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of
Agriculture



Natural
Resources
Conservation
Service



Forest
Service

In cooperation with
United States Department
of Interior, Bureau of Land
Management; and Colorado
Agricultural Experiment
Station

Soil Survey of Animas-Dolores Area, Colorado

Parts of Archuleta, Dolores, Hinsdale, La Plata, Montezuma, San Juan, and San Miguel Counties



How To Use This Soil Survey

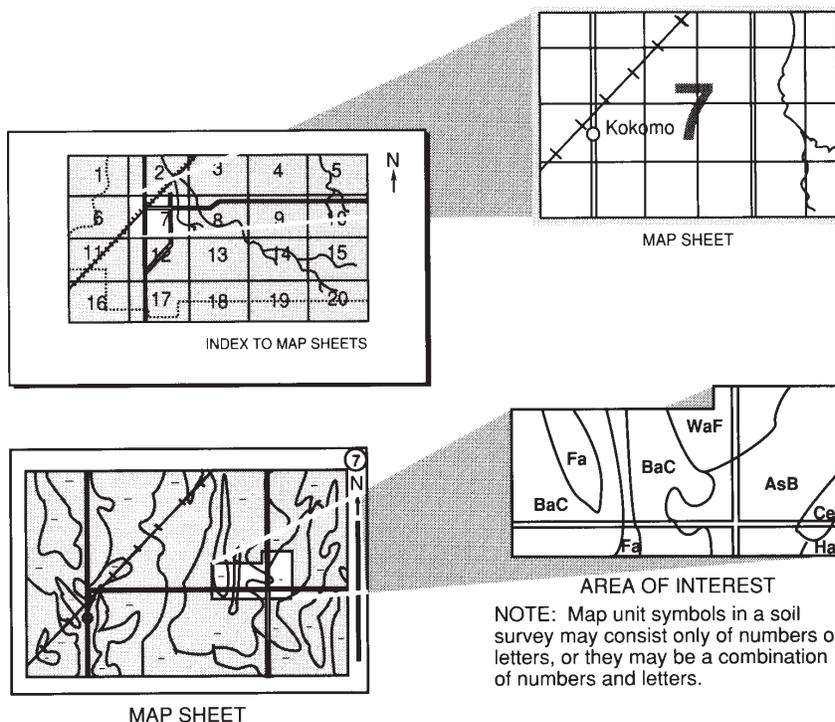
Detailed Soil Maps

The detailed soil maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Contents**, which lists the map units by symbol and name and shows the page where each map unit is described.

The **Contents** shows which table has data on a specific land use for each detailed soil map unit. Also see the **Contents** for sections of this publication that may address your specific needs.



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 Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1992. Soil names and descriptions were approved in 2003. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 2001. This survey was made cooperatively by the Natural Resources Conservation Service; Forest Service; the United States Department of the Interior, Bureau of Land Management; and Colorado Agricultural Experiment Station. The survey is part of the technical assistance furnished to the Dolores, Dove Creek, La Plata, Mancos, San Juan, and San Miguel Basin Soil Conservation Districts.

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Cover: This photo shows the North Fork of the West Mancos River. The La Plata Mountains are in the background.

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Foreword

This soil survey contains information that affects land use planning in this survey area. It contains predictions of soil behavior for selected land uses. The survey also highlights soil limitations, 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 ensure 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.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. The information in this report is intended to identify soil properties that are used in making various land use or land treatment decisions. Statements made in this report are intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

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. 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 Natural Resources Conservation Service or the Cooperative Extension Service.



