvents, very gravelly, general map unit provide vitally important habitat for the remaining wildlife in the plains and foothill areas.

The importance to the remaining wildlife of the undeveloped flood plains and bottom lands in the Alda-Torrifluvents, very gravelly, general map unit cannot be overstated. These areas provide water, food, and shelter for wildlife and in many places link the scattered holdings that constitute the last vestige of original plains habitat in the survey area. Maintenance of these areas may depend on public acquisition, private interest in wildlife needs, and regulations that preclude development of riparian habitat within the 100-year flood plain. The highest use of these flood plains may be to preserve them for wildlife use (fig. 7).

The Critchell-Lavate-Rednun, Flatirons-Veldkamp, Leyden-Lavina, Nunn-Rooney-Leyden, Argiustolls-Rock outcrop-Baller, Platner-Renohill, and Blakeland-Truckton general map units contain a rich diversity of flora and fauna. Nature study and observation is a primary function of the many parks and outdoor recreation areas.

The mountain wildlife grouping includes the Ratake-Lininger, Herbman-Hiwan, Resort-Raleigh, and Raleigh-Earcree Variant general map units. Development and urbanization are taking place on these soils, but not to the same extent as in the area east of the front range. Deer, elk, and black bear are still found here, as are some of the small animals that live at high elevations, for example, Abert's squirrel, blue grouse, and ptarmigan.

Water resources in the survey area include large reservoirs, such as Chatfield Reservoir, Marston Reservoir, Standley Lake, Bear Creek Lake, and Ralston Reservoir, and many smaller impoundments that are used primarily for irrigation and recreation. The South Platte River, Clear Creek, Turkey Creek, and Bear Creek contribute greatly to both faunal and floral diversity, as do the many irrigation canals in the survey area.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate

vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 8, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, 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, beggarweed, wheatgrass, and grama.

Coniferous plants furnish browse and seeds. 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, spruce, fir, cedar, 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, wild millet, wildrice, 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, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, 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, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, 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.

Lawns, Landscaping, and Gardening

Harvey Sprock, area range conservationist, Soil Conservation Service, assisted in preparing this section.

Table 9 lists examples of grasses and grasslike plants, forbs, shrubs, and trees suited to the indicated soils. Only the common major plants that are native on the

indicated soils and some introduced plant species are listed. Many other species may be equally well adapted to the soils. Additional information can be obtained from local nurserymen, horticulturists, landscape architects, extension agents, libraries, and the local office of the Soil Conservation Service.

Even though a plant species is well adapted to a particular soil, care should be taken in planting and during the early stages of growth to ensure that the maximum number of plants survive. The survival rate generally improves if the soil is properly prepared before planting. The specific type of soil preparation used varies from site to site. However, tillage that incorporates composted organic matter, manure, or peat moss into the soil improves the survival and growth rate of most plantings. Soil tests can determine the need for fertilizers and soil amendments. Timely irrigation benefits plantings on most soils. Controlling weeds by hoeing, pulling, or using herbicides may be necessary to reduce plant competition for water and nutrients. Insecticides may be needed to control harmful insects. A mulch helps to conserve soil moisture. For most plantings, mulching reduces watering and cultivation requirements and helps to reduce water and wind erosion. Grass clippings, sawdust, weed-free straw, leaves, and compost make excellent mulches. Mulches should be 3 to 6 inches thick, but care should be taken not to cover plantings. Straw mulch should be crimped into the ground or fastened to the ground by netting. On steeper slopes, mulch should be held in place by a fastened-down netting.

The building of houses and roads often seriously affects the ability of the adjacent soils to support plants. Soil compaction often results from the use of heavy equipment or from heavy foot traffic. Ideally, soil that is not compacted should consist of 45 percent mineral grains, 5 percent organic matter, and 50 percent pores filled with either air or moisture. When a soil is compacted, mineral solids are forced into the pore space; thus, pore space is reduced. As a result, less air and water are available to plants and the permeability rate of the soil is reduced. Compaction is most prevalent in clayey soils such as Denver, Nunn, Ulm, and Englewood soils where they form complexes with Urban land. A compacted soil can be improved by tilling and incorporating organic matter into the upper 12 inches of the soil. Covering the soil with a mulch helps prevent further compaction.

Cut and fill operations and large excavations commonly expose infertile horizons of soils and impervious bedrock, or the fertile topsoil is buried under less fertile fill material. Whenever possible, topsoil should be removed and stockpiled before excavation and placed on the surface after the final reshaping of the landscape. If removal of the topsoil is not practical, for example, on Herbman, Rogert, Midway, and Ratake soils, which are shallow or steep or have a high percentage of rock fragments, backfilling with suitable fill material can be the best alternative. If backfilling is not practical because the area is too large or suitable fill material is not available, measures can be taken to make the less fertile exposed soil suitable for plantings. If calcareous material is exposed or used as fill on the surface, as in disturbed areas of Nunn, Denver, Ulm, Standley, or Heldt soils, additions of mulch or compost, fertilizer, and soil amendments such as gypsum, elemental sulfur, or sulfuric acid are beneficial to plantings. If acidic material is exposed on the surface or used as fill, for example, on Peeler, Grimstone, and Legault soils, the addition of lime and fertilizer in the proper amounts and of compost or mulch aids the growth of most plants.

In grading and reshaping sites for houses and roads, the existing plant cover commonly is removed or destroyed. Severe water and wind erosion can result that can rapidly denude the existing topsoil. A fast-growing ground cover should be planted to protect the topsoil. Annual grasses, for example, wheat, barley, rye, sorghum, and oats, can be planted with a drill in spring or summer. Keeping the seedbed watered promotes maximum survival. This procedure provides good ground cover and erosion control for one growing season. It does not interfere with the planting of gardens or lawns the following season if the grasses are mowed or cut to prevent them from setting seed.

Vegetables and flowers are not listed in table 9. Because flower and vegetable gardens generally are fairly small, it is relatively simple to modify the soil by adding amendments, fertilizer, and organic matter, leveling, removing rock fragments, or even backfilling with more suitable material in order to compensate for most soil limitations or deficiencies. Where sufficient irrigation water is available and the soil is capable of supporting garden plants or has been modified so that it can support garden plants, the length of the growing season is the major factor to be considered in selecting specific plants. The Golden Area has been divided into three ranges of growing seasons: 126 to 142 frost-free days (below 6,500 feet elevation), 76 to 125 days (6,500 to 7,800 feet elevation), and 55 to 75 days (above 7,800 feet elevation). Refer to the specific map unit description to determine the frost-free season. Most seed packages state the length of time needed for the plant to reach maturity. Local nurserymen generally can recommend varieties or species that grow well in the area. Plants that tolerate or require shade should be selected if the planting site is on the north side of a building, on a steep north aspect, or under trees.

Engineering

This section provides information for planning land uses related to urban development and to water management (*4*). 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 must be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, 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 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated

slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock 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 plant growth. Material from the surface layer, therefore, should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to

40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for 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 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 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

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 ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points)

across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

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 (*5*).

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 (*8*). 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 high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

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.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are 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 less than 5 percent finely divided calcium carbonate 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 and less than 5 percent finely divided calcium carbonate, 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 and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

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 or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs, on the average, no more than once in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

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 excavation.

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 (*10*). 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. Table 17 shows the classification of the soils in the survey area. 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 Mollisol.

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 Boroll (*Bor*, meaning cold, plus *oll*, from Mollisol).

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 Argiborolls (*Argi*, meaning illuvial clay accumulation, plus *bor*, the suborder of the Mollisols that have a frigid 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 Argiborolls.

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 Argiborolls.

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 (*7*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*10*). 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."

Alda Series

The Alda series consists of deep, somewhat poorly drained soils on alluvial valley floors, low terraces, and flood plains of major streams. The soils formed in calcareous, stratified alluvium underlain by a mixture of sand and gravel derived from mixed sources. The slope is 0 to 2 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are coarse-loamy, mixed, mesic Fluvaquentic Haplustolls.

Typical pedon of Alda loam, 0 to 2 percent slopes, 200 feet north and 850 feet east of the southwest corner of the northwest quarter of sec. 26, T. 6 S., R. 69 W.

A11—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, friable, slightly sticky; calcareous; mildly alkaline; clear smooth boundary.

A12—5 to 11 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky; calcareous; mildly alkaline; clear smooth boundary.

AC—11 to 17 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to weak medium granular; slightly hard, very friable, sticky; calcareous; moderately alkaline; clear smooth boundary.

C1cag—17 to 25 inches; light gray (10YR 7/2) loam, grayish brown (10YR 5/2) moist; massive; hard, friable, sticky; few fine prominent olive yellow (2.5Y 6/6, moist) mottles; calcareous; moderately alkaline; clear smooth boundary.

C2cag—25 to 29 inches; light gray (2.5Y 7/2) sandy loam, grayish brown (2.5Y 5/2) moist; massive; hard, very friable, slightly sticky; common fine prominent olive yellow (2.5Y 6/6) mottles; calcareous; moderately alkaline; clear smooth boundary.

C3cag—29 to 38 inches; light yellowish brown (2.5Y 6/4) loamy sand, light olive brown (2.5Y 5/4) moist; massive; hard, very friable, nonsticky; many medium prominent olive yellow (2.5Y 6/6) mottles; calcareous; mildly alkaline; gradual smooth boundary.

IIC4g—38 to 60 inches; light gray (2.5Y 7/2) very gravelly loamy sand, light brownish gray (2.5Y 6/2) moist; single grained; loose; neutral.

The depth to the underlying sand and gravel ranges from 20 to 40 inches. The water table fluctuates from a depth of 24 inches to 36 inches in spring and summer.

The A horizon has hue of 10YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is neutral or mildly alkaline.

The C horizon is stratified. It is neutral to moderately alkaline.

Cooler temperatures and less precipitation in the survey area place the Alda soils out of the range established for the series. Thus, Alda soils in this area are a taxadjunct to the series.

Allens Park Variant

The Allens Park Variant consists of moderately deep, well drained soils on north-facing mountain side slopes. Allens Park Variant soils formed in stony, gravelly, and loamy material derived from weathered metamorphic and igneous rocks. The slope is 30 to 50 percent. The average annual precipitation ranges from 17 to 20 inches. The average annual temperature ranges from 43° to 47° F. The average frost-free season ranges from 76 to 125 days. Elevation ranges from 6,500 to 7,800 feet.

These soils are fine-loamy, mixed Typic Eutroboralfs.

Typical pedon of Allens Park Variant stony sandy loam, in an area of Allens Park Variant-Ratake-Rock outcrop complex, 30 to 50 percent slopes, 1,450 feet south and 900 feet west of the northeast corner of sec. 26, T. 3 S., R. 71 W.

O1—1 inch to 0; partly decomposed needles, twigs, and leaves; abrupt smooth boundary.

A1—0 to 2 inches; dark grayish brown (10YR 4/2) stony sandy loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, very friable, nonsticky; 1 percent stones, 20 percent gravel; neutral; clear smooth boundary.

A2—2 to 7 inches; pale brown (10YR 6/3) gravelly loamy sand, brown to dark brown (10YR 4/3) moist; weak fine subangular blocky structure parting to single grained; soft, very friable, nonsticky; 20 percent gravel; slightly acid; clear smooth boundary.

B21t—7 to 13 inches; brown (7.5YR 5/4) sandy clay loam, brown to dark brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky; few thin clay films on faces of peds; 15 percent gravel; slightly acid; gradual smooth boundary.

B22t—13 to 32 inches; strong brown (7.5YR 5/6) sandy clay loam, strong brown (7.5YR 5/6) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; slightly hard, firm, sticky; common moderately thick clay films on faces of peds; 15 percent gravel; slightly acid; clear wavy boundary.

Cr—32 inches; soft, weathered gneiss.

The depth to bedrock and the thickness of the solum range from 20 to 40 inches.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 7 dry and 2 to 6 moist, and chroma of 2 or 3. The darker colors are in the upper part.

The B2t horizon has hue of 7.5YR or 10YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 4 to 6. It is sandy clay loam or gravelly sandy clay loam. The clay content is 20 to 35 percent. Rock fragments make up 5 to 35 percent of the volume.

The Cr horizon is soft metamorphic or igneous bedrock.

Arvada Series

The Arvada series consists of deep, well drained soils on low terraces and flood plains. The soils formed in calcareous, clayey alluvium derived dominantly from weathered shale and mudstone. The slope is 0 to 2 percent. The average annual precipitation is 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Ustollic Natrargids.

Typical pedon of Arvada clay loam, 0 to 2 percent slopes, 440 feet east and 1,100 feet south of the center of sec. 12, T. 2 S., R. 69 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, friable, very sticky; moderately alkaline; clear smooth boundary.

B2tcasa—6 to 12 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; strong medium columnar structure parting to strong medium angular blocky; extremely hard, firm, very sticky; saline; calcareous; few thin clay films on faces of peds; strongly alkaline; gradual smooth boundary.

B31casa—12 to 30 inches; light yellowish brown (10YR 6/2) clay, grayish brown (10YR 5/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, very sticky; saline; calcareous; strongly alkaline; gradual smooth boundary.

B32casa—30 to 43 inches; light yellowish brown (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky; saline; calcareous; strongly alkaline; gradual smooth boundary.

Ccasa—43 to 60 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; hard, friable, sticky; saline; calcareous; strongly alkaline.

The solum is 15 to 50 inches thick. The depth to calcareous material is 0 to 12 inches. The content of rock fragments ranges from 0 to 15 percent.

The A horizon has hue of 2.5Y or 10YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 to 4.

The B horizon has hue of 2.5Y to 7.5YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 to 4. The content of clay ranges from 35 to 60 percent. The horizon is strongly alkaline or very strongly alkaline. Exchangeable sodium ranges from 15 to 34 percent.

The C horizon has hue of 2.5Y to 7.5YR. It is clay loam or clay and has some stratified lenses of sandy loam. It is strongly alkaline or very strongly alkaline.

Ascalon Series

The Ascalon series consists of deep, well drained soils on fans and hill slopes. Ascalon soils formed in calcareous, loamy material derived from mixed sources. The slope is 5 to 15 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine-loamy, mixed, mesic Aridic Argiustolls.

Typical pedon of Ascalon sandy loam, 5 to 9 percent slopes, 400 feet south and 950 feet west of the northeast corner of sec. 31, T. 5 S., R. 69 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; neutral; clear smooth boundary.

A3—4 to 7 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; slightly hard, friable; neutral; clear smooth boundary.

B2t—7 to 18 inches; brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate coarse subangular blocky; hard, friable; thin patchy clay films on faces of peds; mildly alkaline; clear smooth boundary.

B3ca—18 to 23 inches; very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to weak coarse subangular blocky; hard, very friable; thin patchy clay films on faces of peds and in pores; calcareous; moderately alkaline; gradual smooth boundary.

C1ca—23 to 30 inches; very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) moist; massive; hard, very friable; calcium carbonate as soft masses, thin seams, and streaks; calcareous; mildly alkaline; gradual smooth boundary.

C2ca—30 to 60 inches; very pale brown (10YR 7/4) sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; calcium carbonate as soft masses, thin seams, and streaks; calcareous; moderately alkaline.

The depth to calcareous material ranges from 12 to 30 inches. The solum ranges from 15 to 40 inches in thickness.

The A horizon has value of 4 or 5 dry and 2 or 3 moist and chroma of 2 or 3. It is neutral or mildly alkaline.

The B horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 to 4 moist, and chroma of 2 or 3. It is sandy clay loam or sandy loam. The clay content is 18 to 35 percent. Reaction is mildly alkaline or moderately alkaline.

The C horizon has hue of 10YR or 7.5YR. It is sandy loam or gravelly sandy loam. Stratification is common in the lower part.

Baller Series

The Baller series consists of shallow, well drained soils on ridges and hill slopes, mainly on the east-facing dip slope of the Dakota Hogback. The soils formed in noncalcareous, stony, loamy material derived from sandstone of the Dakota Formation. The slope is 15 to 50 percent. The average annual precipitation is 15 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,600 to 6,500 feet.

These soils are loamy-skeletal, mixed, mesic Lithic Haplustolls.

Typical pedon of Baller very stony sandy loam, in an area of Baller-Rock outcrop complex, 15 to 50 percent slopes, 475 feet west and 325 feet east of the center of sec. 26, T. 4 S., R. 70 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) very stony sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, nonsticky; 10 percent stones, 20 percent cobbles, 10 percent gravel; neutral; clear smooth boundary.

AC—4 to 14 inches; dark grayish brown (10YR 4/2) very stony sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure breaking to moderate medium granular; hard, very friable, nonsticky; 10 percent stones, 20 percent cobbles, 15 percent gravel; neutral; clear smooth boundary.

R—14 inches; very pale brown hard sandstone (Dakota Formation).

Depth to bedrock is 10 to 20 inches. The content of rock fragments is 35 to 50 percent. The fragments are mainly cobbles and stones. The control section is 7 to 18 percent clay.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The AC horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 or 3.

Baller Variant

The Baller Variant consists of shallow, well drained soils on dikes, ridges, and hill slopes of volcanic rock. Baller Variant soils formed in noncalcareous, gravelly, loamy material derived from volcanic rock. The slope is 5 to 30 percent. The average annual precipitation is 15 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,600 to 6,500 feet.

These soils are loamy-skeletal, mixed, mesic Lithic Haplustolls.

Typical pedon of Baller Variant stony sandy loam, in an area of Baller Variant-Lavina-Rock outcrop complex, 15 to 30 percent slopes, 490 feet east and 620 feet south of the northwest corner of sec. 4, T. 3 S., R. 70 W.

A11—0 to 3 inches; dark yellowish brown (10YR 4/4) stony sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, nonsticky; approximately 3 percent stones, 5 percent cobbles, 20 percent gravel; neutral; clear smooth boundary.

A12—3 to 8 inches; brown to dark brown (10YR 4/3) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky; 5 percent cobbles, 40 percent gravel; neutral; clear wavy boundary.

Cr—8 to 17 inches; olive brown (2.5Y 4/4) weathered latite.

R—17 inches; olive brown (2.5Y 4/4) hard latite.

The depth to hard bedrock is 10 to 20 inches. The content of rock fragments is 35 to 60 percent. The fragments are dominantly 1/4 inch to 3 inches in diameter. Reaction is neutral or mildly alkaline throughout.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 dry and 2 or 3 moist, and chroma of 2 to 4. In many places there is an AC horizon. In some places, there is no Cr horizon.

Bernal Series

The Bernal series consists of shallow, well drained soils on hill slopes, ridges, and convex knobs in the area between the Dakota Hogback and the metamorphic rocks of the mountains. Bernal soils formed in noncalcareous, mixed material derived from reddish sandstone mainly of the Fountain Formation. The slope is 9 to 30 percent. The average annual precipitation is 15 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,600 to 6,500 feet.

These soils are loamy, mixed, mesic Lithic Argiustolls.

Typical pedon of Bernal sandy loam, in an area of Lavate-Bernal-Rock outcrop complex, 15 to 30 percent slopes, 2,135 feet west and 70 feet south of the center of sec. 24, T. 5 S., R. 70 W.

A1—0 to 2 inches; reddish gray (5YR 5/2) sandy loam, dark reddish brown (5YR 3/3) moist; weak medium granular structure; soft, very friable, nonsticky; 10 percent gravel; slightly acid; clear smooth boundary.
B1—2 to 6 inches; reddish brown (5YR 5/3) sandy loam, dark reddish brown (5YR 3/3) moist; weak coarse subangular blocky structure; slightly hard, friable, nonsticky; 10 percent gravel; few thin clay films on faces of peds; slightly acid; clear smooth boundary.
B2t—6 to 13 inches; light reddish brown (2.5YR 6/4) sandy loam, dark reddish brown (2.5YR 3/4) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable, nonsticky; 15 percent gravel; few thin clay films on faces of peds; medium acid; clear wavy boundary.
R—13 inches; reddish brown (2.5YR 4/4) to pink (5YR 7/4) stratified hard sandstone of the Fountain Formation; upper 4 inches is weathered.

The thickness of the solum and the depth to bedrock range from 8 to 20 inches.

The A horizon has hue of 2.5YR or 5YR, value of 3 to 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B2t horizon has hue of 2.5YR or 5YR, value of 5 or 6 dry and 3 to 5 moist, and chroma of 3 to 5. The clay content is 15 to 20 percent.

Blakeland Series

The Blakeland series consists of deep, somewhat excessively drained soils that formed in noncalcareous eolian sand derived from mixed sources. Blakeland soils formed on high terraces, fans, and hill slopes. The slope is 0 to 15 percent. The average annual precipitation is 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,400 to 6,500 feet.

These soils are sandy, mixed, mesic Torriorthentic Haplustolls.

Typical pedon of Blakeland loamy sand, 0 to 9 percent slopes, 95 feet north and 235 feet east of the southwest corner of sec. 8, T. 6 S., R. 68 W.

A11—0 to 4 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, loose, nonsticky; neutral; clear smooth boundary.
A12—4 to 7 inches; brown to dark brown (10YR 4/3) loamy sand, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine granular; soft, loose, nonsticky; neutral; clear smooth boundary.
AC—7 to 19 inches; brown to dark brown (10YR 4/3) loamy sand, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, very friable, nonsticky; neutral; gradual smooth boundary.
C1—19 to 42 inches; brown (10YR 5/3) loamy sand, brown to dark brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky; neutral; gradual smooth boundary.
C2—42 to 60 inches; light yellowish brown (10YR 6/4) loamy sand, yellowish brown (10YR 5/4) moist; massive; soft, very friable, nonsticky; slightly acid.

The mollic epipedon is 10 to 20 inches thick. The content of rock fragments ranges from 0 to 15 percent. Reaction is mildly alkaline to slightly acid.

The A horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The C horizon has hue of 2.5Y to 7.5YR. It is loamy sand or sand.

Breece Series

The Breece series consists of deep, well drained soils on fans and toe slopes and in drainageways of the mountain front. Breece soils formed in noncalcareous, loamy alluvial and colluvial material derived from igneous and metamorphic rocks. The slope is 9 to 25 percent. The average annual precipitation is 17 to 20 inches, and the average annual temperature is 43° to 47° F. The frost-free season ranges from 76 to 125 days. Elevation ranges from 6,500 to 7,800 feet.

These soils are coarse-loamy, mixed Pachic Haploborolls.

Typical pedon of Breece sandy loam, 9 to 25 percent slopes, 995 feet south and 2,250 feet west of the northeast corner of sec. 3, T. 6 S., R. 70 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky; 5 percent gravel; neutral; clear smooth boundary.
B1—6 to 10 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky; few thin clay films on faces of peds; 5 percent gravel; neutral; clear smooth boundary.
B2—10 to 39 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, very friable, nonsticky; few thin clay films on faces of peds; 10 percent gravel; neutral; clear smooth boundary.
B3—39 to 46 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, very friable, nonsticky; few thin clay films on faces of peds; 15 percent gravel; neutral; gradual smooth boundary.
C—46 to 60 inches; brown (10YR 5/3) gravelly loamy coarse sand, brown to dark brown (10YR 4/3)

moist; massive; slightly hard, very friable, nonsticky; 20 percent gravel; neutral.

The mollic epipedon is 16 to 50 inches thick. These soils most commonly are noncalcareous, but in some places they are calcareous below a depth of 40 inches. In most places, rock fragments make up 10 to 20 percent of the volume, and the fragments most commonly are 1/8 inch to 3 inches in diameter. Reaction is slightly acid or neutral.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5 dry and 2 or 3 moist, and chroma of 1 to 3.

The B horizon has hue of 10YR or 7.5YR, value of 3 or 4 dry and 2 or 3 moist, and chroma of 1 to 3. It is sandy loam or gravelly sandy loam. The clay content is 6 to 18 percent.

The C horizon has hue of 2.5Y to 7.5YR. It is stratified coarse sandy loam or gravelly loamy coarse sand.

Bresser Series

The Bresser series.consists of deep, well drained soils that formed in noncalcareous eolian and alluvial material. Bresser soils are on knobs, high terraces, and hill slopes. The slope is 0 to 25 percent. The average annual precipitation is 13 to 17 inches. The average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,400 to 6,500 feet.

These soils are fine-loamy, mixed, mesic Aridic Argiustolls.

Typical pedon of Bresser sandy loam, 0 to 5 percent slopes, 95 feet west and 180 feet south of the northeast corner of sec. 17, T. 6 S., R. 68 W.

A1—0 to 5 inches; brown (10YR 5/3) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium platy structure; slightly hard, very friable, nonsticky; slightly acid; clear smooth boundary.

B1—5 to 9 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky; very thin patchy clay films on faces of peds; neutral; clear smooth boundary.

B21t—9 to 17 inches; brown to dark brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky; thin discontinuous clay films on faces of peds; neutral; clear smooth boundary.

B22t—17 to 24 inches; yellowish brown (10YR 5/4) sandy clay loam, brown to dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; very hard, friable, sticky; thin discontinuous clay films on faces of peds; neutral; clear smooth boundary.

B3—24 to 34 inches; yellowish brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; very hard, very friable, sticky; few very thin clay films on faces of peds; neutral; gradual smooth boundary.

C—34 to 60 inches; light yellowish brown (10YR 6/4) loamy sand, dark yellowish brown (10YR 4/4) moist; massive; hard, very friable, nonsticky; neutral.

The solum is 18 to 40 inches thick. Bresser soils most commonly are noncalcareous throughout, but in some places calcareous material is at a depth of more than 40 inches.

The A1 horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is sandy loam or gravelly sandy loam. Reaction is slightly acid or neutral.

The B2t horizon has hue of 2.5Y to 7.5YR, value of 4 to 7 dry and 3 to 6 moist, and chroma of 2 to 6. It is 20 to 35 percent clay.

The C horizon has hue of 2.5Y to 7.5YR.

Cathedral Series

The Cathedral series consists of shallow, well drained soils on mountain side slopes and ridges. The soils formed in stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rocks. Slope is 25 to 100 percent. The average annual precipitation ranges from 17 to 20 inches, and the annual temperature ranges from 43° to 47° F. The average frost-free season ranges from 76 to 125 days. Elevation ranges from 6,500 to 7,800 feet.

These soils are loamy-skeletal, mixed Lithic Haploborolls.

Typical pedon of Cathedral very stony sandy loam, in an area of Ratake-Cathedral-Rock outcrop complex, 25 to 60 percent slopes, 2,275 feet north and 1,975 feet west of the southeast corner of sec. 16, T. 4 S., R. 70 W.

A1—0 to 3 inches; dark grayish brown (10YR 4/2) very stony sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky; neutral; clear smooth boundary.

B2—3 to 11 inches; dark grayish brown (10YR 4/2) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, friable, slightly sticky; neutral; clear smooth boundary.

R—11 to 60 inches; pink (7.5YR 7/4) pegmatite, light brown (7.5YR 6/4) moist.

Depth to a lithic contact is 10 to 20 inches. The content of rock fragments ranges from 35 to 80 percent. Reaction is slightly acid to neutral.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 or 3.

The R horizon is igneous or metamorphic rock.

Chapin Variant

The Chapin Variant consists of moderately deep, well drained soils on hill slopes and fans. Chapin Variant soils formed in noncalcareous, reddish material derived from reddish sedimentary rocks mainly of the Fountain Formation. The slope is 9 to 15 percent. The average annual precipitation is 15 to 17 inches, and the average annual temperature is 47° F. The frost-free season is 126 to 142 days. Elevation ranges from 5,600 to 6,500.

These soils are fine, montmorillonitic, mesic Aridic Argiustolls.

Typical pedon of Chapin Variant clay loam, in an area of Rednun-Chapin Variant clay loams, 9 to 15 percent slopes, 315 feet east and 100 feet south of the center of sec. 25, T. 5 S., R. 70 W.

A1—0 to 4 inches; brown to dark brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, very friable, sticky; 5 percent gravel; neutral; clear smooth boundary.

A3—4 to 9 inches; brown to dark brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, sticky; 8 percent gravel; few thin clay films on faces of peds; slightly acid; clear smooth boundary.

B21t—9 to 14 inches; reddish brown (2.5YR 5/4) sandy clay, dark reddish brown (2.5YR 3/4) moist; strong medium prismatic structure parting to strong medium angular blocky; very hard, firm, sticky; 10 percent gravel; common thin clay films on faces of peds; slightly acid; clear smooth boundary.

B22t—14 to 26 inches; reddish brown (2.5YR 5/4) sandy clay, dark red (2.5YR 3/6) moist; strong medium prismatic structure parting to strong medium angular blocky; very hard, firm, sticky; 10 percent gravel; common thin clay films on faces of peds; slightly acid; gradual wavy boundary.

Cr—26 to 30 inches; reddish brown (5YR 5/4) and pink (5YR 8/3) weathered sandstone.

R—30 inches; variegated reddish brown (2.5YR 4/4) to light reddish brown (2.5YR 6/4) stratified hard sandstone of the Fountain Formation.

The solum is 15 to 30 inches thick. Depth to bedrock is 20 to 40 inches. The content of rock fragments is 0 to 15 percent throughout.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 to 4. Reaction is neutral or slightly acid.

The B2t horizon has hue of 5YR or 2.5YR, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 to 4. The darker colors are in the upper part.

Critchell Series

The Critchell series consists of deep, well drained soils that formed in reddish, gravelly, loamy alluvium derived from reddish sedimentary rocks. The soils are on fans, terraces, and hill slopes. The slope is 0 to 15 percent. The average annual precipitation is 13 to 17 inches, the average annual temperature is 47° F, and the frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine-loamy, mixed, mesic Aridic Argiustolls.

Typical pedon of Critchell gravelly sandy loam, 0 to 3 percent slopes, 75 feet east and 320 feet south of the center of sec. 2, T. 6 S., R. 69 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) gravelly sandy loam, very dark grayish brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable, slightly sticky; 20 percent gravel; neutral; clear smooth boundary.

B1—6 to 9 inches; dark grayish brown (10YR 4/2) gravelly sandy clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; hard, very friable, slightly sticky; very thin patchy clay films on faces of peds; 15 percent gravel; neutral; clear smooth boundary.

B21t—9 to 15 inches; brown to dark brown (7.5YR 4/2) gravelly sandy clay loam, dark brown (7.5YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, friable, sticky; moderately thick continuous clay films on faces of peds; 25 percent gravel; neutral; clear smooth boundary.

B22t—15 to 26 inches; reddish brown (5YR 5/3) gravelly sandy clay loam, reddish brown (5YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, friable, sticky; moderately thick continuous clay films on faces of peds; 25 percent gravel; neutral; clear smooth boundary.

B3—26 to 35 inches; reddish brown (5YR 5/4) gravelly sandy clay loam, reddish brown (5YR 4/4) moist; weak moderate prismatic structure parting to weak moderate subangular blocky; very hard, friable, sticky; thin patchy clay films on faces of peds; 30 percent gravel; neutral; gradual smooth boundary.

C1—35 to 52 inches; light reddish brown (5YR 6/4) gravelly sandy loam, reddish brown (5YR 4/4) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable; 30 percent gravel; mildly alkaline; gradual smooth boundary.

C2—52 to 60 inches; pink (5YR 7/4) gravelly coarse sandy loam, reddish brown (5YR 5/4) moist; massive; hard, very friable; 30 percent gravel; mildly alkaline.

The solum is 24 to 48 inches thick. Critchell soils are generally noncalcareous, but in some places they are calcareous below a depth of 40 inches. The content of rock fragments is 15 to 35 percent, by volume, in a major part of the solum. The fragments are dominantly less than 3 inches in diameter.

The A horizon has hue of 10YR to 5YR, value of 3 to 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is gravelly sandy loam or stony sandy loam.

The B horizon has hue of 7.5YR to 2.5YR, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 to 4. It is gravelly sandy clay loam, gravelly loam, or gravelly clay loam. It is 18 to 35 percent clay.

The C horizon has hue of 7.5YR to 2.5YR. It is gravelly sandy loam, gravelly sandy clay loam, or gravelly loam. Stratification is common in the lower part.

Curecanti Series

The Curecanti series consists of deep, well drained soils on mountain fans and foot slopes. The slopes most commonly face south. The soils formed in noncalcareous, stony, and gravelly colluvial material derived from schist, gneiss, and granite. The slope is 15 to 50 percent. The average annual precipitation is 17 to 20 inches, the average annual temperature is 43° to 47° F, and the frost-free season ranges from 76 to 125 days. Elevation ranges from 6,500 to 7,800 feet.

These soils are loamy-skeletal, mixed Typic Argiborolls.

Typical pedon of Curecanti very stony sandy loam, 15 to 50 percent slopes, 350 feet west and 400 feet north of the southeast corner of sec. 30, T. 4 S., R. 70 W.

A1—0 to 6 inches; very dark grayish brown (10YR 3/2) very stony sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky; 10 percent stones, 15 percent cobbles, 25 percent gravel; neutral; clear smooth boundary.

B1—6 to 11 inches; dark grayish brown (10YR 4/2) very cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, very friable, slightly sticky; few thin clay films on faces of peds; 20 percent cobbles, 20 percent gravel; neutral; clear smooth boundary.

B21t—11 to 23 inches; brown to dark brown (7.5YR 4/4) very cobbly sandy clay loam, brown to dark brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky; common thin clay films on faces of peds; 20 percent cobbles, 30 percent gravel; neutral; gradual smooth boundary.

B22t—23 to 33 inches; brown to dark brown (7.5YR 4/4) very cobbly sandy clay loam, brown to dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky; common thin clay films on faces of peds; 25 percent cobbles, 25 percent gravel; neutral; gradual smooth boundary.

B3—33 to 60 inches; brown (7.5YR 4/4) very cobbly sandy clay loam, brown to dark brown (7.5YR 5/4) moist; weak medium subangular blocky structure; hard, friable, sticky; 25 percent cobbles, 25 percent gravel; neutral.

The solum is 20 to 60 inches thick. The content of rock fragments is 35 to 70 percent. The fragments range from 1/8 inch to 10 inches in diameter. Reaction is slightly acid or neutral.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B horizon has hue of 10YR or 7.5YR, value of 4 to 6 dry and 2 to 4 moist, and chroma of 2 to 4. Soil that has moist value of 2 or 3 is at a depth of less than 16 inches. The clay content is 18 to 35 percent.

In some places there is a C horizon. It has hue of 10YR or 7.5YR. It is very cobbly sandy clay loam or very cobbly sandy loam.

Dacono Variant

The Dacono Variant series consists of deep, well drained soils on high terraces. These soils formed in calcareous, gravelly, and clayey material overlying sand and gravel derived from alluvium. The slope is 0 to 3 percent. The average annual temperature is 47° F. The average annual precipitation ranges from 13 to 17 inches. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,400 to 6,500 feet.

These soils are fine, mixed, mesic Aridic Argiustolls.

Typical pedon of Dacono Variant gravelly clay loam, 0 to 3 percent slopes, 470 feet south and 75 feet east of the center of sec. 24, T. 3 S., R. 70 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, friable, sticky; 20 percent gravel; neutral; abrupt smooth boundary.

A3—5 to 9 inches; dark grayish brown (10YR 4/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; slightly hard, firm, sticky; few thin clay films on faces of peds; 20 percent gravel; neutral; abrupt smooth boundary.

B2t—9 to 19 inches; dark grayish brown (10YR 4/2) gravelly sandy clay, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to

moderate coarse subangular blocky; very hard, very firm, very sticky; common moderately thick clay films on faces of peds; 20 percent gravel; neutral; clear smooth boundary.

B31ca—19 to 22 inches; brown (10YR 5/3) gravelly sandy clay loam, brown to dark brown (10YR 4/3) moist; strong coarse subangular blocky structure; hard, firm, sticky; common moderately thick clay films on faces of peds; 20 percent gravel; accumulations of calcareous material on the bottom of rock fragments; moderately alkaline; gradual smooth boundary.

B32ca—22 to 29 inches; very pale brown (10YR 8/3) gravelly sandy clay loam, very pale brown (10YR 7/3) moist; moderate coarse subangular blocky structure; slightly hard, friable, slightly sticky; 20 percent gravel; thick accumulations of calcareous material on the bottom of rock fragments; moderately alkaline; gradual smooth boundary.

IIC1ca—29 to 41 inches; pink (7.5YR 7/4) very gravelly sandy clay loam, brown to dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky; 10 percent cobbles, 30 percent gravel; calcium carbonate on the bottom of rock fragments; moderately alkaline; gradual smooth boundary.

IIC2ca—41 to 60 inches; strong brown (7.5YR 4/6) very cobbly loamy coarse sand, strong brown (7.5YR 4/6) moist; massive; soft, very friable, nonsticky; 25 percent cobbles, 20 percent gravel; calcareous; moderately alkaline.

The solum is 15 to 40 inches thick. The depth to calcareous material is 8 to 20 inches. The mollic epipedon is 7 to 20 inches thick. The content of rock fragments is 35 to 60 percent in the substratum. Depth to a skeletal IIC horizon ranges from 20 to 40 inches.

The A horizon has hue of 2.5Y or 10YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. Reaction is neutral or mildly alkaline.

The B2t horizon has hue of 2.5Y to 7.5YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 or 3. It is gravelly sandy clay or gravelly clay, but the range includes clay loam. The clay content is 35 to 50 percent. Reaction is neutral to moderately alkaline.

The C horizon has hue of 2.5Y to 7.5YR. It is dominantly very cobbly loamy sand and commonly has thin stratified layers of finer textured material.

Denver Series

The Denver series consists of deep, well drained soils on fans, high terraces, hill slopes, and tablelands. The soils formed in calcareous, clayey material derived from mudstone and shale. The slope is 0 to 15 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

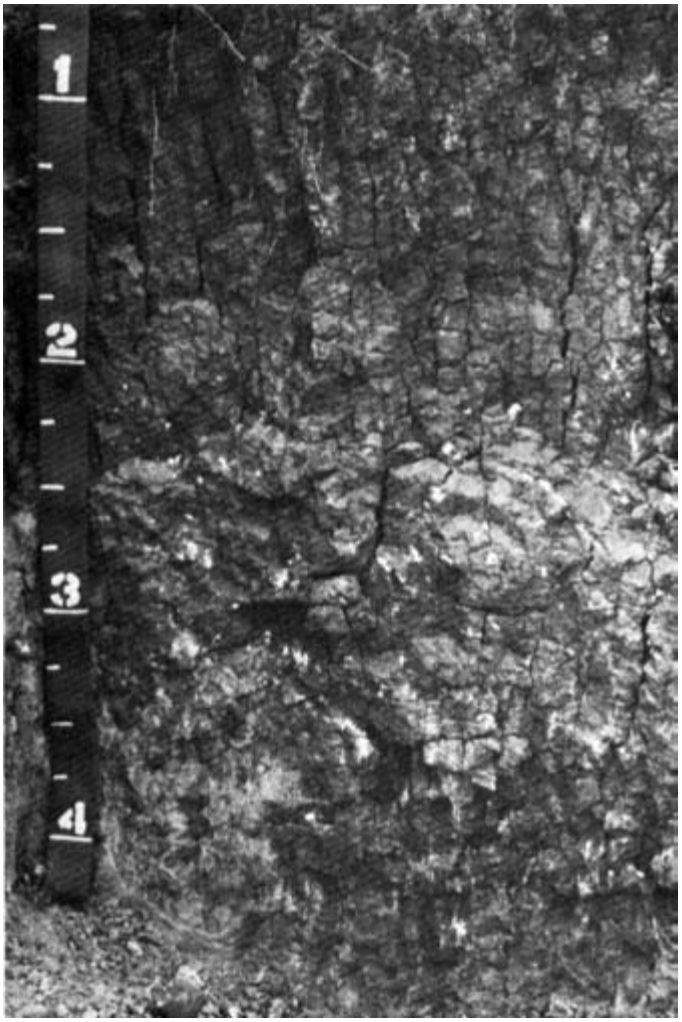


Figure 8.—The vertical cracks in Denver clay loam, 0 to 2 percent slopes, are caused by shrinking and swelling. The scale is in feet.

These soils are fine, montmorillonitic, mesic Torrertic Argiustolls.

Typical pedon of Denver clay loam, 0 to 2 percent slopes (fig. 8), 700 feet north and 400 feet east of the southwest corner of the northwest quarter of sec. 24, T. 5 S., R. 69 W.

A1—0 to 6 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; strong fine subangular blocky structure parting to strong coarse granular; hard, very friable, slightly sticky; mildly alkaline; abrupt smooth boundary.

B21t—6 to 14 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium angular blocky; extremely hard, very firm, sticky; continuous clay films on faces of peds and

filling root channels and pores; mildly alkaline; clear smooth boundary.

B22t—14 to 20 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to moderate medium angular and subangular blocky; hard, friable, sticky; continuous clay films on faces of peds and filling root channels and pores; calcareous; moderately alkaline; gradual smooth boundary.

B23tca—20 to 29 inches; light yellowish brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/3) moist; weak coarse subangular blocky structure; very hard, firm, sticky; few thin clay films on faces of peds and in some root channels and pores; secondary calcium carbonate as soft masses; calcareous; moderately alkaline; diffuse wavy boundary.

B3ca—29 to 60 inches; light yellowish brown (2.5Y 6/3) clay, light olive brown (2.5Y 5/3) moist; weak coarse prismatic structure; extremely hard, very firm, very sticky; calcium carbonate as soft masses and in thin seams and streaks; calcareous; moderately alkaline.

The solum is 15 to 50 inches or more thick. The depth to calcium carbonate is 15 to 40 inches. The content of rock fragments is 0 to 15 percent.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 1 to 3. It is clay loam, clay, or cobbly clay loam.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 to 4. Value of 3 (moist) extends to a depth of less than 20 inches. In some places the lower part of the B horizon is gravelly sandy clay.

In some places there is a C horizon. It has hue of 7.5YR to 2.5Y.

Earcree Series

The Earcree series consists of deep, well drained soils on alluvial fans and toe slopes and in drainageways of the mountains. The soils formed in noncalcareous, loamy alluvium and colluvium derived dominantly from igneous and metamorphic rocks. The slope is 5 to 20 percent. The average annual precipitation is 17 to 20 inches. The average annual temperature is 41° to 43° F. The frost-free season ranges from 55 to 75 days. Elevation ranges from 7,600 to 9,500 feet.

These soils are coarse-loamy, mixed Pachic Cryoborolls.

Typical pedon of Earcree gravelly sandy loam, in an area of Kittredge-Earcree complex, 9 to 20 percent slopes, 970 feet north and 400 feet east of the center of sec. 4, T. 7 S., R. 71 W.

A11—0 to 2 inches; very dark grayish brown (10YR 3/2) gravelly sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky; 15 percent gravel; neutral; clear smooth boundary.

A12—2 to 11 inches; very dark grayish brown (10YR 3/2) gravelly sandy loam, very dark brown (10YR 2/2) moist; weak fine subangular blocky structure; soft, very friable, nonsticky; 20 percent gravel; neutral; clear smooth boundary.

B21—11 to 28 inches; very dark grayish brown (10YR 3/2) gravelly sandy loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, very friable, slightly sticky; 20 percent gravel; neutral; gradual smooth boundary.

B22—28 to 45 inches; very dark grayish brown (10YR 3/2) gravelly sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky; 25 percent gravel; neutral; clear wavy boundary.

C—45 to 60 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky; 20 percent gravel; neutral.

The mollic epipedon is 16 to 40 inches or more thick. The solum is 30 to 60 inches or more thick. The content of rock fragments is 15 to 35 percent, and the fragments commonly are gravel. Reaction is neutral or slightly acid.

The A horizon has value of 3 to 5 dry and 2 or 3 moist and chroma of 1 or 2.

The B horizon has value of 3 to 6 dry and 2 to 5 moist and chroma of 2 or 3. The darker colors are in the upper part. In some places there is no B horizon.

Precipitation in the survey area peaks in spring and early in summer, and this cycle places the Earcree soils out of the range established for the series. Thus, Earcree soils in this area are a taxadjunct to the series.

Earcree Variant

The Earcree Variant consists of deep, well drained soils on fans and toe slopes and in drainageways. These soils formed in gravelly and loamy alluvium and colluvium derived dominantly from grus of the Pikes Peak Granite. The slope is 3 to 15 percent. The average annual temperature is 41° to 43° F. The average annual precipitation ranges from 17 to 20 inches. The average frost-free season ranges from 55 to 75 days. Elevation ranges from 8,000 to 9,500 feet.

These soils are loamy-skeletal, mixed Cumulic Cryoborolls.

Typical pedon of Earcree Variant very gravelly sandy loam, 9 to 15 percent slopes, 2,620 feet north and 1,800 feet west of the southeast corner of sec. 36, T. 6 S., R. 72 W.

A11—0 to 6 inches; dark grayish brown (10YR 4/2) very gravelly sandy loam, very dark grayish brown (10YR

3/2) moist; weak fine granular structure; soft, very friable, nonsticky; 40 percent gravel; neutral; clear smooth boundary.

A12—6 to 12 inches; dark grayish brown (10YR 4/2) very gravelly sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to weak fine granular; soft, very friable, slightly sticky; 40 percent gravel; neutral; clear smooth boundary.

IIB2—12 to 33 inches; dark grayish brown (10YR 4/2) very gravelly sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky; 40 percent gravel; neutral; clear smooth boundary.

IIIC—33 to 60 inches; brown to dark brown (10YR 4/3) very gravelly sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky; 50 percent gravel; neutral.

The solum is 30 to 40 inches thick. The mollic epipedon is 16 to 40 inches or more thick. The 10- to 40-inch control section is 8 to 18 percent clay. The content of rock fragments is 35 to 60 percent. Reaction is slightly acid or neutral.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. In some places there is no B horizon.

The C horizon has hue of 2.5Y or 10YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 to 4.

Englewood Series

The Englewood series consists of deep, well drained and moderately well drained soils on alluvial fans and flood plains and in drainageways. Englewood soils formed in calcareous, clayey alluvium derived dominantly from mudstone and shale. The slope is 0 to 5 percent. The average annual precipitation is 13 to 17 inches. The average annual temperature is 47° F. The frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Torrertic Argiustolls.

Typical pedon of Englewood clay loam, 2 to 5 percent slopes, 1,120 feet east and 500 feet north of the southwest corner of the northwest quarter of sec. 24, T. 4 S., R. 70 W.

A1—0 to 5 inches; dark gray (10YR 4/1) clay loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, sticky; 5 percent gravel; neutral; clear smooth boundary.

A3—5 to 9 inches; very dark gray (10YR 3/1) clay loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, firm, sticky; 5 percent gravel; few thin clay films on faces of peds; neutral; clear smooth boundary.

B21t—9 to 16 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong medium prismatic structure parting to strong medium angular blocky; extremely hard, very firm, very sticky; 5 percent gravel; common moderately thick clay films on faces of peds; neutral; gradual smooth boundary.

B22t—16 to 31 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium angular blocky; extremely hard, very firm, very sticky; 5 percent gravel; common moderately thick clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B23t—31 to 39 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate coarse angular blocky; extremely hard, very firm, very sticky; 5 percent gravel; common moderately thick clay films on faces of peds; mildly alkaline; gradual smooth boundary.

B31ca—39 to 47 inches; brown (10YR 5/3) clay, brown to dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate coarse angular blocky; extremely hard, very firm, very sticky; 5 percent gravel; few thin clay films on faces of peds; calcareous; mildly alkaline; gradual wavy boundary.

B32ca—47 to 60 inches; pale brown (10YR 6/3) clay loam, brown to dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; very hard, friable, sticky; few thin clay films on faces of peds; calcareous; mildly alkaline.