Allen Green
State Conservationist
Natural Resources Conservation Service

Soil Survey of

Animas-Dolores Area, Colorado,

Parts of Archuleta, Dolores, Hinsdale, La Plata, Montezuma, San Juan, and San Miguel Counties

By James P. Pannell, Natural Resources Conservation Service

Fieldwork by James P. Pannell, Joe A. Pepi, Barbara Peregrino, Alan B. Price, Douglas K. Ramsey, Michael A. Rich, and J. Allen White, United States Department of Agriculture, Natural Resources Conservation Service; Donald K. Hoffheins, U.S. Forest Service; and contractors Claude Fly and Associates, and Land Inventory and Development Co. Inc.

in cooperation with
the United States Department of Agriculture, Forest Service; the
United States Department of Interior, Bureau of Land Management;
and the Colorado Agricultural Experiment Station

The Animas-Dolores Area is in the southwestern part of Colorado (*Fig. 1*). It has a total area of about 1,264,600 acres. It is made up of parts of Archuleta, Dolores, Hinsdale, La Plata, Montezuma, San Juan, and San Miguel Counties. Silverton, the only county seat in the survey area, is in San Juan County and has a population of

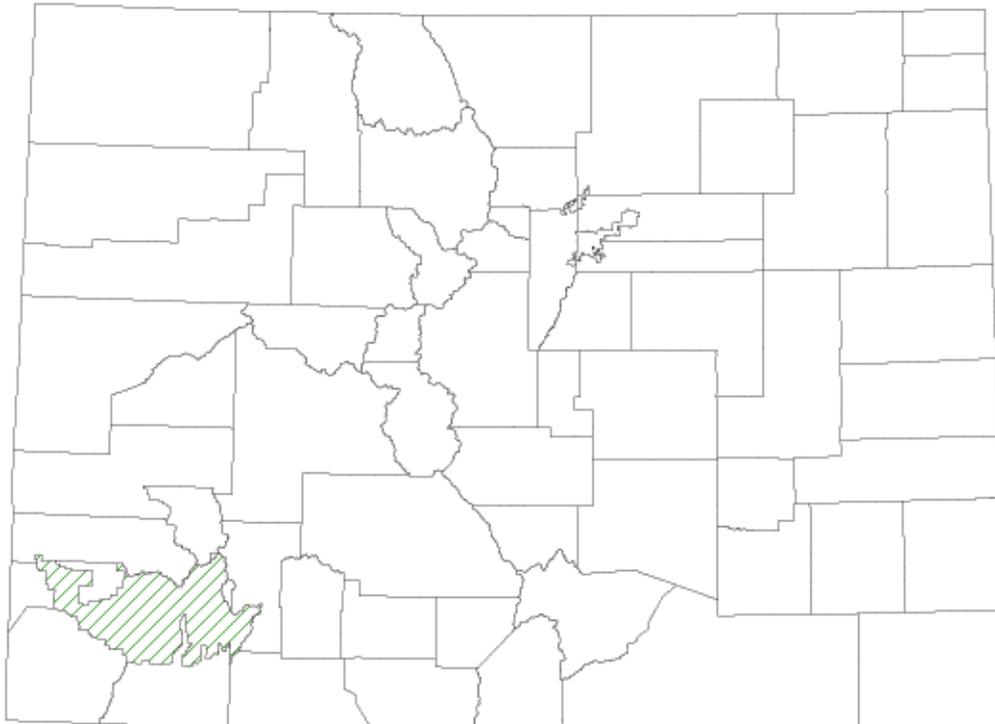


Figure 1.—Location of the Animas-Dolores Area, Colorado.

about 745 people. Rico, the only other town in the area, is in Dolores County and has a population of about 92 people.

The western part of the survey area consists of mesas, canyons, and valleys. The northern and eastern parts consist of mountains, peaks, and valleys. The Animas, Florida, Los Pinos, La Plata, Mancos, and Dolores Rivers head in the survey area; all of those rivers eventually join the Colorado River.

The climate is semi-arid to subhumid. Summers at lower elevations are dry while the mountain areas are generally moist. Winters have heavy snows, especially in the mountain areas.

General Nature of the Survey Area

This section gives general information of the survey area. It discusses the history and development; physiography, relief, and drainage; climate; natural resources; and industry and transportation.