The mollic epipedon is 20 to 40 inches thick. The depth to visible carbonates ranges from 15 to 50 inches. Some areas are seepy and have a fluctuating water table at a depth of 5 to 6 feet.

The A horizon has hue of 2.5Y to 7.5YR, value of 2 to 5 dry and 2 or 3 moist, and chroma of 1 to 3.

The B horizon has hue of 2.5Y to 7.5YR, value of 3 to 7 dry and 2 to 6 moist, and chroma of 1 to 5. Reaction is neutral or mildly alkaline.

In some places there is a C horizon at a depth of less than 60 inches. It has hue of 2.5Y to 7.5YR. It is clay loam or clay. Reaction is mildly alkaline or moderately alkaline.

Flatirons Series

The Flatirons series consists of deep, well drained soils on high terraces, hill slopes, and piedmonts. The soils formed in most commonly noncalcareous, cobbly, stony, gravelly, and loamy material of the Rocky Flats

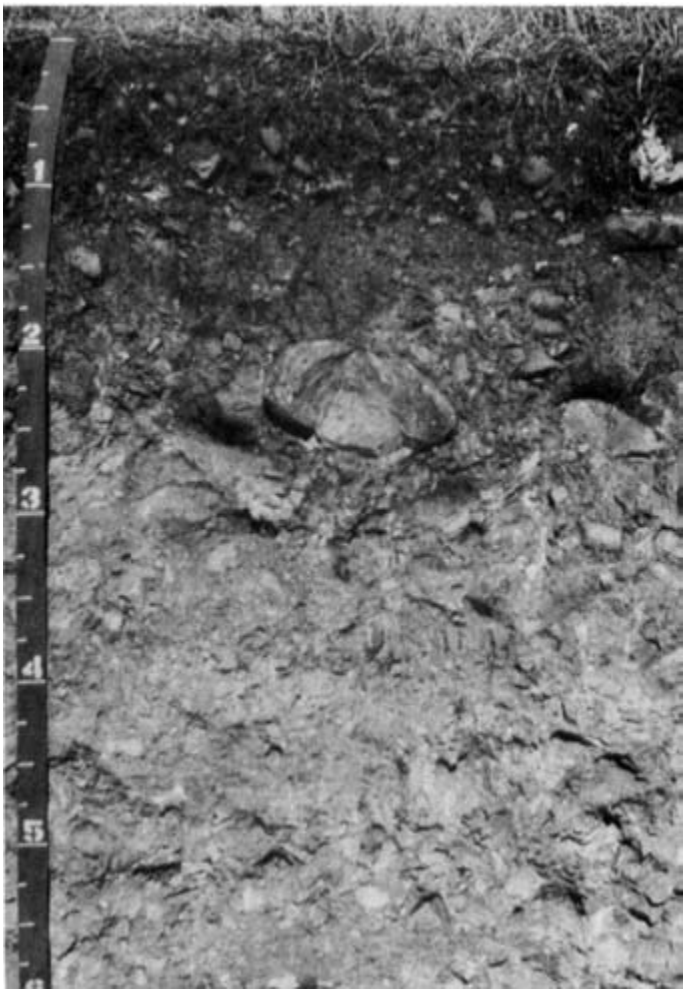


Figure 9.—Profile of Flatirons very cobbly sandy loam, 0 to 3 percent slopes. The scale is in feet.

Alluvium. The slope is 0 to 3 percent. The average annual precipitation is 15 to 17 inches. The average annual temperature is 47° F. The average frost-free season ranges from about 126 to 142 days. Elevation ranges from 6,000 to 6,800 feet.

These soils are clayey-skeletal, montmorillonitic, mesic Aridic Paleustolls.

Typical pedon of Flatirons very cobbly sandy loam, 0 to 3 percent slopes (fig. 9), 60 feet west and 750 feet south of the northeast corner of sec. 20, T. 2 S., R. 70 W.

A11—0 to 6 inches; very dark grayish brown (10YR 3/2) very cobbly sandy loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; soft, very friable, slightly sticky; 20 percent cobbles, 40 percent gravel; neutral; clear smooth boundary.

A12—6 to 13 inches; very dark grayish brown (10YR 3/2) very cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate medium granular; soft, very friable, slightly sticky; 20 percent cobbles, 40 percent gravel; slightly acid; abrupt wavy boundary.

B21t—13 to 21 inches; reddish brown (5YR 5/4) very gravelly clay, reddish brown (5YR 4/4) moist; strong medium prismatic structure parting to strong medium angular blocky; extremely hard, very firm, very sticky; 15 percent cobbles, 45 percent gravel; many thick clay films on faces of peds; medium acid; gradual smooth boundary.

B22t—21 to 38 inches; strong brown (7.5YR 5/6) very gravelly sandy clay, strong brown (7.5YR 4/6) moist; strong medium prismatic structure parting to strong medium angular blocky; very hard, firm, very sticky; 15 percent cobbles, 45 percent gravel; common moderately thick clay films on faces of peds; slightly acid; gradual smooth boundary.

B23t—38 to 47 inches; strong brown (7.5YR 5/8) very gravelly sandy clay, strong brown (7.5YR 5/6) moist; strong medium prismatic structure parting to strong medium angular blocky; hard, friable, very sticky; 15 percent cobbles, 40 percent gravel; common moderately thick clay films on faces of peds; neutral; gradual wavy boundary.

B3—47 to 60 inches; strong brown (7.5YR 5/8) very gravelly sandy clay loam, strong brown (7.5YR 5/6) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, very sticky; 15 percent cobbles, 40 percent gravel; neutral.

The mollic epipedon is 10 to 20 inches thick. The solum is 40 to 60 inches or more thick. The content of rock fragments ranges from 35 to 80 percent.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is very cobbly sandy loam or very stony sandy loam. Reaction is slightly acid to mildly alkaline.

The upper part of the B2t horizon has hue of 5YR or is redder; it has value of 5 or 6 dry and 4 or 5 moist and chroma of 4 to 6. The lower part of the B2t horizon may also have hue of 7.5YR or 10YR; it has value of 5 or 6 dry and 4 or 5 moist and chroma of 5 to 8. The B2t horizon is very gravelly clay, very gravelly sandy clay, very gravelly clay loam, or very cobbly sandy clay. Reaction is neutral to medium acid.

In some places there is a C horizon at a depth of less than 60 inches. It has hue of 10YR through 2.5YR.

Fondis Series

The Fondis series consists of deep, well drained soils on high terraces, tablelands, and convex ridges. The

soils formed in calcareous, loamy eolian material derived from sedimentary rocks. The slope is 0 to 3 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Aridic Paleustolls.

Typical pedon of Fondis loam, 0 to 3 percent slopes, 2,100 feet south and 2,450 feet west of the northeast corner of sec. 3, T. 6 S., R. 68 W.

A1—0 to 5 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, sticky; neutral; abrupt smooth boundary.

B21t—5 to 12 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; strong medium prismatic structure parting to strong medium angular blocky; very hard, firm, very sticky; thin continuous clay films on faces of peds; neutral; clear smooth boundary.

B22t—12 to 25 inches; brown (10YR 5/3) clay, brown (10YR 4/3) moist; strong medium prismatic structure parting to strong medium angular blocky; very hard, firm, very sticky; thin continuous clay films on faces of peds; neutral; clear smooth boundary.

IIB23tca—25 to 32 inches; pale brown (10YR 6/3) clay loam, brown (10YR 4/3) moist; strong medium prismatic structure parting to strong medium angular blocky; very hard, firm, very sticky; thin continuous clay films on faces of peds; secondary carbonate in thin seams; calcareous; moderately alkaline; clear smooth boundary.

IIB31ca—32 to 54 inches; light yellowish brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, very sticky; thin continuous clay films on faces of peds; 5 percent fine gravel; secondary calcium carbonate in streaks and small concretions; calcareous; moderately alkaline; gradual smooth boundary.

IIB32ca—54 to 60 inches; brownish yellow (10YR 6/6) sandy clay loam, yellowish brown (10YR 5/6) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; very hard, firm, very sticky; thin nearly continuous clay films on faces of peds; 5 percent fine gravel; secondary calcium carbonate in streaks and concretions; calcareous; moderately alkaline.

The solum is 40 to 70 inches thick. The depth to calcareous material is 20 to 40 inches.

The A horizon has value of 4 or 5 dry and 2 or 3 moist and chroma of 2 or 3.

The B2t horizon has value of 4 to 6 dry and 2 to 4 moist and chroma of 2 or 3. Soil that has value of 3 or less (moist) is above a depth of 20 inches. This horizon is clay loam or clay.

The IIB2t horizon has hue of 7.5YR to 2.5Y, value of 4 to 6 dry and 4 or 5 moist, and chroma of 3 or 4. It is clay loam or clay. The content of clay is 35 to 50 percent.

Garber Variant

The Garber Variant consists of deep, somewhat excessively drained soils on alluvial fans and toe slopes and in drainageways of mountains. The soils formed in noncalcareous, gravelly, loamy grus derived dominantly from the Pikes Peak Granite. The slope is 5 to 15 percent. The average annual precipitation is 17 to 20 inches, and the average annual temperature is 43° to 47° F. The frost-free season ranges from 76 to 125 days. Elevation ranges from 6,500 to 7,800 feet.

These soils are loamy-skeletal, mixed Pachic Haploborolls.

Typical pedon of Garber Variant very gravelly sandy loam, 9 to 15 percent slopes, 910 feet east and 1,625 feet north of the southwest corner of sec. 26, T. 7 S., R. 71 W.

A11—0 to 4 inches; dark grayish brown (10YR 4/2) very gravelly sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky; 45 percent angular gravel; neutral; clear smooth boundary.

A12—4 to 17 inches; dark grayish brown (10YR 4/2) very gravelly sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky; 45 percent angular gravel; neutral; gradual smooth boundary.

AC—17 to 25 inches; grayish brown (10YR 5/2) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, nonsticky; 45 percent angular gravel; neutral; gradual smooth boundary.

C—25 to 60 inches; grayish brown (10YR 5/2) very gravelly loamy sand, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky; 45 percent angular gravel; neutral.

The mollic epipedon is 16 to 40 inches thick. The clay content in the control section is 5 to 18 percent. The solum is 16 to 40 inches thick. The content of rock fragments ranges from 35 to 60 percent in the solum, and the fragments are mainly 1/4 inch to 3 inches in diameter. Reaction is neutral or slightly acid.

The A horizon has hue of 7.5YR to 2.5Y, value of 3 or 4 dry and 2 or 3 moist, and chroma of 2.

The AC horizon has hue of 7.5YR to 2.5Y, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 or 3. In some places there is no AC horizon.

The C horizon has hue of 7.5YR to 2.5Y. It is very gravelly loamy sand or very gravelly coarse sandy loam.

Grimstone Series

The Grimstone series consists of moderately deep, well drained soils on north-facing mountain side slopes. Grimstone soils formed in noncalcareous, stony, gravelly, and loamy material derived from igneous and metamorphic rocks, mainly schist, gneiss, and granite. The slope is 9 to 60 percent. The average annual precipitation ranges from 17 to 20 inches. The average annual temperature ranges from 41° to 43° F. The frost-free season ranges from 55 to 75 days. Elevation ranges from 7,200 to 9,500 feet.

These soils are fine-loamy, mixed Typic Cryoboralfs.

Typical pedon of Grimstone stony sandy loam, 9 to 15 percent slopes, 50 feet west and 1,450 feet south of the northeast corner of sec. 24, T. 4 S., R. 72 W.

O1—1 inch to 0: partly decomposed leaves, cones, and twigs; abrupt smooth boundary.
A1—0 to 1 inch; grayish brown (10YR 5/2) stony sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, loose, nonsticky; neutral; 2 percent stones, 5 percent gravel; abrupt smooth boundary.
A2—1 inch to 11 inches; very pale brown (10YR 7/3) gravelly loamy sand, brown to dark brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, nonsticky; medium acid; few cobbles and 20 percent gravel; abrupt smooth boundary.
A&B—11 to 16 inches; pale brown (10YR 6/3) gravelly sandy loam, brown to dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky; medium acid; few cobbles and 20 percent gravel; clear smooth boundary.
B2t—16 to 23 inches; strong brown (7.5YR 5/6) gravelly sandy clay loam, brown to dark brown (7.5YR 4/4) moist; moderate coarse subangular blocky structure; hard, friable, sticky; few cobbles and 20 percent gravel; few thin clay films on faces of peds; strongly acid; gradual wavy boundary.
B3—23 to 36 inches; strong brown (7.5YR 5/6) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky; few cobbles and 20 percent gravel; few thin clay films on mineral grains; strongly acid; gradual wavy boundary.
Cr—36 inches; weathered schist.

The thickness of the solum and the depth to bedrock range from 20 to 40 inches. The content of rock fragments is 0 to 35 percent.

The A1 horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 1 to 3.

The A2 horizon has hue of 2.5Y to 7.5YR, value of 5 to 8 dry and 4 to 7 moist, and chroma of 1 to 6. It is dominantly gravelly loamy sand, but the range includes gravelly sandy loam. Reaction is slightly acid to strongly acid.

The B horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 6. It is 18 to 35 percent clay. Reaction is slightly acid to strongly acid.

The Cr horizon is soft metamorphic or igneous rock.

Hargreave Series

The Hargreave series consists of moderately deep, well drained soils on ridges and hill slopes. Hargreave soils formed in noncalcareous, reddish, loamy material derived from red sedimentary rocks, mainly sandstone and shale. The slope is 3 to 15 percent. The average annual precipitation is 15 to 17 inches, and the average annual temperature is 47° F. The frost-free season is 126 to 142 days. Elevation ranges from 5,600 to 6,500 feet.

These soils are fine-loamy, mixed, mesic Aridic Argiustolls.

Typical pedon of Hargreave sandy loam, in an area of Hargreave-Bernal sandy loams, 9 to 15 percent slopes, 890 feet west and 2,025 feet south of the northeast corner of sec. 6, T. 6 S., R. 69 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, sticky; neutral; clear smooth boundary.
B1—4 to 9 inches; brown to dark brown (7.5YR 4/2) sandy clay loam, dark brown (7.5YR 3/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, very friable, sticky; few thin clay films on faces of peds and on mineral grains; neutral; clear smooth boundary.
B2t—9 to 18 inches; dark reddish gray (5YR 4/2) sandy clay loam, dark reddish brown (5YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky; common thin clay films on faces of peds and as bridges holding mineral grains together; neutral; gradual smooth boundary.
B3—18 to 29 inches; reddish brown (5YR 5/3) sandy loam, reddish brown (5YR 4/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; very hard, friable, sticky; few thin clay films on faces of peds; neutral; clear smooth boundary.
Cr—29 inches; reddish brown weathered sandstone.

The thickness of the solum and the depth to bedrock are 20 to 40 inches. Reaction is mildly alkaline to slightly acid.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B2t horizon has hue of 7.5YR or 5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

In some places a C horizon overlies the bedrock. It has hue of 5YR. It is sandy loam.

The reddish hues of the Hargreave soils in the survey area place the soils out of the range established for the series. Thus, Hargreave soils in this area are a taxadjunct to the series.

Haverson Series

The Haverson series consists of deep, well drained soils on flood plains and low terraces. The soils commonly are adjacent to intermittent streams. They formed in stratified loamy alluvium of mixed origin. The slope is 0 to 9 percent. The average annual precipitation is 13 to 17 inches, and the average annual temperature is 47° F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine-loamy, mixed (calcareous), mesic Ustic Torrifluvents.

Typical pedon of Haverson loam, 0 to 3 percent slopes, 1,000 feet north and 200 feet east of the center of sec. 9, T. 2 S., R. 69 W.

A1—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky; neutral; 5 percent gravel; clear smooth boundary.

C1ca—6 to 46 inches; brown (10YR 5/3) stratified clay loam and gravelly loam, very dark grayish brown (10YR 3/2) moist; massive and weak medium granular structure; hard, friable, sticky; calcareous; moderately alkaline; 10 percent gravel; clear smooth boundary.

IIC2ca—46 to 60 inches; grayish brown (10YR 5/2) stratified very gravelly loamy sand, brown to dark brown (10YR 4/3) moist; single grained; slightly hard, very friable, nonsticky; calcareous; mildly alkaline; 40 percent gravel.

The depth to calcium carbonate is 10 to more than 40 inches. Stratification is common. Reaction is neutral to moderately alkaline. The control section is 18 to 35 percent clay.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The C1ca horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 to 4. It is stratified clay loam, loam, and gravelly loam.

The IIC2ca horizon has hue of 10YR or 7.5YR. It is stratified and varies widely in texture.

Heldt Series

The Heldt series consists of deep, well drained soils on alluvial fans, high terraces, and hill slopes. Heldt soils formed in calcareous, clayey material derived dominantly from mudstone and shale. The slope is 3 to 25 percent. The average annual precipitation is 13 to 17 inches, and the average annual temperature is 47° F. The average frost-free season ranges from 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Ustertic Camborthids.

Typical pedon of Heldt clay, 3 to 9 percent slopes, 150 feet south and 45 feet west of the northeast corner of sec. 27, T. 6 S., R. 69 W.

A11—0 to 3 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak fine granular structure; hard, friable, sticky; calcareous; moderately alkaline; clear smooth boundary.

A12—3 to 6 inches; light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; weak medium subangular blocky structure; hard, firm, sticky; calcareous; mildly alkaline; clear smooth boundary.

B21—6 to 11 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; moderate medium prismatic structure parting to moderate coarse angular blocky; very hard, very firm, very sticky; calcareous; moderately alkaline; clear smooth boundary.

B22—11 to 29 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; very hard, very firm, very sticky; calcareous; mildly alkaline; clear smooth boundary.

B3ca—29 to 42 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; very hard, very firm, very sticky; calcareous; moderately alkaline; gradual smooth boundary.

C—42 to 60 inches; light yellowish brown (2.5Y 6/4) clay, light olive brown (2.5Y 5/4) moist; massive; very hard, very firm, very sticky; calcareous; moderately alkaline.

Depth to calcium carbonate is 0 to 12 inches. The clay content is 35 to 50 percent in the control section. The 10- to 40-inch control section is mildly alkaline to strongly alkaline.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 3 to 5 moist, and chroma of 2 or 3. Soil that has value of 3 (moist) is at a depth of less than 5 inches. The A horizon is clay loam, clay, or cobbly clay loam.

The B horizon has hue of 10YR or 2.5Y, value of 5 or 7 dry and 4 to 6 moist, and chroma of 2 to 4. It is clay loam or clay.

The C horizon has hue of 2.5Y or 10YR. It is clay loam or clay.

Herbman Series

The Herbman series consists of shallow, well drained soils on ridges and on mountain side slopes, most commonly on the south, east, and west aspects. The soils formed in noncalcareous, stony, gravelly, and loamy material derived from igneous and metamorphic rocks, mainly schist, gneiss, and granite. The slope is 9 to 70 percent. The average annual precipitation ranges from 17 to 20 inches, and the average annual temperature is 41° to 43° F. The frost-free season ranges from 55 to 75 days. Elevation ranges from 7,600 to 9,500 feet.

The soils are loamy-skeletal, mixed, shallow Typic Cryoborolls.

Typical pedon of Herbman very stony sandy loam, in an area of Rogert-Herbman-Rock outcrop complex, 30 to 70 percent slopes, 1,400 feet east and 80 feet north of the center of sec. 16, T. 3 S., R. 71 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) very stony sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky; slightly acid; 10 percent stones, 5 percent cobbles, 25 percent gravel; clear smooth boundary.

AC—4 to 13 inches; brown to dark brown (10YR 4/3) very gravelly sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky; 10 percent cobbles, 35 percent gravel; neutral; clear wavy boundary.

Cr—13 inches; yellowish brown (10YR 5/4) schist, dark yellowish brown (10YR 4/4) moist.

The depth to a paralithic contact ranges from 7 to 20 inches. The content of rock fragments is 35 to 80 percent. The fragments are dominantly 1/8 inch to 3 inches in diameter. Reaction is slightly acid or neutral.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is stony sandy loam or very stony sandy loam.

The AC horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is very gravelly sandy loam or very gravelly loam.

The Cr horizon is weathered gneiss, schist, or highly weathered granitic rock.

Hiwan Series

The Hiwan series consists of shallow, well drained soils on mountain side slopes, shoulders, and ridges, most commonly on the north aspect. Hiwan soils formed in acidic, stony, gravelly, and sandy material derived from igneous and metamorphic rocks. The slope is 5 to 60 percent. The average annual precipitation ranges from 17 to 20 inches, and the average annual temperature is 41° to 43° F. The frost-free season ranges from 55 to 75 days. Elevation ranges from 7,600 to 10,000 feet.

These soils are sandy-skeletal, mixed Lithic Cryorthents.

Typical pedon of Hiwan stony loamy sand, in an area of Legault-Hiwan stony loamy sands, 15 to 30 percent slopes, 1,275 feet west and 100 feet south of the northeast corner of sec. 5, T. 5 S., R. 71 W.

A1—0 to 1 inch; dark grayish brown (10YR 4/2) stony loamy sand, very dark brown (10YR 2/2) moist; weak fine granular structure; loose (dry), loose (moist), nonsticky; 3 percent stones, 40 percent gravel; medium acid; clear smooth boundary.

A2—1 to 15 inches; very pale brown (10YR 7/3) very gravelly loamy sand, brown to dark brown (10YR 4/3) moist; weak medium subangular blocky structure parting to single grained; soft, very friable, nonsticky; 45 percent gravel; strongly acid; clear wavy boundary.

R—15 inches; hard quartz monzonite; illuvial clay and roots in cracks.

The depth to bedrock and the thickness of the solum range from 5 to 20 inches. The content of rock fragments ranges from 35 to 80 percent. The fragments generally range from 1/8 inch to 3 inches in diameter.

The A1 horizon has hue of 2.5Y or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is stony loamy sand or very stony loamy sand. It is 1 to 3 inches thick.

The A2 horizon has hue of 2.5Y to 7.5YR, value of 6 to 8 dry and 4 or 5 moist, and chroma of 3 to 5. The clay content, on the average, is less than 10 percent.

The R horizon is hard granitic rock or gneiss.

Kittredge Series

The Kittredge series consists of deep, well drained soils on terraces, mountain side slopes, toe slopes, and fans and in concave drainageways. Kittredge soils formed in loamy alluvium and colluvium derived from igneous and metamorphic rocks, mainly schist, gneiss, and granite. The slope is 3 to 30 percent. The average annual precipitation is 17 to 20 inches, and the average annual temperature is 41° to 43° F. The average frost-free season ranges from 55 to 75 days. Elevation ranges from 7,600 to 9,500 feet.

These soils are fine-loamy, mixed Argic Cryoborolls.

Typical pedon of Kittredge sandy loam, in an area of Troutdale-Rogert-Kittredge complex, 15 to 30 percent slopes, 1,220 feet south and 720 feet west of the northeast corner of sec. 19, T. 4 S. R. 71 W.

A1—0 to 5 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky; common sand-sized flakes of mica; 5 percent gravel; neutral; clear smooth boundary.

B1—5 to 8 inches; brown (10YR 5/3) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, very friable, slightly sticky; few thin clay films on faces of peds; common sand-sized flakes of mica; 5 to 10 percent gravel; neutral; clear smooth boundary.

B21t—8 to 14 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky; common sand-sized flakes of mica; 10 percent gravel; thin clay films on faces of peds; neutral; clear smooth boundary.

B22t—14 to 29 inches; brown (10YR 5/3) sandy clay loam, brown to dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky; 10 percent gravel; common sand-sized flakes of mica; thin clay films on faces of peds; neutral; clear smooth boundary.

B3—29 to 42 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to medium subangular blocky; hard, friable, slightly sticky; common sand-sized flakes of mica; 10 percent gravel; few thin clay films on faces of peds; neutral; gradual smooth boundary.

C—42 to 60 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable, slightly sticky; many sand-sized flakes of mica; 10 percent gravel; neutral.

The solum is 15 to 60 inches thick. The content of rock fragments ranges from 0 to 35 percent, and the fragments are mainly 1/4 inch to 3 inches in diameter. Reaction is neutral or slightly acid throughout. The mollic epipedon is 7 to 16 inches thick.

The A horizon has hue of 7.5YR to 2.5Y, value of 3 to 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B horizon has hue of 7.5YR to 2.5Y, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 to 4. It is sandy clay loam, loam, clay loam, or gravelly sandy clay loam. The clay content is 18 to 35 percent.

The C horizon has hue of 7.5YR to 2.5Y. It is sandy clay loam, gravelly sandy loam, or sandy loam.

In part of the survey area, Kittredge soils have a pachic epipedon, which places the soils out of the range established for the series. Thus, the Kittredge soils in these areas are a taxadjunct to the series.

Kutch Series

The Kutch series consists of moderately deep, well drained soils on shoulders, ridges, and hill slopes. Kutch soils formed in calcareous, clayey residuum and colluvium derived dominantly from mudstone and shale. The slope is 5 to 25 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Torrertic Argiustolls.

Typical pedon of Kutch clay loam, in an area of Denver-Kutch-Urban land complex, 9 to 15 percent slopes, 1,620 feet south and 1,350 feet west of the northeast corner of sec. 34, T. 5 S., R. 69 W.

A1—0 to 3 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, sticky; neutral; clear smooth boundary.

B21t—3 to 6 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; moderate thick nearly continuous clay films on faces of peds; neutral; clear smooth boundary.

B22t—6 to 11 inches; dark brownish gray (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate medium prismatic structure parting to moderate coarse angular blocky; extremely hard, very firm, very sticky; few thin clay films on faces of peds; dark organic staining on ped faces; mildly alkaline; clear smooth boundary.

B31ca—11 to 19 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to weak coarse angular blocky; extremely hard, very firm, very sticky; few thin clay films on faces of peds; calcareous; moderately alkaline; gradual smooth boundary.

B32ca—19 to 26 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderately weak coarse prismatic structure parting to weak coarse subangular blocky; very hard, firm, sticky; 5 percent small fragments of shale; soft masses, seams, and streaks of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

Cr—26 inches; light gray (2.5Y 7/2) clay shale, grayish brown (2.5Y 5/2) moist; moderately alkaline.

The depth to calcareous material is 6 to 20 inches. The depth to bedrock is 20 to 40 inches. The content of shale and rock fragments ranges from 0 to 15 percent.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B2t horizon has hue of 10YR or 2.5Y, value of 4 to 6 dry and 3 or 4 moist, and chroma of 2 or 3. The darker colors are in the upper part. The B2t horizon is clay loam or clay. It is 35 to 60 percent clay.

The Cr horizon is soft mudstone or shale.

Laporte Variant

The Laporte Variant consists of shallow, well drained soils that formed in calcareous, channery, loamy material derived from limestone and shale. Laporte Variant soils are on hill slopes and shoulders associated with the hogback of the Fort Hays Member of the Niobrara Formation. The slope is 15 to 60 percent. The average annual precipitation is 15 to 17 inches, the average annual temperature is 47° F, and the average frost-free season is 126 to 142 days. Elevation ranges from 5,600 to 6,500 feet.

These soils are loamy, mixed, mesic, shallow Entic Haplustolls.

Typical pedon of Laporte Variant channery loam, in an area of Laporte Variant complex, 15 to 60 percent slopes, 12 feet north and 1,050 feet west of the center of sec. 4, T. 6 S., R. 69 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) channery loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, sticky; 2 percent flagstones, 20 percent channers; calcareous; moderately akaline; clear smooth boundary.

AC—4 to 10 inches; grayish brown (10YR 5/2) channery loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate fine granular; hard, friable, sticky; 30 percent channers; calcareous; moderately alkaline; clear smooth boundary.

C—10 to 18 inches; pale brown (10YR 6/3) channery loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, sticky; 30 percent channers; calcareous; moderately alkaline; clear smooth boundary.

Cr—18 inches; white (10YR 8/2) limestone.

The thickness of the solum and the depth to soft bedrock range from 10 to 20 inches. The mollic epipedon is 5 to 20 inches thick. The content of rock fragments ranges from 15 to 35 percent, and the fragments are dominantly less than 6 inches in length. The soils are calcareous within a few inches of the surface. Reaction is mildly alkaline to strongly alkaline.

The A horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 1 to 3.

The C horizon has hue of 2.5Y to 7.5YR.

The Cr horizon is soft limestone or shale.

Lavate Series

The Lavate series consists of deep, well drained soils on fans, terraces, and hill slopes. Lavate soils formed in reddish, loamy material derived from reddish sedimentary rocks. The slope is 3 to 30 percent. The average annual precipitation is 15 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,600 to 6,500 feet.

These soils are fine-loamy, mixed, mesic Aridic Argiustolls.

Typical pedon of Lavate sandy loam, in an area of Lavate-Bernal-Rock outcrop complex, 15 to 30 percent slopes, 700 feet east and 1,900 feet south of the center of sec. 11, T. 5 S., R. 70 W.

A1—0 to 5 inches; brown to dark brown (7.5YR 4/2) sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; slightly hard, very friable, nonsticky; neutral; clear smooth boundary.

B1—5 to 10 inches; brown to dark brown (7.5YR 4/2) sandy clay loam, dark brown (7.5YR 3/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, very friable, slightly sticky; few thin clay films on faces of peds and in root channels and pores; neutral; gradual wavy boundary.

B21t—10 to 16 inches; dark reddish gray (5YR 4/2) sandy clay loam, dark reddish brown (5YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, very friable, sticky; many thin clay films on faces of peds and in root channels and pores; neutral; clear smooth boundary.

B22t—16 to 33 inches; reddish brown (5YR 4/3) sandy clay loam, reddish brown (5YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, sticky; few thin clay films on faces of peds and in root channels and pores; neutral; gradual smooth boundary.

B3—33 to 44 inches; reddish brown (5YR 5/4) sandy loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, friable, sticky; few thin clay films on faces of peds; mildly alkaline; gradual smooth boundary.

C—44 to 60 inches; reddish brown (5YR 5/4) sandy loam, reddish brown (5YR 4/4) moist; massive; very hard, firm, sticky; mildly alkaline.

The solum is 25 to 50 inches or more thick. These soils are most commonly noncalcareous, but in some places they are calcareous below a depth of 50 inches. Reaction is neutral or mildly alkaline.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B2t horizon has value of 4 or 5 dry and 3 or 4 moist and chroma of 2 to 4. It is sandy clay loam, loam, or clay loam. The clay content is 18 to 35 percent.

The C horizon has hue of 5YR. It is loam, sandy loam, or sandy clay loam. It commonly is stratified in the lower part.

Lavina Series

The Lavina series consists of shallow, well drained soils on mesa tops, hill slopes, and dikes. Lavina soils formed in calcareous, clayey alluvium and loess deposited over hard volcanic rock. The slope is 0 to 30 percent. The average annual precipitation is 15 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,600 to 6,500 feet.

These soils are clayey, montmorillonitic, mesic Lithic Argiustolls.

Typical pedon of Lavina loam, very rocky, 0 to 5 percent slopes, 1,775 feet south and 1,475 feet west of the northeast corner of sec. 36, T. 3 S., R. 70 W.

A1—0 to 5 inches; brown to dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable, sticky; 10 percent gravel; neutral; clear smooth boundary.

B2t—5 to 12 inches; dark yellowish brown (10YR 4/4) clay, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, very sticky; common thin clay films on faces of peds; 10 percent gravel; neutral; clear wavy boundary.

IIR—12 inches; hard latite (fine-grained volcanic rock).

The thickness of the solum and the depth to bedrock range from 10 to 20 inches. The mollic epipedon is 5 to 20 inches thick. Calcareous material is commonly immediately above the bedrock. Reaction is neutral or mildly alkaline.

The A horizon has hue of 7.5YR to 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B2t horizon has hue of 10YR or 7.5YR, value of 3 to 6 dry and 2 to 5 moist, and chroma of 2 to 4. The darker colors are in the upper part. The B2t horizon is clay or clay loam. It is 35 to 60 percent clay.

The IIR horizon is hard volcanic rock that commonly has clay coatings in fractures.

Lebsack Series

The Lebsack series consists of deep, moderately well drained soils that formed on flood plains and low terraces. The soils formed in calcareous, saline, clayey alluvium derived dominantly from mudstone and shale. The slope is 0 to 2 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Pachic Haplustolls.

Typical pedon of Lebsack clay loam, saline, 0 to 2 percent slopes, 200 feet west and 260 feet south of the center of sec. 32, T. 2 S., R. 69 W.

Ap—0 to 5 inches; dark gray (10YR 4/1) clay loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to weak medium granular; hard, friable, very sticky; calcareous; moderately alkaline; abrupt smooth boundary.

B2casa—5 to 14 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, very sticky; few thin clay films on faces of peds; thin seams of calcium carbonate and salt; calcareous; moderately alkaline; clear smooth boundary.

B3casa—14 to 23 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak medium prismatic structure parting to weak coarse subangular blocky; very hard, very firm, very sticky; few thin clay films on faces of peds; thin seams of calcium carbonate and salt; calcareous; moderately alkaline; gradual wavy boundary.

Ccasa—23 to 60 inches; light brownish gray (10YR 6/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, very firm, very sticky; thin seams of calcium carbonate and salt; calcareous; moderately alkaline.

The mollic epipedon is 20 to 40 inches thick. The depth to calcareous material is 0 to 6 inches. The control section is 35 to 50 percent clay.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 1 to 3.

The B2 horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 1 or 2.

The C horizon has hue of 10YR to 2.5Y. It is clay or clay loam.

Legault Series

The Legault series consists of shallow, well drained soils on mountain side slopes and ridges, most commonly on a north aspect. Legault soils formed in acidic, gravelly, stony, and sandy material derived dominantly from igneous and metamorphic rocks. The slope is 5 to 70 percent. The average annual precipitation is 17 to 20 inches, and the average annual temperature is 41° to 43° F. The frost-free season ranges from 55 to 75 days. Elevation ranges from 7,000 to 10,000 feet.

These soils are sandy-skeletal, mixed, shallow Typic Cryorthents.

Typical pedon of Legault stony loamy sand, in an area of Legault-Hiwan stony loamy sands, 15 to 30 percent slopes, 1,600 feet west and 740 feet north of the southeast corner of sec. 9, T. 6 S., R. 71 W.

O1—1 inch to 0; partly decomposed leaves, twigs, needles, and bark; abrupt smooth boundary.

A1—0 to 1 inch; grayish brown (10YR 5/2) stony loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky; 3 percent stones, 30 percent gravel; slightly acid; abrupt smooth boundary.
A2—1 inch to 13 inches; light gray (10YR 7/2) very gravelly loamy sand, grayish brown (10YR 5/2) moist; weak fine granular structure; soft, very friable, nonsticky; few cobbles and 35 percent gravel; medium acid; abrupt smooth boundary.
Cr—13 inches; soft granite rock; accumulations of clay as seams in cracks and as thin films on rock surface along cracks; common roots in cracks.

The depth to bedrock is 5 to 20 inches. Reaction is slightly acid to strongly acid.

The A1 horizon has value of 4 or 5 dry and 2 or 3 moist and chroma of 2 or 3. It is very stony loamy sand or stony loamy sand and is 1 inch to 2 inches thick. In some places there is no A1 horizon.

The A2 horizon has hue of 10YR or 2.5Y, value of 6 or 7 dry and 4 or 5 moist, and chroma of 2 or 3.

The Cr horizon is soft schist, gneiss, or granitic rock.

Leyden Series

The Leyden series consists of moderately deep, well drained soils on ridges and hill slopes. Leyden soils formed in calcareous, gravelly, cobbly, stony, and clayey material derived from mixed sources. The slope is 9 to 50 percent. The average annual precipitation is 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Aridic Argiustolls.

Typical pedon of Leyden cobbly clay loam, in an area of Leyden-Primen-Standley cobbly clay loams, 15 to 50 percent slopes, 140 feet east and 210 feet south of the center of sec. 7, T. 4 S., R. 69 W.

A1—0 to 3 inches; very dark grayish brown (10YR 3/2) cobbly clay loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, sticky; 15 percent cobbles, 10 percent gravel; neutral; clear smooth boundary.
B1—3 to 8 inches; dark grayish brown (10YR 4/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, friable, sticky; 20 percent gravel; neutral; clear smooth boundary.
B21t—8 to 19 inches; brown to dark brown (10YR 4/3) gravelly clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky; common thin clay films on faces of peds; 20 percent gravel; neutral; gradual smooth boundary.
B22t—19 to 29 inches; brown (10YR 5/3) gravelly clay, brown to dark brown (10YR 4/3) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; hard, firm, very sticky; common thin clay films on faces of peds; 20 percent gravel; neutral; gradual wavy boundary.
B3—29 to 35 inches; light yellowish brown (2.5Y 6/4) gravelly clay loam, olive brown (2.5Y 4/4) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, firm, very sticky; 20 percent gravel; neutral; clear smooth boundary.
Cr—35 inches; light yellowish brown (2.5Y 6/4) mudstone, olive brown (2.5Y 4/4) moist; mildly alkaline.

The depth to bedrock is 20 to 40 inches. The depth to calcareous material most commonly is 15 to 40 inches. In a few places there are no carbonates above the bedrock. The content of rock fragments ranges from 15 to 35 percent, and the fragments are dominantly 1/2 inch to 3 inches in diameter. Reaction is neutral to moderately alkaline.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is cobbly clay loam, very cobbly clay loam, very stony clay loam, extremely stony clay loam, or cobbly loam.

The B2t horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 or 3. It is gravelly clay loam, cobbly clay loam, or gravelly clay. The clay content is 35 to 60 percent.

In some places there is a C horizon. It has hue of 10YR or 2.5Y. It is gravelly clay loam or cobbly clay loam.

The Cr horizon is soft, fractured shale or mudstone.

Lininger Series

The Lininger series consists of moderately deep, well drained soils that formed in stony, gravelly, and loamy material derived from igneous and metamorphic rocks. Lininger soils are on mountain side slopes and stable summits. The slope is 3 to 60 percent. The average annual precipitation ranges from 17 to 20 inches, and the average annual temperature ranges from 43° to 47° F. The frost-free season ranges from 76 to 125 days. Elevation ranges from 6,500 to 7,800 feet.

These soils are fine-loamy, mixed Typic Argiborolls.

Typical pedon of Lininger sandy loam, in an area of Lininger-Trag sandy loams, 3 to 9 percent slopes, 370 feet west of the northeast corner of the northwest quarter of sec. 8, T. 5 S., R. 70 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky; neutral; clear smooth boundary.

B1—4 to 8 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky; thin continuous clay films on faces of peds; 10 percent gravel; neutral; clear smooth boundary.

B21t—8 to 13 inches; brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky; moderately thick continuous clay films on faces of peds; 10 percent gravel; slightly acid; clear smooth boundary.

B22t—13 to 32 inches; brown (7.5YR 4/4) sandy clay loam, dark brown (7.5YR 4/4) moist; strong medium prismatic structure parting to strong medium subangular blocky; hard, friable, sticky; moderately thick continuous clay films on faces of peds; 10 percent gravel; slightly acid; clear smooth boundary.

B3—32 to 36 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; weak coarse subangular blocky structure; very hard, firm, nonsticky; 10 percent gravel; slightly acid; clear wavy boundary.

Cr—36 inches; brown (7.5YR 4/4) weathered schist.

The thickness of the solum and the depth to a paralithic contact range from 20 to 40 inches. The content of rock fragments ranges from 0 to 35 percent. The fragments are mainly 1/4 inch to 3 inches in diameter. Flakes of mica are common throughout. Reaction is neutral or slightly acid throughout.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is sandy loam, gravelly sandy loam, or stony sandy loam.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 to 4. The clay content is 18 to 35 percent.

The Cr horizon is weathered metamorphic or igneous rock.

Loveland Series

The Loveland series consists of deep, somewhat poorly drained soils on alluvial valley floors, low terraces, and flood plains of major streams. Loveland soils formed in calcareous, loamy alluvium underlain by mottled sand and gravel derived from mixed sources. The slope is 0 to 1 percent. The average annual precipitation is 15 inches, and the average annual temperature is 47° F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 5,600 feet.

These soils are fine-loamy over sandy or sandy-skeletal, mixed (calcareous), mesic Fluvaquentic Haplaquolls.

Typical pedon of Loveland clay loam, 0 to 1 percent slopes, 425 feet west of the center of sec. 14, T. 6 S., R. 69 W.

Ap1—0 to 10 inches; gray (10YR 5/1) clay loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, friable, sticky; calcareous; mildly alkaline; abrupt smooth boundary.

A12—10 to 13 inches; gray (10YR 5/1) clay loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure parting to weak medium granular; hard, friable, sticky; calcareous; moderately alkaline; clear smooth boundary.

ACca—13 to 19 inches; light gray to gray (10YR 6/1) clay loam, dark gray (10YR 4/1) moist; weak medium prismatic structure parting to weak medium subangular blocky; very hard, friable, sticky; calcium carbonate in thin seams and streaks and as soft masses; calcareous; moderately alkaline; clear smooth boundary.

C1cag—19 to 25 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; very hard, friable, sticky; few fine distinct light olive brown (2.5Y 5/6) and yellowish brown (10YR 5/8, moist) mottles; thin seams and streaks and soft masses of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

IIC2cag—25 to 34 inches; light brownish gray (2.5Y 6/2) sandy clay loam, grayish brown (2.5Y 5/3) moist; massive; very hard, firm, sticky; common fine distinct olive yellow (2.5Y 6/8) mottles; calcareous; moderately alkaline; gradual wavy boundary.

IIIC3g—34 to 60 inches; pale yellow (2.5Y 7/3) very gravelly sand, light olive brown (2.5Y 5/4) moist; massive; very hard, very friable, nonsticky; prominent olive yellow (2.5Y 6/8, moist) and yellowish brown (10YR 5/8) mottles; 40 percent gravel; neutral.

The mollic epipedon is 8 to 20 inches thick. The depth to the underlying sand and gravel is 20 to 40 inches. The upper part of the control section is 18 to 35 percent clay. The high water table is at a depth of 1.5 to 2.5 feet.

The A horizon has value of 4 or 5 dry and 2 or 3 moist and chroma of 1 or 2. Reaction is mildly alkaline or moderately alkaline.

The C horizon is stratified and is clay loam, sandy clay loam, or loam.

The IIC horizon is mottled very gravelly sand or gravelly sand. Reaction is neutral or mildly alkaline.

Loveland Variant

The Loveland Variant consists of deep, somewhat poorly drained soils on alluvial valley floors and low terraces of major streams. Loveland Variant soils formed in calcareous, gravelly, loamy alluvium underlain by a mixture of sand and gravel. The slope is 0 to 2 percent. The average annual precipitation ranges from 13 to 17

inches, and the average annual temperature is 47° F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine-loamy, mixed, mesic Aquic Argiustolls.

Typical pedon of Loveland Variant gravelly sandy loam, 0 to 2 percent slopes, 70 feet east and 875 feet south of the northwest corner of sec. 22, T. 3 S., R. 69 W.

Ap—0 to 3 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky; 20 percent gravel; neutral; abrupt smooth boundary.

A3ca—3 to 9 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, very friable, slightly sticky; few thin clay films on faces of peds; 20 percent gravel; calcareous; mildly alkaline; clear smooth boundary.

B2tca—9 to 12 inches; pale brown (10YR 6/3) gravelly sandy clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, sticky; common moderately thick clay films on faces of peds; 20 percent gravel; calcareous; mildly alkaline; clear smooth boundary.

IIB3ca—12 to 28 inches; light yellowish brown (10YR 6/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky; common thin clay films on faces of peds; 45 percent gravel; few medium faint strong brown (7.5YR 4/6) mottles; mildly alkaline; clear smooth boundary.

IIIC—28 to 60 inches; brownish yellow (10YR 6/6) very gravelly sand, yellowish brown (10YR 5/6) moist; single grained; loose, nonsticky; 60 percent gravel; many large prominent strong brown (7.5YR 4/6) mottles; neutral.

Depth to the underlying very gravelly sand is 20 to 40 inches. The water table fluctuates between depths of 24 and 60 inches. The content of rock fragments in the control section is 15 to 35 percent. The fragments are dominantly 1/2 inch to 6 inches in diameter. Reaction is neutral or mildly alkaline.

The A horizon has hue of 10YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 or 3.

The C horizon is stratified, mixed sand, gravel, and cobbles.

Manzano Series

The Manzano series consists of deep, well drained soils on alluvial valley floors, fans, flood plains, and terraces and in concave drainageways. Manzano soils formed in calcareous, loamy alluvium derived from mixed sources. The slope is 0 to 2 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine-loamy, mixed, mesic Cumulic Haplustolls.

Typical pedon of Manzano fine sandy loam, 0 to 2 percent slopes, 180 feet west and 1,670 feet south of the northeast corner of sec. 10, T. 6 S., R. 69 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; hard, very friable, sticky; mildly alkaline; abrupt smooth boundary.

B2—6 to 23 inches; very dark grayish brown (10YR 3/2) sandy clay loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak very coarse subangular blocky; hard, very friable, sticky; mildly alkaline; clear smooth boundary.

B3—23 to 31 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse blocky structure grading to massive; hard, friable, sticky; mildly alkaline; clear smooth boundary.

C1ca—31 to 44 inches; brown (7.5YR 4/4) fine sandy loam, dark brown (7.5YR 4/2) moist; massive; hard, very friable, slightly sticky; calcareous; moderately alkaline; clear smooth boundary.

C2ca—44 to 60 inches; brown (7.5YR 4/4) sandy clay loam stratified with clay loam material, dark brown (7.5YR 4/2) moist; massive; hard, friable, sticky; soft masses, thin seams, and streaks of calcium carbonate; calcareous; moderately alkaline.

The depth to calcareous material is 15 to 40 inches. The control section is 18 to 34 percent clay. The mollic epipedon is 20 to 50 inches thick.

The A horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is loam, sandy clay loam, or clay loam.

The C horizon has hue of 2.5Y to 7.5YR. It is loam, fine sandy loam, or sandy clay loam.

Manzanola Series

The Manzanola series consists of deep, well drained soils on hill slopes and convex ridges. Manzanola soils formed in calcareous, clayey material derived from

mudstone and shale. The slope is 0 to 25 percent. The average annual precipitation is 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Ustollic Haplargids.

Typical pedon of Manzanola clay loam, 9 to 15 percent slopes, 75 feet west and 1,400 feet north of the southeast corner of sec. 23, T. 5 S., R. 69 W.

A1—0 to 5 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, firm, sticky; mildly alkaline; clear smooth boundary.

B2tca—5 to 12 inches; brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, very sticky; few thin clay films on faces of peds; calcareous; mildly alkaline; gradual smooth boundary.

B31ca—12 to 20 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, sticky; calcareous; moderately alkaline; clear smooth boundary.

B32ca—20 to 29 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, sticky; calcareous; moderately alkaline; gradual smooth boundary.

C1ca—29 to 36 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; weak fine prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky; calcareous; moderately alkaline; gradual smooth boundary.

C2ca—36 to 60 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; weak fine prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky; calcareous; moderately alkaline.

The solum is 10 to 40 inches thick. The content of rock fragments is 0 to 15 percent. The depth to calcareous material is 0 to 8 inches.

The A horizon has hue of 2.5Y to 7.5YR, value of 4 to 7 dry and 3 to 6 moist, and chroma of 1 to 4. It is clay loam or cobbly clay loam.

The B horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. It is clay or clay loam. The clay content is 35 to 45 percent. Reaction is mildly alkaline or moderately alkaline.

The C horizon has hue of 2.5Y to 7.5YR. It is clay loam or loam. Reaction is moderately alkaline or strongly alkaline.