History and Development

The first known explorers to the area were a party led by Coronado in 1541. The Baker expedition of gold seekers came to the Silverton area around 1859-61, and there has been prospecting in the area ever since. The prospectors and miners essentially opened the way for settlement of the area. Ranching and farming soon followed in areas away from the mining districts. The Denver & Rio Grande Railroad reached the town of Durango in 1881 and the town of Silverton in 1882.

The Animas-Dolores area includes part of the San Juan National Forest, land administered by the Bureau of Land Management, and private land. The San Juan National Forest was established in 1905 and grazing permits were given to ranchers to use a certain part of the area for cattle and sheep grazing. The system is still used. The San Juan National Forest Headquarters is located in Durango. The Bureau of Land Management was created in 1946 and took the place of the former General Land Office and the Grazing Service. It administers most of the public land in the survey area that is not part of the national forest.

Physiography, Relief, and Drainage

The Animas-Dolores Soil Survey Area consists of mountains, foothills, mesas, and valleys. Part of the area is in the Southern Rocky Mountain physiographic province, and part is in the Navajo section of the Colorado Plateaus province. The lowest elevation in the area is about 6000 feet where the Dolores River leaves the survey area, and the highest point is 14,246 feet on Mount Wilson in the San Miguel Mountains. There are several peaks over 14,000 feet and many more that are over 13,000 feet.

The mountainous part of the area is in the San Juan Mountains, La Plata Mountains, Rico Mountains, and San Miguel Mountains. During Tertiary and Quaternary time these mountains were formed by an uplift that was accompanied or followed by periods of high volcanic activity. This part of the area consists of high mountains and narrow valleys. The mountaintops are as much as 4000 feet higher than adjacent valleys. The mountainsides are usually steep or very steep. High mesas with more gentle slopes occur in some areas.

The western part of the area consists of mesas, deep canyons, and valleys. The mesas are mostly gently sloping to strongly sloping and have been dissected by narrow valleys. The valleys typically have very steep sides and have rock ledges along the edge of the mesas. The mesa tops can be from 100 to 2200 feet higher than the valley bottoms.

Some foothills occur in the Ryman Creek area in the northwestern part of the survey area. They are transitional between mesas and upland valleys. The foothills are mostly gently sloping to steep and consist of shale and sandstone derived soils. These areas usually have short steep hillsides, narrow upland valleys, alluvial fans and gentle slopes below the hills, and shale and sandstone rock outcrops in many places. Elevation of these foothill areas is about 6500 to 8000 feet.

Several rivers of the Colorado River system drain the survey area. The largest are the Dolores and the Animas Rivers. The Dolores River heads in the San Miguel and San Juan Mountains and leaves the area in the northwest corner. The Animas River heads in the San Juan Mountains and flows south. The smaller rivers are the Los Pinos and Florida in the eastern part of the area; the La Plata, heading in the La Plata Mountains, in the central part of the area; and the Mancos in the southwestern part, also heading in the La Plata Mountains. All of the rivers except the Dolores, flow south to join the San Juan River in New Mexico, which eventually flows into the Colorado River in Utah.