McClave Series

The McClave series consists of deep, somewhat poorly drained soils on alluvial valley floors, concave flood plains, and low terraces. McClave soils formed in stratified, loamy alluvium derived from mixed sources. The slope is 0 to 3 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine-loamy, mixed, mesic Cumulic Haplaquolls.

Typical pedon of McClave clay loam, 0 to 3 percent slopes, 1,450 feet north and 250 feet west of the southeast corner of sec. 28, T. 2 S., R. 69 W.

A11—0 to 7 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, sticky; neutral; clear smooth boundary.

A12—7 to 12 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; slightly hard, friable, sticky; neutral; clear smooth boundary.

B2—12 to 26 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, sticky; mildly alkaline; gradual smooth boundary.

B3g—26 to 42 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, sticky; common fine distinct strong brown (7.5YR 5/6, moist) mottles; mildly alkaline; gradual smooth boundary.

Cg—42 to 60 inches; brown (10YR 5/3) sandy clay loam, brown to dark brown (10YR 4/3) moist; massive; hard, friable, sticky; many medium distinct strong brown (7.5YR 5/6, moist) mottles; moderately alkaline.

The mollic epipedon is 24 to 50 inches or more thick. The content of coarse fragments ranges from 0 to 15 percent and most commonly is less than 10 percent. McClave soils have a fluctuating high water table that moistens the C horizon and the lower part of the mollic epipedon. Reaction is neutral or mildly alkaline above a depth of 40 inches and neutral to moderately alkaline below that depth. There are mottles at a depth of 20 to 40 inches.

The A horizon has hue of 10YR or 2.5Y and value of 4 or 5 dry and 2 or 3 moist.

The B horizon has hue of 10YR or 2.5Y and value of 4 or 5 dry and 2 or 3 moist. It is loam, clay loam, or sandy clay loam. Mottles are common.

The C horizon has hue of 10YR or 2.5Y. It is sandy clay loam, loam, or clay loam.

Midway Series

The Midway series consists of shallow, well drained soils on the crest of ridges and on hill slopes. Midway soils formed in calcareous, clayey material derived from shale and mudstone. The slope is 9 to 60 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are clayey, montmorillonitic (calcareous), mesic, shallow Ustic Torriorthents.

Typical pedon of Midway clay loam, in an area of Renohill-Midway complex, 9 to 15 percent slopes, 30 feet east and 1,050 feet north of the southwest corner of sec. 2, T. 6 S., R. 69 W.

A1—0 to 3 inches; olive brown (2.5Y 4/4) clay loam, very dark grayish brown (2.5Y 3/2) moist; weak medium granular structure; hard, friable, sticky; neutral; abrupt smooth boundary.

AC—3 to 10 inches; light olive brown (2.5Y 5/4) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to coarse subangular blocky; very hard, firm, very sticky; calcareous; mildly alkaline; gradual smooth boundary.

Cca—10 to 14 inches; light yellowish brown (2.5Y 6/4) clay, olive brown (2.5Y 4/4) moist; weak thin platy structure grading to moderate subangular blocky; very hard, firm, very sticky; calcareous; moderately alkaline; 5 percent shale fragments; gradual wavy boundary.

Cr—14 inches; soft calcareous shale.

The depth to shale ranges from 6 to 20 inches. These soils commonly are calcareous throughout, but in some places they are leached of lime to a depth of 2 or 3 inches. The control section is 35 to 45 percent clay. The content of rock and shale fragments ranges from 0 to 15 percent.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 or 3. Soil that has value of 3 (moist) does not extend below a depth of 4 inches. The A horizon is clay loam, cobbly clay loam, or stony clay loam. Reaction is neutral to moderately alkaline.

The C horizon has hue of 10YR or 2.5Y. It is clay loam or clay. Reaction is moderately alkaline or strongly alkaline.

The Cr horizon is soft mudstone or shale.

Nederland Series

The Nederland series consists of deep, well drained soils on piedmont fan terraces, alluvial terraces, stable summits, and terrace escarpments. Nederland soils formed in cobbly, gravelly, and loamy alluvium derived from mixed sources. The slope is 0 to 50 percent. The average annual precipitation is 15 to 17 inches. The average annual temperature is 47° F. The average frost-free season ranges from 126 to 142 days. Elevation ranges from 5,600 to 6,500 feet.

These soils are loamy-skeletal, mixed, mesic Aridic Argiustolls.

Typical pedon of Nederland very cobbly sandy loam, in an area of Veldkamp-Nederland very cobbly sandy loams, 0 to 3 percent slopes, 1,050 feet east and 200 feet north of the southwest corner of the northwest quarter of sec. 33, T. 2 S., R. 70 W.

A1—0 to 7 inches; dark brown (10YR 3/3) very cobbly sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky; few stones, 40 percent cobbles, 20 percent gravel; mildly alkaline; clear smooth boundary.

A3—7 to 10 inches; brown to dark brown (7.5YR 4/2) very cobbly sandy loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky; few stones, 40 percent cobbles, 20 percent gravel; mildly alkaline; clear smooth boundary.

B21t—10 to 21 inches; dark brown (7.5YR 3/4) very cobbly sandy clay loam, dark brown (7.5YR 3/4) moist; moderate medium subangular blocky structure parting to moderate medium granular; hard, very friable, sticky; 40 percent cobbles, 20 percent gravel; common moderately thick clay films on faces of peds; neutral; gradual wavy boundary.

B22t—21 to 38 inches; strong brown (7.5YR 4/6) very cobbly sandy clay loam, strong brown (7.5YR 4/6) moist; moderate medium subangular blocky structure parting to moderate medium granular; hard, very friable, sticky; 10 percent stones, 30 percent cobbles, 20 percent gravel; common moderately thick clay films on faces of peds; neutral; gradual wavy boundary.

B3—38 to 62 inches; strong brown (7.5YR 4/6) very cobbly sandy clay loam, strong brown (7.5YR 4/6) moist; weak coarse subangular blocky structure; hard, very friable, sticky; 5 percent stones, 25 percent cobbles, 30 percent gravel; few thin clay films on faces of peds; neutral; gradual wavy boundary.

C—62 to 70 inches; strong brown (7.5YR 4/6) very stony sandy loam, strong brown (7.5YR 4/6) moist; single

grained; loose, slightly sticky; 20 percent stones, 20 percent cobbles, 20 percent gravel; neutral.

The mollic epipedon is 7 to 19 inches thick. The solum is more than 20 inches thick. The content of rock fragments ranges from 35 to 75 percent throughout. The fragments are dominantly 10 inches or less in diameter. In most places the soils are noncalcareous. Reaction is neutral to mildly alkaline.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B horizon has hue of 10YR or 7.5YR, value of 3 to 5 dry and 3 or 4 moist, and chroma of 4 to 6. The clay content is 20 to 35 percent.

The C horizon has hue of 10YR or 7.5YR. It is very cobbly sandy loam or very stony sandy loam. In some places it is at a depth of less than 60 inches.

The absence of hues redder than 7.5YR and a solum more than 60 inches thick place the Nederland soils out of the range established for the series. Thus, Nederland soils in this survey area are a taxadjunct to the series.

Nederland Variant

The Nederland Variant consists of deep, well drained soils on hill slopes and ridges of Green Mountain. Nederland Variant soils formed in cobbly, gravelly, and loamy alluvium derived from mixed sources. The slope is 30 to 50 percent. The average annual precipitation is 15 to 17 inches. The average annual temperature is 47° F. The average frost-free season ranges from 126 to 142 days. Elevation ranges from 6,200 to 6,900 feet.

These soils are loamy-skeletal, mixed, mesic Aridic Argiustolls.

Typical pedon of Nederland Variant very cobbly sandy loam, 30 to 50 percent slopes, 950 feet west and 360 feet south of the northeast corner of the northwest quarter of sec. 19, T. 4 S., R. 69 W.

A1—0 to 3 inches; brown to dark brown (10YR 4/3) very cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky; 20 percent cobbles, 30 percent gravel; medium acid; clear smooth boundary.

B21t—3 to 8 inches; brown to dark brown (10YR 4/3) very cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky; 20 percent cobbles, 30 percent gravel; medium acid; clear smooth boundary.

B22t—8 to 17 inches; brown to dark brown (10YR 4/3) very cobbly sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable, nonsticky; 25 percent cobbles, 25 percent gravel; neutral; gradual wavy boundary.

C—17 to 60 inches; yellowish brown (10YR 5/6) very cobbly loamy sand, dark yellowish brown (10YR 4/4) moist; single grained; loose, nonsticky; 30 percent cobbles, 30 percent gravel; neutral.

The solum is 15 to 40 inches thick. The content of rock fragments ranges from 35 to 65 percent. The fragments are dominantly gravel and cobbles. The soil is noncalcareous to a depth of 40 inches or more. Reaction is neutral to medium acid.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B horizon has hue of 10YR or 7.5YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 or 3. The clay content is 10 to 18 percent.

The C horizon has hue of 10YR or 7.5YR. It is stratified very cobbly loamy sand.

Niwot Series

The Niwot series consists of deep, somewhat poorly drained soils on alluvial valley floors, low terraces, and abandoned meander belts. Niwot soils formed in calcareous, stratified loamy over sandy and gravelly alluvium derived from mixed sources. The slope is 0 to 2 percent. The average annual precipitation ranges from 13 to 17 inches. The average annual temperature is 47° F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,200 feet.

These soils are fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls.

Typical pedon of Niwot gravelly loam, in an area of Alda-Niwot complex, 0 to 2 percent slopes, 110 feet east and 980 feet north of the southwest corner of sec. 15, T. 3 S., R. 69 W.

A11cag—0 to 5 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky; 20 percent gravel; calcareous; mildly alkaline; common fine distinct mottles; clear smooth boundary.

A12cag—5 to 13 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky; 30 percent gravel; calcareous; mildly alkaline; common fine distinct mottles; clear smooth boundary.

IICg—13 to 60 inches; light yellowish brown (10YR 6/4) very gravelly sand, yellowish brown (10YR 5/4) moist; single grained; loose, nonsticky; 15 percent cobbles, 40 percent gravel; many large distinct mottles; neutral.

The depth to very gravelly sand is 10 to 20 inches. The mollic epipedon is 7 to 20 inches thick. The upper part of the control section is 15 to 30 percent, by volume, coarse fragments, and it is 18 to 27 percent clay. In most places there are mottles in the lower part

of the mollic epipedon. The seasonal high water table is at a depth of 6 to 18 inches. In some areas the soils have been artificially drained.

The A horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 1 to 3. Reaction is neutral or mildly alkaline.

The IIC horizon has hue of 2.5Y through 10YR and is mottled throughout. Reaction is neutral.

Nunn Series

The Nunn series consists of deep, well drained soils on terraces, stable summits, alluvial fans, hill slopes, and tablelands. The soils formed in calcareous, clayey material derived from mudstone and shale (fig. 10). Slope is 0 to 25 percent. The average annual precipitation ranges from 13 to 17 inches. The average annual temperature is 47° F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Aridic Argiustolls.

Typical pedon of Nunn clay loam, in an area of Nunn-Urban land complex, 0 to 2 percent slopes, 100 feet west and 450 feet south of the center of sec. 15, T. 2 S., R. 69 W.

A1—0 to 2 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure and weak thin platy structure in the lower part of the horizon; hard, friable, sticky; neutral; clear smooth boundary.

B1—2 to 6 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky; few thin clay films on faces of peds; neutral; clear smooth boundary.

B21t—6 to 12 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; strong medium prismatic structure parting to strong medium to fine subangular blocky; hard, firm, sticky; few thin clay films on faces of peds; neutral; clear smooth boundary.

B22t—12 to 23 inches; brown (10YR 4/3) clay, brown (10YR 4/3) moist; strong medium prismatic structure parting to strong medium angular blocky; very hard, very firm, very sticky; few thin clay films on faces of peds; mildly alkaline; clear smooth boundary.

B23tca—23 to 30 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky; few thin clay films on faces of peds; soft masses, thin seams, and streaks of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

B3ca—30 to 35 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak coarse

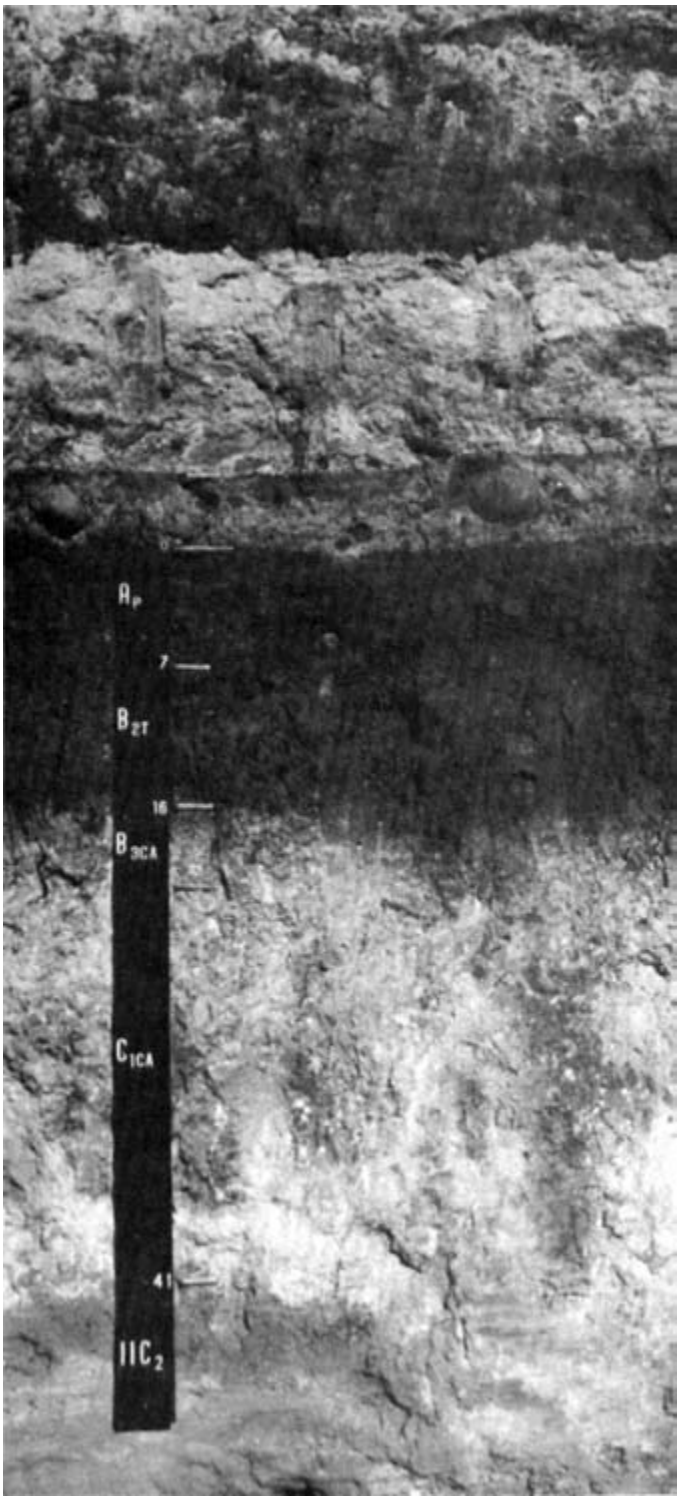


Figure 10.—Profile of Nunn clay loam, in an area of Nunn-Urban land complex, 5 to 9 percent slopes. The Nunn soil was buried under fill material when the land was leveled for use as homesites. Numbers on the right side of the scale indicate the depth in inches.

prismatic structure parting to weak coarse subangular blocky; very hard, very firm, sticky; few thin clay films on faces of peds; soft masses, thin seams, and streaks of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C1ca—35 to 48 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure; hard, firm, sticky; soft masses, thin seams, and streaks of calcium carbonate; calcareous; moderately alkaline; gradual smooth boundary.

C2ca—48 to 60 inches; very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable, sticky; thin seams and streaks of calcium carbonate; calcareous; moderately alkaline.

The solum is 16 to 40 inches thick. Depth to calcareous material is 10 to 30 inches. The mollic epipedon is 7 to 19 inches thick.

The A horizon has hue of 7.5YR to 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 1 to 3. It is clay loam or gravelly clay loam.

The B horizon has hue of 7.5YR to 2.5Y, value of 4 to 7 dry and 3 to 6 moist, and chroma of 2 or 3. It is clay or clay loam.

The C horizon has hue of 7.5YR to 2.5Y. It is clay loam or loam.

Nunn Variant

The Nunn Variant consists of deep, somewhat poorly drained and moderately well drained soils on terraces, alluvial fans, and flood plains. Nunn Variant soils formed in calcareous alluvium derived from mixed sources. The slope is 0 to 3 percent. The average annual precipitation ranges from 13 to 17 inches. The average annual temperature is about 47° F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Aquic Argiustolls.

Typical pedon of Nunn Variant clay loam, in an area of Nunn Variant-Urban land complex, 0 to 3 percent slopes, 1,375 feet east and 1,575 feet north of the southwest corner of sec. 14, T. 3 S., R. 69 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, sticky; neutral; clear smooth boundary.

B1—6 to 12 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure parting to weak fine granular; slightly hard, friable, sticky; neutral; clear smooth boundary.

B2tca—12 to 29 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak to moderate medium prismatic structure parting to weak to moderate medium subangular blocky; hard, firm, sticky; few thin clay films on faces of peds; calcareous; mildly alkaline; gradual wavy boundary.

B3cag—29 to 43 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, firm, sticky; few thin clay films on faces of peds; common medium distinct strong brown (7.5YR 5/8) mottles; calcareous; moderately alkaline; clear wavy boundary.

Ccag—43 to 60 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, sticky; common medium distinct strong brown (7.5YR 5/8) mottles; calcareous; moderately alkaline.

The solum is 16 to 40 inches thick. The depth to calcareous material is 10 to 20 inches. The seasonal high water table is at a depth of 24 to 72 inches. In some areas the soils have been artificially drained. The content of rock fragments generally is less than 5 percent, but the range is from 0 to 15 percent.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 5 dry and 2 or 3 moist, and chroma of 1 to 3. Reaction is neutral or mildly alkaline.

The B2t horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 to 4 moist, and chroma of 2 to 4. Soil that has value of 3 (moist) is at a depth of less than 20 inches. The B2t horizon is clay loam or clay. The clay content is 35 to 50 percent. Reaction is mildly alkaline or moderately alkaline.

The C horizon has hue of 10YR to 2.5Y. It is clay loam or loam. Reaction is mildly alkaline or moderately alkaline.

Paymaster Series

The Paymaster series consists of deep, well drained soils on low terraces. Paymaster soils formed in gravelly, sandy, and loamy alluvium derived from mixed sources. The slope is 0 to 3 percent. The average annual precipitation is 15 to 17 inches, and the average annual temperature is 47° F. The average frost-free season ranges from 126 to 142 days. Elevation ranges from 5,600 to 6,500 feet.

These soils are coarse-loamy, mixed, mesic Cumulic Haplustolls.

Typical pedon of Paymaster sandy loam, 0 to 3 percent slopes, 900 feet north and 1,820 feet east of the southwest corner of sec. 27, T. 6 S., R. 68 W.

A11—0 to 5 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky; 10 percent gravel; neutral; clear smooth boundary.

A12—5 to 21 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky; 15 percent gravel; neutral; clear wavy boundary.

IIA13b—21 to 36 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable, slightly sticky; 5 percent gravel; neutral; gradual wavy boundary.

IIIC—36 to 60 inches; grayish brown (10YR 5/2) stratified gravelly loamy sand and gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; massive parting to single grained; loose, nonsticky; 30 percent gravel; neutral.

The solum is 20 to 50 inches or more thick. The clay content in the control section from a depth of 10 to 40 inches is 5 to 18 percent. The content of rock fragments ranges from 0 to 15 percent in the control section and can be as much as 60 percent below a depth of 40 inches. Reaction is neutral or mildly alkaline.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The C horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is gravelly sandy loam, very gravelly sandy loam, gravelly loamy sand, or very gravelly loamy sand.

Peeler Series

The Peeler series consists of deep, well drained soils on north-facing, forested mountain side slopes. Peeler soils formed in acidic, stony, gravelly, and loamy material derived from metamorphic and igneous rocks. The slope is 15 to 50 percent. The average annual precipitation is 17 to 20 inches, and the average annual temperature is 41° to 43° F. The frost-free season ranges from 55 to 75 days. Elevation ranges from 7,200 to 9,500 feet.

These soils are fine-loamy, mixed Typic Cryoboralfs.

Typical pedon of Peeler stony sandy loam, in an area of Grimstone-Peeler-Rock outcrop complex, 30 to 50 percent slopes, 200 feet west and 400 feet south of the northeast corner of sec. 11, T. 5 S., R. 71 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) stony sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, loose, nonsticky; 5 percent stones, 15 percent gravel; slightly acid; clear smooth boundary.

A2—4 to 10 inches; pale brown (10YR 6/3) gravelly loamy sand, brown (10YR 5/3) moist; weak medium granular structure; soft, loose, nonsticky; 20 percent gravel; strongly acid; clear smooth boundary.

A&B—10 to 15 inches; light yellowish brown (10YR 6/4) gravelly loamy sand, yellowish brown (10YR 5/4) moist; weak medium granular structure; soft, very friable, nonsticky; few cobbles and 20 percent gravel; very strongly acid; clear smooth boundary.

B21t—15 to 29 inches; brown (7.5YR 5/4) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky; few thin clay films on mineral grains; few cobbles and 20 percent gravel; very strongly acid; gradual smooth boundary.

B22t—29 to 35 inches; strong brown (7.5YR 5/6) gravelly sandy clay loam, brown to dark brown (7.5YR 4/4) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, sticky; few thin clay films as bridges holding mineral grains together; few cobbles and 20 percent gravel; very strongly acid; gradual smooth boundary.

B3—35 to 60 inches; strong brown (7.5YR 5/6) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; hard, friable, sticky; few thin clay films as bridges holding mineral grains together; few cobbles and 20 percent gravel; strongly acid.

The solum is 20 to 60 inches or more thick. Rock fragments in the control section range from 0 to 35 percent.

The A1 horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. Reaction is slightly acid or medium acid.

The A2 horizon has hue of 2.5Y to 7.5YR, value of 5 to 8 dry and 4 to 7 moist, and chroma of 2 to 4. It is dominantly gravelly sandy loam and gravelly loamy sand. Reaction is slightly acid to strongly acid.

The B2t horizon has hue of 2.5Y to 7.5YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 6. It is gravelly sandy clay loam or gravelly sandy loam. The clay content is 18 to 35 percent. Reaction is slightly acid to very strongly acid.

In some places there is a C horizon. It has hue of 2.5Y to 7.5YR.

Platner Series

The Platner series consists of deep, well drained soils that formed in calcareous alluvial and eolian material derived from mudstone and shale. Platner soils are on tablelands, hill slopes, and high terraces. The slope is 0 to 5 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,000 feet.

These soils are fine, montmorillonitic, mesic Aridic Paleustolls.

Typical pedon of Platner loam, in an area of Platner-Urban land complex, 0 to 3 percent slopes, 400 feet

west and 1,375 feet south of the northeast corner of sec. 13, T. 2 S., R. 69 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) loam, dark brown (10YR 3/3) moist; moderate fine granular structure; slightly hard, friable, sticky; neutral; clear smooth boundary.

B2t—8 to 18 inches; dark grayish brown (10YR 4/2) clay, dark brown (10YR 4/3) moist; strong medium prismatic structure parting to strong medium subangular blocky; very hard, firm, sticky; neutral; clear smooth boundary.

B3ca—18 to 25 inches; yellowish brown (10YR 5/4) clay loam, yellowish brown (10YR 5/4) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; very hard, firm, sticky; common soft masses of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

C1ca—25 to 45 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; massive; hard, firm, sticky; soft masses of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

C2ca—45 to 60 inches; pink (7.5YR 7/4) loam, brown (7.5YR 4/4) moist; massive; slightly hard, friable, sticky; soft masses of calcium carbonate; calcareous; moderately alkaline.

Depth to calcareous material is 8 to 24 inches. The content of rock fragments ranges from 0 to 15 percent. The mollic epipedon is 7 to 20 inches thick.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 to 4. It is clay loam or clay. The clay content is 35 to 50 percent.

The C horizon has hue of 2.5Y, 7.5YR, or 10YR. It is clay loam or loam.

Primen Series

The Primen series consists of shallow, well drained soils on hill slopes and convex ridges. Primen soils formed in clayey, gravelly, stony, and cobbly material derived from mixed sources. The slope is 9 to 70 percent. The average annual precipitation ranges from 13 to 17 inches. The average annual temperature is 47° F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are clayey, montmorillonitic, mesic, shallow Aridic Argiustolls.

Typical pedon of Primen cobbly clay loam, in an area of Leyden-Primen-Standley cobbly clay loams, 15 to 50 percent slopes, 110 feet east and 1,750 feet south of the northwest corner of sec. 33, T. 3 S., R. 69 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) cobbly clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, sticky; 10 percent cobbles, 10 percent gravel; mildly alkaline; clear smooth boundary.

B1—4 to 9 inches; dark grayish brown (10YR 4/2) cobbly clay loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; hard, friable, sticky; few thin clay films on faces of peds; 10 percent cobbles, 15 percent gravel; mildly alkaline; clear smooth boundary.

B21t—9 to 14 inches; dark grayish brown (10YR 4/2) cobbly clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; very hard, firm, sticky; common thin clay films on faces of peds; 10 percent cobbles, 15 percent gravel; mildly alkaline; clear wavy boundary.

B22t—14 to 18 inches; dark grayish brown (2.5Y 4/2) gravelly clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; very hard, firm, sticky; few thin clay films on faces of peds; 15 percent gravel; mildly alkaline; gradual wavy boundary.

IICr—18 inches; light gray (2.5Y 7/2) soft sandstone, dark grayish brown (2.5Y 4/2) moist.

Depth to bedrock is 10 to 20 inches. The mollic epipedon is 7 to 20 inches thick. The content of rock fragments is 15 to 35 percent throughout the solum. The clay content is 35 to 50 percent throughout the solum. In some places the soil is calcareous throughout. The calcium carbonate content is 0 to 15 percent.

The A horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is cobbly clay loam, very cobbly clay loam, very stony clay loam, or extremely stony clay loam. Reaction is neutral or mildly alkaline.

The B horizon has hue of 2.5Y to 7.5YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 to 4. The darker colors are in the upper part. The B horizon is gravelly clay loam, gravelly clay, cobbly clay loam, or cobbly clay. Reaction is mildly alkaline or moderately alkaline.

The IICr horizon is soft interbedded shale, mudstone, and sandstone.

Raleigh Series

The Raleigh series consists of shallow, somewhat excessively drained soils on mountain side slopes and summits. Raleigh soils formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite. The slope is 2 to 70 percent. The average annual precipitation ranges from 17 to 20 inches, and the average annual temperature ranges from 41° to 45° F. The average frost-free season ranges from 55 to 125 days. Elevation ranges from 6,500 to 10,000 feet.

The soils are loamy-skeletal, mixed, shallow Typic Cryoborolls.

Typical pedon of Raleigh very gravelly sandy loam, 15 to 30 percent slopes, 1,750 feet west and 650 feet north of the southeast corner of sec. 35, T. 6 S., R. 72 W.

O1—1 inch to 0; partly decomposed needles and twigs.
A1—0 to 1 inch; grayish brown (10YR 5/2) very gravelly sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky; 45 percent angular gravel; neutral; clear smooth boundary.
B2—1 inch to 5 inches; brown (10YR 5/3) very gravelly sandy loam, dark brown (10YR 3/3) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky; 45 percent angular gravel; neutral; clear smooth boundary.
B3—5 to 8 inches; light brownish gray (10YR 6/2) very gravelly sandy loam, dark brown (10YR 3/3) moist; weak coarse subangular blocky structure; soft, very friable, slightly sticky; 50 percent angular gravel; neutral; gradual smooth boundary.
C—8 to 14 inches; brown (7.5YR 5/4) extremely gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; single grained; loose, nonsticky; 75 percent angular gravel; neutral; gradual smooth boundary.
Cr—14 inches; brown (7.5YR 5/4) weathered Pikes Peak Granite, brown to dark brown (7.5YR 4/4) moist.

The depth to the paralithic contact is 10 to 20 inches. Rock fragments are dominantly angular gravel 1/8 to 1 inch in diameter. Reaction is neutral or slightly acid.

The O horizon is 1 inch to 3 inches thick. In some places there is no O horizon.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is very gravelly sandy loam or stony sandy loam.

The B horizon has hue of 10YR or 7.5YR, value of 4 to 6 dry and 3 or 4 moist, and chroma of 2 or 3. Soil that has a value of 3 (moist) is at a depth of less than 16 inches.

Ratake Series

The Ratake series consists of shallow, well drained soils that formed in noncalcareous, stony, gravelly, and loamy colluvium and in residuum dominantly of igneous and metamorphic rocks. The soils are on mountain side slopes, summits, and ridges. The slope is 5 to 60 percent. The average annual precipitation ranges from 17 to 20 inches, and the average annual temperature is 43° to 47° F. The average frost-free season ranges from 76 to 125 days. Elevation ranges from 6,500 to 7,800 feet.

These soils are loamy-skeletal, mixed, shallow Typic Haploborolls.

Typical pedon of Ratake very stony sandy loam, in an area of Ratake-Cathedral-Rock outcrop complex, 25 to 60 percent slopes, 450 feet south and 425 feet east of the center of sec. 16, T. 4 S., R. 70 W.

A1—0 to 3 inches; dark brown (10YR 3/3) very stony sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable, nonsticky; 10 percent stones, 10 percent cobbles, and 10 percent gravel; neutral; clear smooth boundary.
B2—3 to 12 inches; dark brown (10YR 3/3) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak medium granular; hard, friable, slightly sticky; few cobbles, 40 percent gravel; neutral; diffuse smooth boundary.
Cr—12 inches; partly decomposed schist and gneiss bedrock.

Depth to soft bedrock is 10 to 20 inches. The content of rock fragments is 35 to 80 percent, by volume. Reaction is neutral or slightly acid. The mollic epipedon is 7 to 20 inches thick.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is stony sandy loam or very stony sandy loam.

The B horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 or 3.

The Cr horizon is soft, weathered schist, gneiss, or igneous rock.

Razor Series

The Razor series consists of moderately deep, well drained soils that formed in calcareous, clayey material derived from mudstone and shale. Razor soils are on ridges and hill slopes. The slope is 9 to 30 percent. The average annual precipitation is 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Ustollic Camborthids.

Typical pedon of Razor clay loam, in an area of Razor-Heldt clay loams, 9 to 25 percent slopes, 440 feet east and 235 feet south of the northwest corner of sec. 28, T. 5 S., R. 69 W.

A1—0 to 3 inches; dark grayish brown (2.5Y 4/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; weak fine granular structure; slightly hard, firm, sticky; neutral; clear smooth boundary.
B21—3 to 11 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, very sticky; mildly alkaline; clear smooth boundary.

B22—11 to 21 inches; light brownish gray (2.5Y 6/2) clay, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, very firm, very sticky; mildly alkaline; clear smooth boundary.
B23ca—21 to 31 inches; light yellowish brown (2.5Y 6/4) clay, grayish brown (2.5Y 5/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; extremely hard, very firm, very sticky; calcareous; mildly alkaline; clear smooth boundary.
Cr—31 inches; light yellowish brown (2.5Y 6/4) weathered shale, olive brown (2.5Y 4/4) moist; mildly alkaline.

The solum is 20 to 40 inches thick.

The A horizon has hue of 2.5Y or 10YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is clay loam or cobbly clay loam.

The B horizon has hue of 2.5Y or 10YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 4. It is clay loam or clay.

The Cr horizon is calcareous, soft mudstone or shale.

Rednun Series

The Rednun series consists of deep, well drained soils on fans, high terraces, and hill slopes. Rednun soils formed in calcareous, reddish, clayey material derived from sandstone and shale of the Fountain and Lykins Formations. The slope is 0 to 15 percent. The average annual precipitation is 15 to 17 inches. The average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,500 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Aridic Argiustolls.

Typical pedon of Rednun clay loam, 9 to 15 percent slopes, 135 feet south and 50 feet west of the northeast corner of sec. 25, T. 5 S, R. 70 W.

Ap—0 to 4 inches; grayish brown (10YR 5/2) clay loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, sticky; slightly acid; abrupt smooth boundary.
B1—4 to 10 inches; brown to dark brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, very sticky; few thin clay films on faces of peds; slightly acid; clear smooth boundary.
B2t—10 to 27 inches; reddish brown (5YR 5/3) clay, reddish brown (5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, very sticky; few thin clay films on faces of peds; neutral; clear smooth boundary.
B3ca—27 to 39 inches; light reddish brown (5YR 6/3) sandy clay loam, reddish brown (5YR 4/4) moist; weak medium prismatic structure parting to weak coarse subangular blocky; very hard, friable, sticky; few thin clay films on faces of peds; calcareous; mildly alkaline; clear smooth boundary.
Cca—39 to 60 inches; light reddish brown (5YR 6/3) sandy clay loam, reddish brown (5YR 4/4) moist; massive; hard, friable, sticky; calcareous; mildly alkaline.

The solum is 15 to 42 inches thick. The depth to calcareous material ranges from 10 to 30 inches. The mollic epipedon is 7 to 19 inches thick.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. Reaction is slightly acid to mildly alkaline.

The B2t horizon has hue of 5YR to 2.5YR, value of 5 or 6 dry and 3 or 4 moist, and chroma of 3 or 4. The darker colors are in the upper part. The B2t horizon is clay, sandy clay, or clay loam. The clay content ranges from 35 to 55 percent. Reaction is slightly acid to mildly alkaline.

The C horizon has hue of 5YR to 2.5YR. It is sandy clay loam, clay loam, or loam and is sandy loam in some places. It is mildly alkaline or moderately alkaline.

Renohill Series

The Renohill series consists of moderately deep, well drained soils that formed in calcareous, clayey material derived from interbedded soft shale, mudstone, and sandstone. Renohill soils are on ridges and hill slopes. The slope is 5 to 15 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Ustollic Haplargids.

Typical pedon of Renohill loam, 5 to 9 percent slopes, 660 feet west and 1,320 feet south of the northeast corner of the southeast quarter of sec. 3, T. 6 S., R. 69 W.

A1—0 to 3 inches; grayish brown (2.5Y 5/2) loam, very dark grayish brown (2.5Y 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky; neutral; clear smooth boundary.
B21t—3 to 6 inches; dark grayish brown (2.5Y 4/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure parting to weak fine angular blocky; few very thin clay films on faces of peds; hard, friable, sticky; neutral; clear smooth boundary.
B22tca—6 to 10 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist;

moderate medium prismatic structure parting to strong medium subangular blocky; hard, friable, sticky; thin continuous clay films on faces of peds; calcareous; mildly alkaline; clear smooth boundary.

B3ca—10 to 16 inches; light brownish gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; hard, friable, sticky; calcareous; moderately alkaline; gradual smooth boundary.

Cca—16 to 32 inches; pale yellow (2.5Y 7/4) clay loam, light yellowish brown (2.5Y 6/4) moist; massive; soft masses, thin seams, and streaks of calcium carbonate; calcareous; moderately alkaline; clear smooth boundary.

Cr—32 inches; light gray (2.5Y 7/2) partly weathered soft shale, grayish brown (2.5Y 5/2) moist.

Depth to bedrock is 20 to 40 inches. The solum is 15 to 30 inches thick. The content of shale and gravel is 0 to 15 percent. The depth to calcareous material is 6 to 20 inches.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 to 3. It is loam or clay loam.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6 dry and 4 or 5 moist, and chroma of 2 to 4. It is clay loam or clay.

The C horizon has hue of 2.5Y or 10YR.

Resort Series

The Resort series consists of shallow, somewhat excessively drained soils on mountain side slopes and summits that commonly have a south, east, or west aspect. The soils formed in noncalcareous, gravelly material derived from grus of the Pikes Peak Granite. The slope is 9 to 70 percent. The average annual precipitation is 17 to 20 inches, and the average annual temperature is 43° to 47° F. The average frost-free season ranges from 76 to 125 days. Elevation ranges from 6,500 to 7,800 feet.

These soils are sandy-skeletal, mixed, shallow Entic Haploborolls.

Typical pedon of Resort very gravelly sandy loam, in an area of Resort-Sphinx very gravelly sandy loams, 30 to 50 percent slopes, 70 feet west and 860 feet south of the center of sec. 17, T. 7 S., R. 70 W.

A1—0 to 3 inches; brown (10YR 5/3) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky; 45 percent gravel; neutral; clear smooth boundary.

B2—3 to 8 inches; brown to dark brown (10YR 4/3) very gravelly sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable, slightly sticky; 45 percent gravel; few thin clay films in pores; slightly acid; gradual wavy boundary.

C—8 to 15 inches; brown to dark brown (7.5YR 4/4) very gravelly loamy sand, brown to dark brown (7.5YR 4/4) moist; massive; loose, nonsticky; 45 percent gravel; neutral; gradual wavy boundary.

Cr—15 inches; reddish yellow (7.5YR 6/6) to light brown (7.5YR 6/4) weathered Pikes Peak Granite.

The depth to the paralithic contact is 10 to 20 inches. Rock fragments are dominantly angular gravel 1/2 to 1 inch in diameter. The clay content is 5 to 15 percent. Reaction is neutral or slightly acid.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 or 3.

Rogert Series

The Rogert series consists of shallow, well drained soils on mountain ridges and side slopes. The slopes commonly have a south, east, or west aspect. The soils formed in noncalcareous, stony and gravelly, loamy material derived from metamorphic and igneous rocks (fig. 11). The slope is 15 to 70 percent. The average annual precipitation is 17 to 20 inches, and the average annual temperature is 41° to 43° F. The frost-free season ranges from 55 to 75 days. Elevation ranges from 7,600 to 10,000 feet.

These soils are loamy-skeletal, mixed Lithic Cryoborolls.

Typical pedon of Rogert very stony sandy loam, in an area of Rogert-Herbman-Rock outcrop complex, 30 to 70 percent slopes, 1,015 feet west and 2,300 feet south of the northeast corner of sec. 13, T. 4 S., R. 72 W.

A11—0 to 4 inches; dark grayish brown (10YR 4/2) very stony sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky; 10 percent stones, 10 percent cobbles, 20 percent gravel; neutral; clear smooth boundary.

A12—4 to 13 inches; brown to dark brown (10YR 4/3) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky; 10 percent cobbles, 30 percent gravel; neutral; clear wavy boundary.

R—13 inches; yellow (10YR 7/6) pegmatite.

The depth to a lithic contact is 10 to 20 inches. Rock fragments make up 35 to 80 percent of the solum. They are 1/8 inch to 10 inches in diameter. Reaction is slightly acid or neutral. The mollic epipedon is 7 to 20 inches thick.

Figure 11.—Profile of Rogert cobbly sandy loam, in an area of Troutdale-Rogert-Kittredge complex, 15 to 30 percent slopes. Hard bedrock (pegmatite) is at a depth of less than 20 inches.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The R horizon is hard metamorphic or igneous rock.

Rooney Series

The Rooney series consists of shallow, well drained soils on convex hill slopes and ridges. The soils formed in cobbly and gravelly colluvium and in residuum of conglomerate and sandstone. The slope is 9 to 70 percent. The average annual precipitation ranges from 13 to 17 inches. The average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,600 to 6,500 feet.

These soils are loamy-skeletal, mixed, nonacid, mesic, shallow Ustic Torriorthents.

Typical pedon of Rooney very cobbly sandy loam, 15 to 50 percent slopes, 1,900 feet south and 1,575 feet west of the northeast corner of sec. 19, T. 4 S., R. 69 W.

A1—0 to 3 inches; olive brown (2.5Y 4/4) very cobbly sandy loam, very dark grayish brown (2.5Y 3/2) moist; weak fine granular structure; soft, very friable, nonsticky; 20 percent cobbles, 30 percent gravel; neutral; clear smooth boundary.

AC—3 to 8 inches; light olive brown (2.5Y 5/4) very gravelly sandy loam, very dark grayish brown (2.5Y 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky; 5 percent cobbles, 45 percent gravel; neutral; gradual smooth boundary.

Cr—8 inches; stratified conglomerate and sandstone.

The depth to a paralithic contact and the thickness of the solum range from 4 to 20 inches. Reaction is neutral or mildly alkaline. The clay content is 8 to 18 percent. The content of rock fragments ranges from 35 to 80 percent.

The A1 horizon has hue of 7.5YR to 2.5Y, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 to 4. It is less than 4 inches thick. It is very cobbly sandy loam or extremely cobbly sandy loam.

The AC horizon has hue of 7.5YR to 2.5Y, value of 4 to 6 dry and 4 or 5 moist, and chroma of 2 to 4. In some places there is no AC horizon.

Rosane Series

The Rosane series consists of deep, poorly drained soils that formed in loamy alluvium underlain by sand and gravel. Rosane soils are on alluvial valley floors, flood plains, and low terraces. The slope is 0 to 3 percent. The average annual precipitation is 17 to 20 inches, and the average annual temperature is 41° to 45° F. The frost-free season ranges from 55 to 125 days. Elevation ranges from 6,500 to 9,500 feet.

These soils are coarse-loamy, mixed Typic Cryaquolls.

Typical pedon of Rosane sandy loam, 0 to 3 percent slopes, 825 feet north and 1,725 feet east of the southwest corner of sec. 26, T. 7 S., R. 71 W.

A11—0 to 5 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky; neutral; clear smooth boundary.
A12g—5 to 12 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; common fine distinct strong brown (7.5YR 5/6, moist) mottles; weak fine granular structure; soft, very friable, slightly sticky; neutral; gradual wavy boundary.
ACg—12 to 23 inches; brown (10YR 5/3) sandy loam, dark grayish brown (10YR 4/2) moist; many medium distinct strong brown (7.5YR 5/6, moist) mottles; massive; soft, very friable, slightly sticky; neutral; gradual wavy boundary.
IICg—23 to 60 inches; pale brown (10YR 6/3) very gravelly loamy sand, brown (10YR 5/3) moist; many prominent mottles; 45 percent gravel; neutral.

The mollic epipedon is 10 to 16 inches thick. The depth to very gravelly loamy sand is 20 to 40 inches. Rock fragments make up 0 to 15 percent of the upper part of the control section and 35 to 70 percent of the substratum. The seasonal high water table is at a depth of 6 to 24 inches. The solum has distinct or prominent mottles.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 1 to 3. It is sandy loam or fine sandy loam. Distinct or prominent mottles are common in the lower part.

The IICg horizon is stratified.

Sphinx Series

The Sphinx series consists of shallow, somewhat excessively drained soils on mountain side slopes and ridges. The soils formed in gravelly, sandy material derived from grus of the Pikes Peak Granite. The slope is 9 to 70 percent. The average annual precipitation is 17 to 20 inches, and the average annual temperature is 43° to 47° F. The average frost-free season ranges from 76 to 125 days. Elevation ranges from 6,500 to 7,800 feet.

These soils are sandy-skeletal, mixed, frigid, shallow Typic Ustorthents.

Typical pedon of Sphinx very gravelly sandy loam, in an area of Resort-Sphinx very gravelly sandy loams, 30 to 50 percent slopes, 700 feet west and 920 feet south of the northeast corner of sec. 28, T. 7 S., R. 71 W.

A1—0 to 2 inches; brown to dark brown (10YR 4/3) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky; 40 percent angular gravel; neutral; clear smooth boundary.
AC—2 to 10 inches; yellowish brown (10YR 5/4) very gravelly loamy coarse sand, dark yellowish brown (10YR 4/4) moist; massive; loose, nonsticky; 55 percent angular gravel; slightly acid; gradual wavy boundary.
Cr—10 inches; strong brown (7.5YR 5/6) weathered Pikes Peak Granite.

The depth to bedrock is 8 to 20 inches. Rock fragments are dominantly angular gravel 1/8 to 1 inch in diameter. A few fragments are as much as 3 inches in diameter. The fine-earth fraction of the control section is 5 to 15 percent clay. Reaction is slightly acid or neutral.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 2 to 4.

The AC horizon has hue of 7.5YR or 10YR, value of 4 to 6 dry and 4 or 5 moist, and chroma of 4 or 5.

Sprucedale Series

The Sprucedale series consists of shallow, well drained soils on mountain side slopes, toe slopes, and summits and in knoblike areas. Sprucedale soils formed in noncalcareous, micaceous, gravelly, and loamy alluvial and colluvial material derived from igneous and metamorphic rocks, mainly schist, gneiss, and granitic rocks. The slope is 3 to 30 percent. The average annual precipitation is 17 to 20 inches. The average annual temperature is 41° to 43° F. The frost-free season ranges from 55 to 75 days. Elevation ranges from 7,600 to 9,500 feet.

These soils are loamy, mixed, shallow Argic Cryoborolls.

Typical pedon of Sprucedale gravelly sandy loam, in an area of Troutdale-Sprucedale gravelly sandy loams, 3 to 15 percent slopes, 1,400 feet east and 825 feet north of the southwest corner of sec. 29, T. 4 S., R. 71 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) gravelly sandy loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; soft, loose, slightly sticky; 20 percent gravel; neutral; clear smooth boundary.
B2t—6 to 12 inches; brown to dark brown (10YR 4/3) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, very friable, slightly sticky; 10 percent gravel; few thin clay films on faces of peds; neutral; clear wavy boundary.
Cr—12 inches; dark grayish brown (2.5Y 4/2) weathered micaceous schist.

The solum is 10 to 20 inches thick. The depth to bedrock is 10 to 20 inches. The mollic epipedon is 4 to 16 inches thick.

The A horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B2t horizon has hue of 2.5Y to 7.5YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 3 or 4. The darker colors are in the upper part. This horizon is loam, sandy loam, or gravelly sandy loam. It is 7 to 18 percent clay. Reaction is neutral or slightly acid.

The Cr horizon is weathered micaceous schist, gneiss, or fractured granitic rock.

Standley Series

The Standley series consists of deep, well drained soils that formed in calcareous, gravelly, cobbly, stony, and clayey material derived from mixed sources. Standley soils are on terraces, alluvial fans, ridges, and hill slopes. The slope is 0 to 60 percent. The average annual precipitation is 13 to 17 inches, and the average annual air temperature is 47° F. The average frost-free season ranges from 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Aridic Argiustolls.

Typical pedon of Standley gravelly clay loam, in an area of Standley-Nunn gravelly clay loams, 0 to 5 percent slopes, 80 feet east and 415 feet north of the southwest corner of the northwest quarter of sec. 16, T. 2 S., R. 69 W.

Ap1—0 to 5 inches; dark grayish brown (10YR 4/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, sticky; 15 percent gravel; mildly alkaline; abrupt smooth boundary.

Ap2—5 to 9 inches; dark grayish brown (10YR 4/2) gravelly clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, friable, sticky; 15 percent gravel; mildly alkaline; abrupt smooth boundary.

B2t—9 to 17 inches; brown (10YR 5/3) gravelly clay, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, very sticky; 15 percent gravel; mildly alkaline; clear smooth boundary.

B3ca—17 to 22 inches; pale brown (10YR 6/3) gravelly clay loam, brown to dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky; 15 percent gravel; calcium carbonate as coating on gravel; calcareous; moderately alkaline; clear wavy boundary.

C1ca—22 to 37 inches; very pale brown (10YR 8/3) gravelly clay loam, very pale brown (10YR 7/4) moist; massive; slightly hard, very friable, sticky; 15 percent gravel; calcium carbonate as thick coating on gravel; calcareous; moderately alkaline; gradual wavy boundary.