Climate

The climate in the survey area varies considerably from lower to higher elevations. It has warm summer temperatures at the lower elevations and it gets cooler as elevation increases. Winter temperatures are cold, usually colder in the higher mountains than at lower elevations. Precipitation generally occurs in every month of the year though May and June receives the least amount. Snow accumulates throughout the winter and builds up a deep snowpack. As it melts in the spring there is usually much runoff and high water in the rivers. In the summer, rain generally occurs as showers, but some thunderstorms and hail do occur. The data given in the following paragraphs and in the climatic tables are from stations located in valleys and are at lower to mid elevations for the survey area. The average annual precipitation in the area is actually much wider than given in the tables. The western edge of the area receives about 14 inches of precipitation while the higher mountains receive about 40 inches or more.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Rico, Silverton, and Vallecito Dam in the period 1961 to 1990. 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 temperature in Rico is 23 degrees F, 17 degrees F in Silverton, and 24 degrees F at Vallecito Dam. The average daily minimum temperatures are 6 degrees F in Rico, -2 degrees F in Silverton, and 9 degrees F at Vallecito Dam. The lowest temperature on record, which occurred on February 1, 1985 at Silverton, is -39 degrees F. In summer, the average temperatures are 55 degrees F at Rico, 53 degrees F at Silverton, and 61 degrees F at Vallecito Dam; the average daily maximum temperatures are 73, 71, and 79 degrees F, respectively. The highest recorded temperature, which occurred in Silverton on June 26, 1929, is 96 degrees F.

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 in Rico is about 29 inches; in Silverton it is about 25 inches; and at Vallecito Dam the annual precipitation is 27 inches. Of this, about 15 inches, or 50 percent, usually falls in April through September at Rico; about 13 inches, or 53 percent, at Silverton; and about 13 inches, or 48 percent, falls at Vallecito Dam during the same period. The growing season for most crops falls within

this period. In 2 years out of 10, the rainfall in April through September is less than 8 inches at Rico, less than 8 inches at Silverton, and less than 7 inches at Vallecito Dam. The heaviest 1-day rainfall during the period of record was 4.05 inches on October 5, 1911 at Silverton. Thunderstorms occur on about 38 days each year, and most occur in the month of August.

The average seasonal snowfall is about 176 inches at Rico, 137 inches at Silverton, and 134 inches at Vallecito Dam. The greatest snow depth at any one time during the period of record was 89 inches at Rico, recorded April 2, 1980. On the average, 150 days of the year have at least 1 inch of snow on the ground at Rico. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 30 percent. Humidity is higher at night, and the average at dawn is about 50 percent. The sun shines 80 percent of the time possible in summer and 65 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, about 10 miles per hour, in the spring months.

Natural Resources

Natural resources in the survey area include timber, range plants, lead, zinc, silver, gold, sand, gravel, soil, and water. Timber is produced on soils throughout the survey area. Timber is important to the area for wood production, watershed protection, wildlife habitat, and for its recreational and scenic value.

Lead, zinc, silver, and gold occur in the La Plata Mountains, Rico Mountains, and the Silverton area. They have been important to the settlement and development of the area, though mining is a minor activity at present.

Sand and gravel, and other rock material, are mined throughout the area as a source of construction materials. These are usually obtained from sites near where the material is needed.

Soil and water are important natural resources. Crops, range plants, wood products, and food and cover for wildlife are produced on the soils in the survey area. Water, originating in the area is used for irrigation, domestic, industrial, and recreational purposes in the area and in downstream locations. Wildlife and domestic animals also use water. The water comes from rainfall, from melting snow and streams in the area and much of it is stored in McFee, Vallecito, and Lemon Reservoirs, as well as reservoirs farther downstream.

Industry and Transportation

Industry in the survey area includes tourist and recreational enterprises, production and processing of timber, ranching, and mining. Tourist and recreational enterprises are a large part of the income for the area.

The high peaks, wooded mountains, rivers, creeks, and climate attract sightseers, hikers, picnickers, and campers. There are many maintained hiking trails in the area. The big game animals and other wildlife in the area, and the lakes, reservoirs, and streams draw many people for hunting, fishing, and to see the wildlife. McFee Reservoir, the largest reservoir in the survey area, provides opportunities for water sports. A major ski area and high winter snowfall attract many people for winter sports. A narrow gauge railroad that provides daily scenic trips from Durango, up the Animas River Valley, to Silverton in summer and fall draws many people to the area.

Timber is produced throughout the survey area. Much of it is processed in nearby sawmills that provide employment and benefit the economy.