IIC2ca—37 to 60 inches; very pale brown (10YR 8/3) gravelly loam, very pale brown (10YR 7/4) moist; massive; slightly hard, very friable, sticky; 25 percent gravel; calcium carbonate as thick coating on gravel; calcareous; moderately alkaline.

The solum is 15 to 30 inches thick. Depth to calcareous material is 5 to 20 inches. The content of rock fragments is 15 to 35 percent in the solum. The fragments are mainly 1/8 inch to 3 inches in diameter; however, a few fragments range from 3 to 10 inches in diameter. In the horizons of calcium carbonate accumulation, calcium carbonate makes up 5 to 25 percent or more of the volume.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 dry and 2 or 3 moist, and chroma of 2 or 3. Reaction is neutral or mildly alkaline. The A horizon is gravelly clay loam, cobbly clay loam, very cobbly clay loam, very stony clay loam, or extremely stony clay loam.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 6 dry and 3 or 4 moist, and chroma of 2 or 3. Reaction is neutral to moderately alkaline. The B horizon is gravelly clay loam or gravelly clay. The clay content is 35 to 50 percent.

The C horizon has hue of 7.5YR to 2.5Y, value of 5 to 7 dry and 4 to 6 moist, and chroma of 3 to 6. It is gravelly loam or gravelly clay loam.

Stoneham Series

The Stoneham series consists of deep, well drained soils on hill slopes, knobs, and ridges. The soils formed in calcareous, loamy eolian and alluvial material derived from mixed sources. The slope is 9 to 15 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine-loamy, mixed, mesic Ustollic Haplargids.

Typical pedon of Stoneham loam, in an area of Manzanola-Renohill-Stoneham complex, 9 to 15 percent slopes, 325 feet south and 460 feet east of the northwest corner of sec. 19, T. 6 S., R. 67 W.

A1—0 to 3 inches; brown (10YR 5/3) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, sticky; 5 percent gravel; neutral; clear smooth boundary.

B2tca—3 to 12 inches; pale brown (10YR 6/3) clay loam, brown to dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky; few thin clay films on faces of peds; 5 percent gravel; few fine seams of calcium carbonate; calcareous; mildly alkaline; clear smooth boundary.

C1ca—12 to 30 inches; very pale brown (10YR 7/4) clay loam, light yellowish brown (10YR 6/4) moist; weak

medium prismatic structure parting to weak coarse subangular blocky; hard, friable, sticky; 5 percent gravel; calcareous; moderately alkaline; gradual smooth boundary.

C2ca—30 to 60 inches; very pale brown (10YR 7/4) loam, light yellowish brown (10YR 6/4) moist; massive; hard, friable, sticky; 10 percent gravel; calcareous; moderately alkaline.

The depth to calcareous material is 3 to 10 inches. The solum is 10 to 15 inches thick.

The A horizon has hue of 2.5Y to 7.5YR, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 or 3. Reaction is neutral or mildly alkaline.

The B2t horizon has hue of 2.5Y to 7.5YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 3 or 4. It is dominantly clay loam, but the range includes sandy clay loam and loam. The clay content ranges from 18 to 35 percent. Reaction is neutral or mildly alkaline.

The C horizon has hue of 2.5Y to 7.5YR. It is loam or sandy clay loam. Reaction is moderately alkaline or strongly alkaline.

Tolvar Series

The Tolvar series consists of deep, well drained soils on north-facing mountain side slopes. The soils formed in stony, gravelly, and loamy material derived from igneous and metamorphic rocks. The slope is 15 to 70 percent. The average annual precipitation is 17 to 20 inches. The average annual temperature is 41° to 43° F. The frost-free season ranges from 55 to 75 days. Elevation ranges from 6,500 to 10,000 feet.

These soils are loamy-skeletal, mixed Typic Cryoboralfs.

Typical pedon of Tolvar very gravelly loamy sand, 15 to 30 percent slopes, 1,250 feet west and 1,825 feet south of the northeast corner of sec. 18, T. 6 S., R. 71 W.

O1—2 inches to 0; partly decomposed needles and twigs.

A1—0 to 1 inch; grayish brown (10YR 5/2) very gravelly loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky; 5 percent cobbles, 40 percent gravel; slightly acid; abrupt smooth boundary.

A2—1 inch to 21 inches; white (10YR 8/2) very gravelly loamy sand, light brownish gray (10YR 6/2) moist; single grained; loose, nonsticky; 5 percent cobbles, 40 percent gravel; strongly acid; clear smooth boundary.

A&B—21 to 29 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; weak coarse subangular blocky structure; soft, friable, slightly sticky; 5 percent cobbles, 40 percent gravel; strongly acid; gradual wavy boundary.

B2t—29 to 60 inches; light brown (7.5YR 6/4) very gravelly sandy clay loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, firm, sticky; 5 percent cobbles, 40 percent gravel; strongly acid.

Rock fragments are dominantly gravel. Stones commonly are scattered throughout the profile and cover 2 percent of the surface. Reaction is slightly acid to strongly acid.

The A horizon has hue of 10YR or 7.5YR, value of 5 to 8 dry and 3 to 7 moist, and chroma of 2 to 4. It is very stony loamy sand or very gravelly loamy sand.

The A&B horizon has hue of 10YR or 7.5YR, value of 5 to 8 dry and 4 to 7 moist, and chroma of 2 to 4. It is very gravelly sandy loam and very gravelly sandy clay loam.

The B2t horizon has hue of 10YR or 7.5YR, value of 5 to 7 dry and 4 to 6 moist, and chroma of 2 to 6.

In some places there is a C horizon. It has hue of 2.5Y to 7.5YR.

Trag Series

The Trag series consists of deep, well drained soils on mountain side slopes and toe slopes and in drainageways. The soils formed in loamy alluvial and colluvial material derived from igneous and metamorphic rocks, mainly gneiss, schist, and granitic rocks. The slope is 3 to 25 percent. The average annual precipitation is 17 to 20 inches, and the average annual temperature is 43° to 47° F. The frost-free season ranges from 76 to 125 days. Elevation ranges from 6,500 to 7,800 feet.

These soils are fine-loamy, mixed Typic Argiborolls.

Typical pedon of Trag sandy loam, in an area of Lininger-Trag sandy loams, 9 to 20 percent slopes, 1,200 feet east and 1,140 feet north of the southwest corner of sec. 6, T. 5 S., R. 70 W.

A1—0 to 7 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; medium fine granular structure; soft, very friable, nonsticky; slightly acid; clear smooth boundary.

B21t—7 to 13 inches; brown to dark brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, firm, sticky; few thin clay films on faces of peds; slightly acid; clear smooth boundary.

B22t—13 to 32 inches; strong brown (7.5YR 4/6) sandy clay loam, strong brown (7.5YR 4/6) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky; common thin clay films on faces of peds; slightly acid; gradual smooth boundary.

B3t—32 to 60 inches; strong brown (7.5YR 5/6) sandy clay loam, strong brown (7.5YR 4/6) moist; weak

medium subangular blocky structure; slightly hard, very friable, sticky; few thin clay films as bridges holding mineral grains together; neutral.

The solum is 24 to 60 inches or more thick. The mollic epipedon is 7 to 16 inches thick. Reaction is neutral or slightly acid.

The A horizon has hue of 10YR or 7.5YR, value of 3 or 4 dry and 2 or 3 moist, and chroma of 2 or 3.

The B2t horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 3 or 4 moist, and chroma of 4 to 6. The darker colors are in the upper part. The B2t horizon is dominantly sandy clay loam, but the range includes clay loam and loam. The clay content is 22 to 35 percent.

In some places there is a C horizon. It has hue of 10YR or 7.5YR. It is stratified sandy loam and sandy clay loam. Depth to the C horizon commonly is more than 60 inches.

In part of the survey area, the Trag soils have a pachic epipedon, which places these soils out of the range established for the series. Thus, Trag soils in these areas are a taxadjunct to the series.

Troutdale Series

The Troutdale series consists of moderately deep, well drained soils on mountain side slopes, stable summits, and the crest of ridges. Troutdale soils formed in gravelly, loamy material derived dominantly from igneous and metamorphic rocks. The slope is 3 to 30 percent. The average annual precipitation is 17 to 20 inches, and the average annual temperature is 41° to 43° F. The frost-free season ranges from 55 to 75 days. Elevation ranges from 7,600 to 9,500 feet.

These soils are fine-loamy, mixed Argic Cryoborolls.

Typical pedon of Troutdale sandy loam, in an area of Troutdale-Kittredge sandy loams, 5 to 15 percent slopes, 150 feet west and 320 feet south of the northeast corner of the southeast quarter of sec. 24, T. 4 S., R. 72 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, friable, slightly sticky; 5 percent gravel; slightly acid; clear smooth boundary.

A3—4 to 8 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; hard, friable, slightly sticky; few thin clay films on faces of peds; 5 percent gravel; neutral; clear smooth boundary.

B21t—8 to 14 inches; brown to dark brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky; 5 percent gravel; common sand-sized flakes of mica; common moderately thick clay films on faces of peds; neutral; clear smooth boundary.

B22t—14 to 18 inches; brown to dark brown (7.5YR 4/4) sandy clay loam, brown to dark brown (7.5YR 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky; 10 percent gravel; common sand-sized flakes of mica; common thin clay films on faces of peds; neutral; clear smooth boundary.

B3—18 to 29 inches; brown to dark brown (7.5YR 4/4) coarse sandy loam, brown to dark brown (7.5YR 4/4) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, slightly sticky; 10 percent gravel; common to many sand-sized flakes of mica, mainly in the lower part of the horizon; very few thin clay films on faces of peds; neutral; clear wavy boundary.

Cr—29 inches; weathered schist.

The solum is 15 to 40 inches thick. Depth to the paralithic contact is 20 to 40 inches. The mollic epipedon is 7 to 16 inches thick. Reaction is neutral or slightly acid.

The A horizon has hue of 2.5Y to 7.5YR, value of 3 to 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is sandy loam or gravelly sandy loam.

The B2t horizon has hue of 2.5Y to 7.5YR, value of 4 to 5 dry and 3 or 4 moist, and chroma of 2 to 4. Soil that has value of 3 (moist) is at a depth of less than 16 inches. This horizon is sandy clay loam, loam, gravelly sandy clay loam, or clay loam. The clay content is 18 to 35 percent.

In some places there is a C horizon. It has hue of 2.5Y to 7.5YR. It is sandy loam, coarse sandy loam, or gravelly sandy loam.

The Cr horizon is weathered micaceous schist, gneiss, or granitic rock.

Truckton Series

The Truckton series consists of deep, well drained soils on high terraces, tablelands, and hill slopes. The soils formed in noncalcareous, sandy eolian material. The slope is 0 to 9 percent. The average annual precipitation is 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season is 126 to 142 days. Elevation ranges from 5,400 to 6,500 feet.

These soils are coarse-loamy, mixed, mesic Aridic Argiustolls.

Typical pedon of Truckton sandy loam, 0 to 3 percent slopes, 650 feet north and 280 feet east of the southwest corner of sec. 18, T. 6 S., R. 68 W.

A11—0 to 4 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, nonsticky; slightly acid; clear smooth boundary.

A12—4 to 7 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, nonsticky; slightly acid; clear smooth boundary.
B1—7 to 13 inches; brown (10YR 5/3) sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky; slightly acid; clear smooth boundary.
B2t—13 to 19 inches; yellowish brown (10YR 5/4) sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, slightly sticky; slightly acid; clear smooth boundary.
B3—19 to 35 inches; light yellowish brown (10YR 6/4) loamy sand, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky; neutral; gradual smooth boundary.
C—35 to 60 inches; very pale brown (10YR 7/4) loamy sand, light yellowish brown (10YR 6/4) moist; massive; slightly hard, very friable, nonsticky; neutral.

The solum is 15 to 40 inches thick. The content of rock fragments is 0 to 15 percent. Reaction is neutral or slightly acid. The mollic epipedon is 7 to 20 inches thick.

The A horizon has hue of 2.5Y to 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B2t horizon has hue of 2.5Y to 7.5YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 to 4.

The C horizon has hue of 10YR or 2.5Y. It is sandy loam or loamy sand.

Ulm Series

The Ulm series consists of deep, well drained soils on hill slopes, high terraces, and tablelands. Ulm soils formed in calcareous, clayey material derived from mudstone and shale. The slope is 0 to 18 percent. The average annual precipitation is 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are fine, montmorillonitic, mesic Ustollic Haplargids.

Typical pedon of Ulm clay loam, in an area of Ulm-Urban land complex, 0 to 3 percent slopes, 180 feet south and 540 feet west of the center of sec. 24, T. 2 S., R. 69 W.

Ap—0 to 6 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate fine granular structure; hard, very friable, slightly sticky; neutral; clear smooth boundary.
B21t—6 to 21 inches; yellowish brown (10YR 5/4) clay, brown to dark brown (10YR 4/3) moist; strong medium prismatic structure parting to strong medium angular blocky; extremely hard, firm, very sticky; common moderately thick clay films on faces of peds; neutral; gradual smooth boundary.
B22tca—21 to 29 inches; yellowish brown (10YR 5/4) clay, brown to dark brown (10YR 4/3) moist; strong coarse prismatic structure parting to strong coarse angular blocky; extremely hard, very firm, very sticky; common moderately thick clay films on faces of peds; calcareous; mildly alkaline; clear smooth boundary.
B31ca—29 to 42 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; very hard, firm, sticky; common thin clay films on faces of peds; calcareous; moderately alkaline; gradual smooth boundary.
B32ca—42 to 50 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; very hard, friable, sticky; few thin clay films on faces of peds; calcareous; moderately alkaline; clear smooth boundary.
Cca—50 to 60 inches; very pale brown (10YR 7/3) clay loam, light yellowish brown (10YR 6/4) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; very hard, friable, sticky; calcareous; moderately alkaline.

The solum is 15 to 50 inches thick. Depth to calcareous material is 12 to 30 inches.

The A horizon has hue of 2.5Y or 10YR and chroma of 2 or 3.

The B2t horizon has hue of 2.5Y or 10YR, value of 5 or 6 dry and 4 or 5 moist, and chroma of 3 or 4. It is dominantly clay or clay loam. The clay content is 35 to 50 percent.

The C horizon has hue of 2.5Y or 10YR. It is clay loam or loam.

Valmont Series

The Valmont series consists of deep, well drained soils on high terraces, hill slopes, and alluvial fans. Valmont soils formed in calcareous, clayey alluvium underlain by calcareous, very cobbly or very gravelly material. The slope is 0 to 3 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The average frost-free season is 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are clayey over loamy-skeletal, montmorillonitic, mesic Aridic Argiustolls.

Typical pedon of Valmont clay loam, 0 to 3 percent slopes, 60 feet west and 1,285 feet south of the northeast corner of sec. 1, T. 2 S., R. 70 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable, sticky; neutral; clear smooth boundary.

B1—4 to 7 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, sticky; few thin clay films on faces of peds and in pores; neutral; clear smooth boundary.

B21t—7 to 11 inches; grayish brown (10YR 5/2) clay, dark brown (10YR 3/3) moist; strong medium prismatic structure parting to strong medium angular blocky; extremely hard, very firm, very sticky; moderately thick continuous clay films on faces of peds and in pores; neutral; clear smooth boundary.

B22tca—11 to 17 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong coarse prismatic structure parting to strong coarse angular blocky; extremely hard, extremely firm, very sticky; moderately thick continuous clay films on faces of peds and in pores; calcareous; moderately alkaline; clear smooth boundary.

B23tca—17 to 24 inches; pale brown (10YR 6/3) clay, dark brown (10YR 4/3) moist; extremely hard, very firm, very plastic and very sticky; few thin clay films on faces of peds and in pores; calcareous; moderately alkaline; clear smooth boundary.

B3ca—24 to 31 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak coarse angular blocky; extremely hard, very firm, very sticky; few thin clay films on faces of peds and in pores; 15 percent gravel; calcareous; moderately alkaline; gradual smooth boundary.

IICca—31 to 60 inches; light gray (10YR 7/2) very gravelly sandy loam, pale brown (10YR 6/3) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky; 40 percent gravel; calcareous; moderately alkaline.

The depth to very cobbly or very gravelly material is 20 to 40 inches. The mollic epipedon is 7 to 19 inches thick. The content of rock fragments ranges from 0 to 15 percent in the solum but exceeds 35 percent in some part of the C horizon between depths of 20 and 40 inches. The depth to calcareous material is 8 to 20 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 1 to 3.

The B horizon has hue of 10YR or 2.5Y, value of 4 to 7 dry and 3 to 5 moist, and chroma of 2 or 3. It is clay or clay loam. The clay content is 35 to 50 percent.

The IIC horizon has hue of 10YR or 2.5Y. It is very gravelly sandy loam or very cobbly sandy loam.

Veldkamp Series

The Veldkamp series consists of deep, well drained soils on alluvial terraces, stable summits, and piedmont fan terraces. Veldkamp soils formed in noncalcareous, stratified, cobbly, gravelly, and clayey alluvial material. The slope is 0 to 3 percent. The average annual precipitation ranges from 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are clayey-skeletal, mixed, mesic Aridic Argiustolls.

Typical pedon of Veldkamp very cobbly sandy loam, in an area of Veldkamp-Nederland very cobbly sandy loams, 0 to 3 percent slopes, 105 feet north and 100 feet west of the southeast corner of the southwest quarter of sec. 2, T. 3 S., R. 70 W.

A1—0 to 3 inches; dark grayish brown (10YR 4/2) very cobbly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky; 20 percent cobbles, 20 percent gravel; neutral; clear smooth boundary.

B21t—3 to 6 inches; dark grayish brown (10YR 4/2) very cobbly clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to moderate medium granular; hard, firm, sticky; 20 percent cobbles, 20 percent gravel; few thin clay films on faces of peds and as coatings on rock fragments; neutral; clear smooth boundary.

B22t—6 to 12 inches; brown to dark brown (10YR 4/3) very cobbly clay, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, firm, very sticky; 20 percent cobbles, 20 percent gravel; common moderately thick clay films on faces of peds and as coatings on rock fragments; neutral; clear smooth boundary.

B23t—12 to 21 inches; dark yellowish brown (10YR 4/4) very cobbly clay loam, dark yellowish brown (10YR 3/4) moist; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, firm, sticky; 20 percent cobbles, 20 percent gravel; few thin clay films on faces of peds and as coatings on rock fragments; neutral; clear wavy boundary.

IIC—21 to 60 inches; dark yellowish brown (10YR 4/4) stratified very cobbly sandy loam, dark yellowish brown (10YR 3/4) moist; massive; slightly hard, friable, slightly sticky; 20 percent cobbles, 20 percent gravel; neutral.

The mollic epipedon is 7 to 20 inches thick. The solum is 15 to 30 inches thick. The content of rock fragments ranges from 35 to 60 percent. Reaction is neutral or mildly alkaline.

The A horizon has hue of 7.5YR to 2.5Y, value of 3 to 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B2t horizon has hue of 7.5YR to 2.5Y, value of 3 to 6 dry and 2 to 5 moist, and chroma of 3 to 5. Soil that has value of 2 or 3 (moist) is at a depth of less than 20 inches. The B2t horizon commonly is very cobbly. The clay content is 35 to 50 percent.

The C horizon has hue of 7.5YR to 2.5Y. It is stratified and commonly is very cobbly. The clay content is 8 to 25 percent.

Venable Series

The Venable series consists of deep, poorly drained soils on alluvial valley floors, low terraces, and flood plains of the mountains. Venable soils formed in loamy alluvium derived from igneous and metamorphic rocks. The slope is 0 to 9 percent. The average annual precipitation ranges from 17 to 20 inches, and the average annual temperature is 41° to 43° F. The frost-free season ranges from 55 to 75 days. Elevation ranges from 7,200 to 9,500 feet.

These soils are fine-loamy, mixed Cumulic Cryaquolls.

Typical pedon of Venable loam, 3 to 9 percent slopes, 1,220 feet east and 150 feet north of the southwest corner of sec. 29, T. 4 S., R. 71 W.

A1—0 to 5 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable, nonsticky; 5 percent gravel; neutral; clear smooth boundary.

B21—5 to 14 inches; very dark grayish brown (10YR 3/2) sandy clay loam, very dark brown (10YR 2/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky; 5 percent gravel; neutral; gradual smooth boundary.

B22g—14 to 28 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky; 5 percent gravel; few medium faint yellowish red (7.5YR 6/8) mottles; neutral; gradual smooth boundary.

B23g—28 to 43 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; very hard, firm, sticky; 5 percent gravel; few medium faint yellowish red (7.5YR 6/8) mottles; neutral; gradual smooth boundary.

IICg—43 to 60 inches; grayish brown (10YR 5/2) sandy loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure parting to single grained; slightly hard, friable, nonsticky; common medium distinct yellowish red (7.5YR 6/8) mottles; neutral.

The solum is 20 to 50 inches thick. The mollic epipedon is 20 to 50 inches thick. The content of rock fragments ranges from 0 to 15 percent. Reaction is neutral or slightly acid. The clay content is 18 to 35 percent. The depth to the seasonal high water table ranges from 6 to 30 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4 dry and 2 or 3 moist, and chroma of 1 or 2. It is loam or fine sandy loam.

The B horizon has hue of 7.5YR or 10YR, value of 3 to 5 dry and 2 to 4 moist, and chroma of 2 or 3. It is clay loam, loam, or sandy clay loam.

The C horizon has hue of 2.5Y to 7.5YR. It is highly stratified and is variable in texture.

Wann Series

The Wann series consists of deep, somewhat poorly drained soils on alluvial valley floors, flood plains, and low terraces. Wann soils formed in stratified, loamy alluvium derived from mixed sources. The slope is 0 to 2 percent. The average annual precipitation is 13 to 17 inches. The average annual temperature is 47° F. The average frost-free season ranges from 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are coarse-loamy, mixed, mesic Fluvaquentic Haplustolls.

Typical pedon of Wann fine sandy loam, 0 to 2 percent slopes, 1,010 feet west and 70 feet north of the southeast corner of the northeast quarter of sec. 1, T. 3 S., R. 70 W.

Ap1—0 to 6 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure parting to weak fine granular; soft, very friable, nonsticky; neutral; clear smooth boundary.

A12—6 to 13 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; soft, very friable, nonsticky; neutral; clear smooth boundary.

C1g—13 to 20 inches; yellowish brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; soft, friable, slightly sticky; few fine faint mottles; mildly alkaline; clear smooth boundary.

C2g—20 to 37 inches; yellowish brown (10YR 5/4) fine sandy loam, brown to dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; soft, friable, slightly sticky; common medium prominent mottles; mildly alkaline; clear smooth boundary.

IIC3g—37 to 60 inches; brownish yellow (10YR 6/6) sandy clay loam, yellowish brown (10YR 5/6) moist; moderate medium subangular blocky structure; soft, friable, sticky; many medium prominent mottles; mildly alkaline.

The solum is 10 to 20 inches thick. The mollic epipedon is 8 to 20 inches thick. The control section is 0 to 15 percent rock fragments. The content of clay in the control section is 10 to 18 percent. The depth to the seasonal high water table ranges from 18 to 42 inches.

The A horizon has hue of 7.5YR to 2.5Y, value of 3 to 5 dry and 2 to 4 moist, and chroma of 2 or 3.

The C horizon has hue of 7.5YR to 2.5Y, value of 5 or 6 dry and 4 or 5 moist, and chroma of 3 to 6. It is stratified fine sandy loam to sandy clay loam.

Cooler temperatures and less precipitation in the survey area and the absence of free carbonates within a depth of 40 inches place the Wann soils out of the range established for the series. Thus, Wann soils in this area are a taxadjunct to the series.

Willowman Series

The Willowman series consists of deep, well drained soils on ridges, hill slopes, knobs, and terrace escarpments. Willowman soils formed in calcareous, cobbly, gravelly, and loamy alluvium. The slope is 0 to 30 percent. The average annual precipitation is 13 to 17 inches, and the average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are loamy-skeletal, mixed, mesic Aridic Argiustolls.

Typical pedon of Willowman cobbly loam, in an area of Willowman-Leyden cobbly loams, 9 to 30 percent slopes, 15 feet west and 750 feet north of the southeast corner of sec. 12, T. 2 S., R. 70 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) cobbly loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable, sticky; 15 percent cobbles, 15 percent gravel; mildly alkaline; clear smooth boundary.

B2t—6 to 10 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky; few thin clay films on faces of peds; 15 percent cobbles, 25 percent gravel; calcareous; mildly alkaline; clear wavy boundary.

B3ca—10 to 15 inches; light brownish gray (10YR 6/2) very gravelly loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, sticky; few thin clay films on faces of peds; 10 percent cobbles, 30 percent gravel; calcareous; mildly alkaline; clear wavy boundary.

C1ca—15 to 29 inches; white (10YR 8/2) very gravelly loam, very pale brown (10YR 7/3) moist; massive; slightly hard, very friable, sticky; 10 percent cobbles, 30 percent gravel; calcareous; moderately alkaline; gradual wavy boundary.

C2ca—29 to 60 inches; very pale brown (10YR 8/3) very gravelly sandy loam, very pale brown (10YR 7/3) moist; massive; slightly hard, very friable, slightly sticky; 10 percent cobbles, 30 percent gravel; calcareous; moderately alkaline.

The solum is 7 to 20 inches thick. The mollic epipedon is 7 to 20 inches thick. The depth to carbonates ranges from 7 to 30 inches.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is cobbly sandy loam or cobbly loam.

The B2t horizon has hue of 10YR or 7.5YR, value of 4 to 6 dry and 3 to 5 moist, and chroma of 2 to 4. It is very gravelly loam, very gravelly clay loam, or very gravelly sandy clay loam. The clay content is 18 to 35 percent.

The C horizon has hue of 10YR or 7.5YR. It commonly is very gravelly sandy loam or very gravelly loam. The content of calcium carbonate, on the average, is 15 to 40 percent.

Yoder Variant

The Yoder Variant consists of deep, somewhat excessively drained soils on alluvial fans, hill slopes, and ridges. The soils formed in reddish, noncalcareous, gravelly, and sandy alluvium. The slope is 9 to 60 percent. The average annual precipitation is 13 to 17 inches. The average annual temperature is 47° F. The frost-free season ranges from 126 to 142 days. Elevation ranges from 5,200 to 6,500 feet.

These soils are sandy-skeletal, mixed, mesic Ustollic Camborthids.

Typical pedon of Yoder Variant gravelly sandy loam, 9 to 30 percent slopes, 36 feet west of the center of sec. 2, T. 6 S., R. 69 W.

A1—0 to 3 inches; dark brown (7.5YR 4/2) gravelly sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky; 25 percent gravel; neutral; clear smooth boundary.

B21—3 to 8 inches; reddish brown (5YR 5/4) gravelly sandy loam, reddish brown (5YR 4/4) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky; few thin clay films on faces of peds and in root channels; 25 percent gravel; neutral; clear smooth boundary.

B22—8 to 15 inches; yellowish red (5YR 4/6) gravelly sandy loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; hard, friable, nonsticky; few thin clay films on faces of peds and in root channels; 30 percent gravel; neutral; gradual smooth boundary.

IIC—15 to 60 inches; yellowish red (5YR 4/6) very gravelly loamy sand, reddish brown (5YR 4/4) moist;

massive; hard, very friable, nonsticky; 40 percent gravel; neutral.

The depth to very gravelly loamy sand is 10 to 20 inches. The soils commonly are noncalcareous, but in some places there is calcium carbonate at a depth of more than 40 inches. The content of rock fragments ranges from 15 to 35 percent in the solum and 35 to 60 percent in the IIC horizon. The fragments are dominantly 1/8 inch to 3 inches in diameter. Reaction is neutral or slightly acid.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3.

The B2 horizon has hue of 5YR to 7.5YR, value of 3 to 6 dry and 2 to 5 moist, and chroma of 4 to 6.

The C horizon has hue of 5YR to 7.5YR.

Formation of the Soils

In this section, the factors of soil formation are discussed as they relate to the soils in the survey area, and the processes of soil formation are explained.

Soil is formed by the action of soil-forming processes on parent material that was deposited or accumulated by geologic forces. The characteristics of the soil are determined by the interaction of five factors of soil formation: (1) the physical and mineralogical composition of the parent material; (2) the climate under which the parent material has accumulated and existed since accumulation; (3) the living organisms on and in the soil; (4) the topography, or lay of the land; and (5) the length of time these forces have acted on the parent material. Under different conditions, some factors are more effective than others. Where any one factor varies widely from place to place, different soils are formed.

Parent Material

The Golden Area has many kinds of parent material that derived from the diverse geology of the area. Different rock types, mineralogy, color, chemical reaction, consistence, and other physical and chemical characteristics of the parent material are important in determining the characteristics of a soil profile.

The dominant parent materials in the area are discussed in the following paragraphs.

Alluvium—Alluvium is present on recent flood plains and terraces and on piedmont slopes as old as early Pleistocene.

The recent deposits on flood plains and low terraces most commonly are made up of stratified, rounded rock fragments that have Precambrian igneous and metamorphic lithology and layers of finer textured material derived from mixed sources. In some areas there are rock fragments derived from sandstone and conglomerate, particularly just east of the hogbacks and in the Douglas County part of the survey area. In most places this recent alluvium correlates with the Post Piney Creek alluvium. Many of the areas are too narrow to delineate at the scale used in mapping. Examples of young alluvial soils on flood plains and low terraces are Fluvaquents, sandy; Torrifluvents, very gravelly; and Cryofluvents. These soils show minimal evidence of soil development because a relatively short time has passed since their deposition.

The Piney Creek Alluvium is on low terraces, most commonly adjacent to flood plains. This alluvium is Holocene in age but is older than the Post Piney Creek alluvium. Rock fragments, where present, commonly have igneous or metamorphic lithology and generally show evidence of fluvial stratification. Texture of the fine-earth fraction varies according to the source of the parent material. Soils that formed in alluvium derived from shale and mudstone are fine-loamy and clayey, for example, the Haverson, McClave, Arvada, and Lebsack soils. Soils that formed in alluvium derived from sandstone are coarse-loamy, for example, the Paymaster soils. These soils generally exhibit more pedogenic development than the soils associated with the Post Piney Creek alluvium. Paymaster, McClave, and Lebsack soils have a thick A horizon, and Arvada soils have developed a clayey B horizon. Most of these soils exhibit secondary enrichment of calcium carbonate, which indicates relative stability in respect to erosion. In the mountains, soils that formed in Piney Creek Alluvium have Precambrian igneous and metamorphic rocks as original parent material. The texture of these soils commonly is fine-loamy and coarse-loamy, and there generally is a secondary accumulation of clay in the B horizon. Most of the soils have a thick A horizon. Kittredge, Earcree, Venable, and Trag soils are examples.

The Golden Area has a well documented sequence of Pleistocene terraces and piedmont slopes. These Pleistocene alluviums of various ages were originally deposited by ancestral streams. Because of cycles of uplift and climatic change, the streams have eroded downward and left their alluvial deposits high above the current flood plain. Some of these alluviums show a good chronosequence of increased soil development corresponding to greater age of the alluvial parent material. However, in many areas of Pleistocene terraces there is on the surface a transported mantle of younger material that is Holocene in age. Therefore, Pleistocene terraces of varying age can have similar soil development. In some areas, soils of the same series are on terraces of different ages. For example, soils of the Nunn series formed in a transported mantle deposited over the Broadway (Pinedale Glaciation), Louviers (Bull Lake Glaciation), and Slocum (Illinoian or Sangamon) Alluviums. This transported mantle generally is more than 5 or 6 feet thick and exceeds the normal depth of sampling for soil survey. Where this transported mantle thins to a depth of 20 to 40 inches over the

Louviers Alluvium, the Dacono Variant soil has formed. This soil exhibits the often contrasting properties of the mantle and the alluvium. The mantle is clayey and has some rounded pebbles. The Louviers Alluvium is sandy-skeletal. The mode of deposition of this transported mantle is presumed to be primarily alluvial, but some areas show evidence of colluvial and eolian deposition.

Some areas of Pleistocene terraces and piedmont slopes locally have been relatively undisturbed by deposition or erosion since the alluvium was deposited. The major Pleistocene deposit, which has the oldest alluvium and consequently the best developed soil, is the Rocky Flats Alluvium. The Rocky Flats Alluvium (Nebraskan or Aftonian in age) has been calculated to be 910,000 years old. The Flatirons soil series is dominant on the Rocky Flats Alluvium in the northern part of the area. The Flatirons soils exhibit a high degree of pedogenic development. They have a well developed dark surface layer (mollic epipedon), and there is an abrupt increase in clay content from the surface layer to the B horizon (argillic horizon). The fine-earth fraction of the B horizon is clayey and developed from very coarse alluvial parent material. Some part of the B horizon has red hues (5YR or redder).

The Verdos Alluvium (Kansan or Yarmouth in age) is just younger than the Rocky Flats Alluvium. It has been estimated to be 600,000 years old. In the northern part of the survey area it exhibits good pedogenic development. Nederland soils are among the dominant soils on the Verdos Alluvium in this area. Nederland soils have a developed dark surface layer (mollic epipedon); they have a fine-loamy control section in the fine-earth fraction, which developed from very coarse alluvium; and they have a thick solum. However, these soils do not exhibit the degree of development seen in the older Flatirons soils.

Material that weathered from shale and mudstone—This material commonly is calcareous and clayey and is derived from several different geologic formations, mainly from the Pierre Shale, the Laramie Formation, and the Arapahoe Formation (all Upper Cretaceous in age) and the Denver Formation, which spans the Cretaceous-Tertiary boundary. These formations are exposed east of the mountain front. The soils that formed in this parent material commonly have a well developed argillic B horizon and commonly have secondary accumulations of calcium carbonate, which indicate relative stability in respect to erosion and to further deposition. This parent material was deposited primarily as a transported mantle over older surfaces (*Alluvium*) as alluvium, colluvium, and loess. The age of this transported mantle is presumed to be Holocene. Nunn, Denver, Ulm, Manzanola, Heldt, Platner, Renohill, and Kutch soils formed in this material.

Material that weathered from igneous and metamorphic rocks in the mountains—This material commonly is noncalcareous and loamy or sandy, and it varies widely in the percentage of rock fragments. The dominant rock types are Precambrian gneiss, schist, phyllite, granite, quartz monzonite, and pegmatite dikes (fig. 12). The soils that formed in this parent material do not have the same kind and degree of development because of the influence of other soil-forming factors. This parent material commonly was deposited by colluvial or alluvial action, or it is residuum that weathered in place from the bedrock. Its age is mainly Holocene. Herbman, Hiwan, Grimstone, Troutdale, Lininger, and Raleigh soils formed in this parent material.

Material that weathered from red sedimentary rock—This material commonly is loamy or clayey and has red hues (5YR or redder) derived from the reddish bedrock of the Fountain Formation (Pennsylvanian and Permian in age) and the Lykins Formation (Permian and Triassic in age). Most soils that formed in this parent material have a mollic epipedon and an argillic horizon, which indicate that the soils are relatively unmodified by erosion and further deposition. This parent material commonly was deposited by alluvial action, which lays down a transported mantle, or, on steeper slopes, by colluvial action. Its age presumably is Holocene. Rednun, Lavate, Critchell, and Hargreave soils formed in this parent material.

Material that weathered from volcanic rock overlying mudstone and shale—This material commonly is clayey and stony. The stones derived from Tertiary volcanic rock (latite and monzonite), and the clayey material derived primarily from the Denver Formation, which is Cretaceous and Tertiary in age. This combination of sources of parent material is confined to North and South Table Mountains and the Ralston Dike, east and southeast of Ralston Reservoir. The parent material was deposited primarily by colluvial action on the steeper slopes; on the mesa tops, loess is predominant. The age of these parent materials is presumed to be Holocene. Lavina, Baller Variant, Leyden, Standley, and Primen soils formed in this parent material. (Leyden, Standley, and Primen soils also formed in parent material derived from other sources or combinations of sources.)

Material that weathered from conglomerate and sandstone overlying mudstone and shale—This material commonly is cobbly, gravelly, and clayey. The cobbles and gravel derived from the conglomerate, and the clayey material derived from the underlying shale and mudstone. This unique mixture of sources of parent material is derived from the Tertiary Dawson Arkose. It is in the southern part of the survey area in Douglas County. The parent material was deposited primarily by colluvial action on steep side slopes, by wind action (which produced the clayey loess) on stable summits, and by alluvial action in drainageways and on low terraces. The age of these deposits commonly is Holocene, but the clayey loess on the stable summits is Pleistocene in age. Rooney soils formed on the conglomerate, Leyden and Primen soils formed on the shale and mudstone below the conglomerate, and Nunn

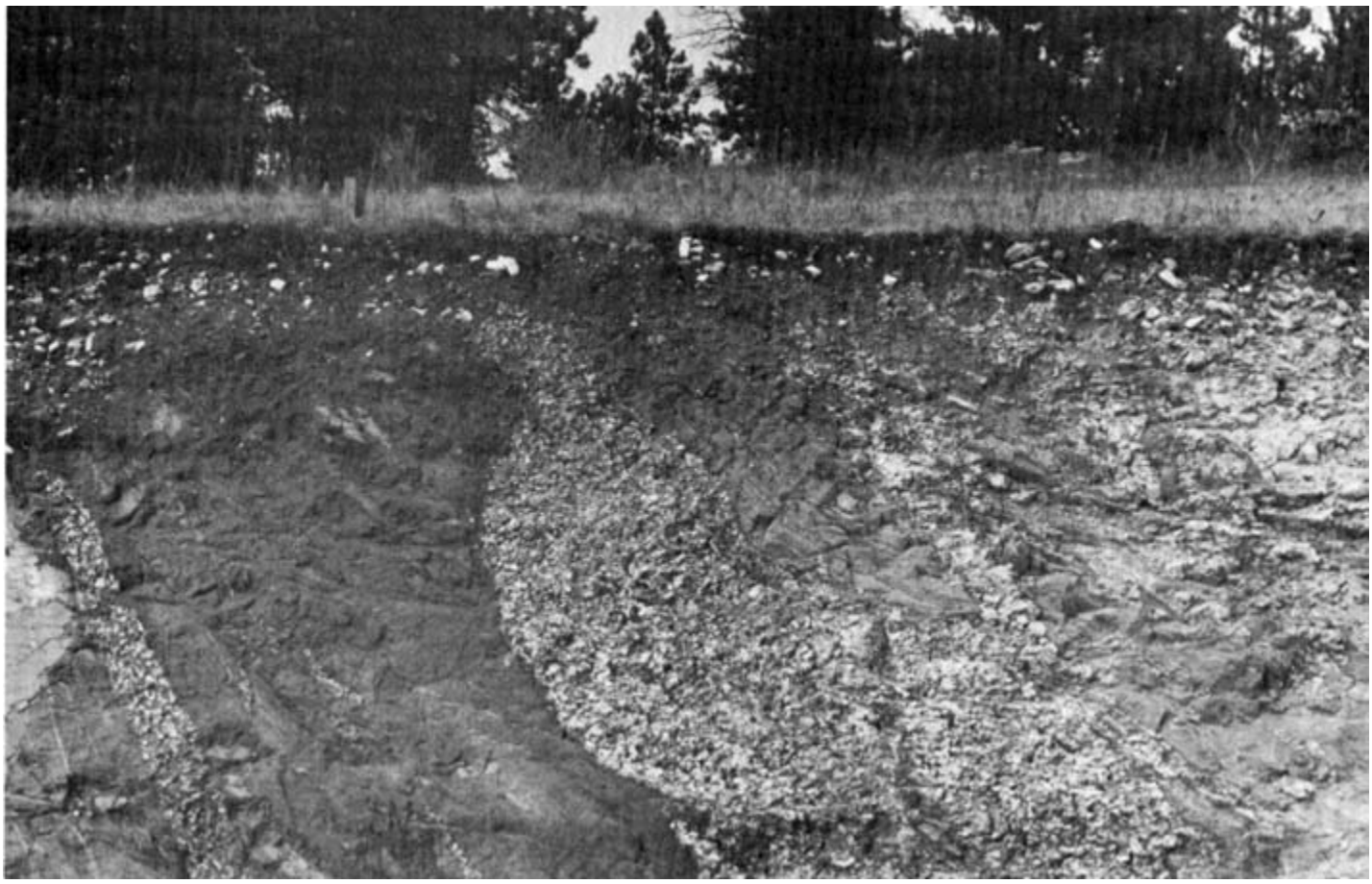


Figure 12.—This deep cut into bedrock in an area of Troutdale-Rogert-Kittredge complex, 15 to 30 percent slopes, shows light-colored pegmatite dikes intruding into gneiss and schist.

soils formed in the clayey loess. These soils also formed in parent material derived from other sources or combinations of sources.

Loess derived from alluvial sands—This material consists of noncalcareous, sandy, windblown deposits derived from alluvial sand along the South Platte River. Its location is southeast of the South Platte River in Douglas County. The loess was deposited as a thick mantle. Its age is correlated as Holocene. In most areas of this parent material, the soils show little pedogenic development. Blakeland, Truckton, and Bresser soils formed in this parent material.

Material accruing from the activities of man—This material is the product of excavations, fills, and mining operations. Although this material is small in extent, it tends to increase as the activities of man increase in the area. The characteristics and properties of this parent material are highly variable, depending on the source, degree of disturbance, and location. Very little or no evidence of soil development can be seen because of the relative youth of this material. Ustic Torriorthents, clayey, are an example of soils forming in this parent material.

Climate

Through its influence on the vegetation, on the rate of biological activity, and on the physical and chemical weathering of parent material, climate has materially affected the development of the soils in the Golden Area. Soil temperature and moisture exert most influence, but wind velocity and humidity are also significant.

The Golden Area has a wide variation in average annual temperature, annual precipitation, and frost-free season. Generally, as elevation increases, the average annual temperature is lower, annual precipitation is higher, and the average frost-free season is shorter. On

the plains in the northeastern part of the survey area, elevation is generally between 5,200 and 5,600 feet, the average annual temperature is 47° F or more, the average annual precipitation is 13 to 15 inches, and the frost-free season ranges from 126 to 142 days. The foothills area, which parallels the mountain front to eastward, ranges in elevation from 5,600 to 6,500 feet; the average annual temperature is 47° F, the average annual precipitation is 15 to 17 inches, and the frost-free season is 126 to 142 days. In the mountains, from an elevation of 6,500 to 7,800 feet, the average annual temperature is 43° to 47° F, the average annual precipitation is 17 to 20 inches, and the frost-free season ranges from 76 to 125 days. At elevations of 7,800 to 10,000 feet, the average annual temperature is 41° to 43° F, the average annual precipitation is 17 to 20 inches, and the frost-free season ranges from 55 to 75 days. Local variations in climate occur within these ranges in elevation, particularly in the mountains where soils on north-facing slopes generally are cooler and have a shorter growing season than soils on south-facing slopes.

Moisture in and on the soil and temperature and variations in temperature affect the accumulation of organic matter in the soil, the movement of substances in solution and in suspension, and the rate of physical and mechanical weathering.

Living Organisms

Plants, bacteria, fungi, and animals play an important role in the formation of soils. Plants supply nearly all the organic matter in the soil. The surface layer of the soil commonly is dark because of its comparatively high content of organic matter. Most plants take nutrients from the soil. When the plants decompose on and in the soil, the nutrients are returned to the soil to be utilized again. Plant residue is decomposed primarily by bacteria and fungi. Nitrogen is added to the soil by microorganisms alone or in association with plants. The plant cover reduces natural erosion and the rate of water runoff. Earthworms, insects, and burrowing animals mix soils and commonly affect soil structure by making the soil more porous.

The activities of man in the Golden Area have affected the formation of soil. In some areas the soils have been made more porous and fertile by tillage and management practices. Many areas of heavy traffic have become compacted. In other areas the soils have been mixed, disturbed, and buried by excavation and mining operations. In some places, the soil has been stabilized against erosion by management practices such as mulching or planting vegetation.

Topography

Topography, the relief of the land surface, affects the formation of soils through its influence on drainage, runoff, and erosion. The Golden Area has diverse topography from the abruptly rising mountains to the west to the nearly level plains in the northeast. The dramatic change in elevation strongly influences the types of soils that are formed. On the steeper slopes and convex shoulders, the potential for runoff and erosion is increased. Thus, shallow soils, such as the Midway, Primen, Rooney, Herbman, and Hiwan soils, are most common on steep slopes and convex shoulders, because soil erosion is taking place at a rate equal to or greater than soil formation. Areas that have less slope commonly have less potential for runoff and erosion, and the soils tend to be deep and to have pronounced pedogenic development, as in the Platner, Nunn, and Fondis soils. Soils that formed in depressions commonly have minimal erosion. Because runoff tends to collect in the depressions, these soils receive more water than is supplied by precipitation alone and generally have a thick surface layer, such as that of the Englewood, Breece, and Earcree soils. Soils that formed on flood plains and low terraces commonly are stratified in some or all horizons as a result of repeated flooding and the deposition of parent material by floodwater. Haverson soils and Torrifluvents, very gravelly, are examples. Also, the soils on low terraces and flood plains commonly have a fluctuating water table such as that of the McClave, Venable, and Alda soils.

Time

All the other factors of soil formation—parent material, climate, living organisms, and topography—need time to influence the properties of developing soils. The weathering of bedrock into parent material takes time. The development of pedogenic horizons takes time; and yet, the time needed to develop pedogenic horizons is a function of the other factors of soil formation. A few years may be all that is required to develop a soil profile in a flood plain soil, where the parent material is deposited in a relatively short time. Conversely, the formation of a soil in residuum of hard bedrock may require thousands of years. Soil development most commonly is measured by the thickness and color of the surface layer, the structure in the subsoil, evidence of the movement of clay downward in the soil, and the thickness of the solum. However, the effects of the other factors of soil formation can increase or decrease the time needed for a soil to develop. If the other factors of soil formation are unvarying, soil development can indicate the time required for a given soil or soils to form. An excellent demonstration of increased soil development corresponding to greater age of the parent material can be seen on some of the Pleistocene and Holocene alluviums in the Golden Area.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

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.

Alluvial valley floors. Nearly level areas that are close to the stream channel in valleys and are covered with unconsolidated stream-laid deposits. The water in the stream is sufficient for subirrigation or for flood irrigation of crops.

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.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

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

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.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

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.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

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.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

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.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

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 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

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.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

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.

Congeliturbate. Soil material disturbed by frost action.

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.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms. The Lco horizon is a limnic layer that contains many fecal pellets.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

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 resting grazingland for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

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.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

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.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

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 is not 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.

Excess sulfur (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

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.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

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.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

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.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

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.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Grus. Granite that is fragmented or finely granulated but not decomposed by weathering.

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.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, alluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon 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 Arabic numeral 2 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.

Slow intake (in tables). The slow movement of water into the soil.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

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 capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

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.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

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.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

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.

Narrow-base terrace. A terrace no more than 4 to 8 feet wide at the base. A narrow-base terrace is similar to a broad-base terrace, except for the width of the ridge and channel.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

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.

Permafrost. Layers of soil, or even bedrock, occurring in arctic or subarctic regions, in which a temperature below freezing has existed continuously for a long time.

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 0.2 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.

Pitting (in tables). Pits caused by melting ground ice. They form on the soil after plant cover is removed.

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.

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

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.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables.) Water that is too salty for consumption by livestock.

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.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

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 surface runoff.

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.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

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.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

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.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

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 millimeters 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.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

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.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

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."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

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.

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.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

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.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

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.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

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.