Most ranches that use the areas for grazing are located outside of the survey area. Ranchers have grazing permits for the San Juan National Forest or land administered by the Bureau of Land Management. They move their stock to this land for a specified

time in summer months, then move them to lower areas during fall, winter, and spring. Little farming occurs in the area, though there is some irrigated pasture and hayland in some of the valleys.

Two highways run through the survey area; U.S. Highway 550 crosses it in a north-south direction and connects Silverton with Durango and Montrose; and Colo. Highway 145 crosses it in a northeast-southwest direction and connects Rico with Cortez and Telluride. All livestock, minerals, and timber produced in the area are shipped over these highways and their connecting route, U.S. Highway 160. The nearest airports are at Durango and Cortez.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and their location and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; 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 biological activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept or model of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area 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-vegetation-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, reaction, 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. Soil taxonomy, 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 interpret the data from these analyses and tests as well as the field-

observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are 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 are 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 predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict 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.

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of a better knowledge of soils, modifications of series concepts, or variations in the intensity of mapping or in the extent of the soils in the survey area.

Detailed Soil Map Units

The map units delineated on the detailed soil maps in this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. 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 other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties 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, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. The contrasting components are mentioned in the map unit descriptions. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit 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, 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, slope, stoniness, salinity, 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, Needleton stony loam, 15 to 30 percent slopes is a phase of the Needleton series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes or associations.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Frisco-Quazar complex, 15 to 30 percent slopes is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Quazar-Cryaquolls-Cryohemists association, 1 to 30 percent slopes is an example.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Table 5 gives the acreage and proportionate extent of each map unit. Other 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 or miscellaneous areas.

Plant associations depicted in the map unit descriptions are potential natural communities which have definite floristic composition. A *potential natural community* is the biotic community that would be established under present environmental conditions if all successional sequences were completed without additional human-caused disturbance. Plant associations consider potential climax communities, and thus may or may not indicate current vegetative cover. Plant associations are named and described using the dominant climax overstory tree species, and the dominant or indicator climax understory species. An example is *Pinus ponderosa/Quercus gambelii*. Plant associations used for this survey were identified from *Plant Associations of Region Two* (Johnston, Barry C. 1987.)

1—Bradfield-Narraguinnep complex, 0 to 5 percent slopes

Map Unit Description

This map unit is a complex of very deep and well drained soils on mesas and alluvial fans. The elevation is 7,600 to 8,500 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is 40 to 44 degrees F., and the average frost-free period is 70 to 90 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 45 percent Bradfield clay loam and 40 percent Narraguinnep clay loam. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include soils that have argillic horizons and soils that do not have the thick dark surface layers. These similar soils make up about 15 percent of the total acreage; the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Bradfield clay loam

The Bradfield soil formed in alluvium and slope alluvium derived dominantly from shale. Typically, the surface layer is grayish brown clay loam about 7 inches thick.

The upper part of the subsoil is brown clay loam about 8 inches thick. The next part is dark grayish brown clay about 13 inches thick. The lower part of the subsoil is brown and yellowish brown clay about 8 inches thick. The substratum is light yellowish brown clay to a depth of 60 inches or more.

The permeability of the Bradfield soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is high.

Narraguinnep clay loam

The Narraguinnep soil formed in alluvium and slope alluvium derived dominantly from shale. Typically, the surface layer is dark grayish brown clay loam about 6 inches thick. The upper 17 inches of the subsoil are grayish brown clay, and the lower 7 inches are grayish brown clay loam. The substratum is pale brown clay to a depth of 60 inches or more.

The permeability of the Narraguinnep soil is slow. The available water capacity is high. The hydrologic group is D. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is high.

Vegetation

The dominant plant association is *Artemisia tridentata/Elytrigia smithii*. Some *Artemisia tridentata/Festuca thurberi* may also occur on the same landscape. The native vegetation on this unit consists mainly of mountain big sagebrush, western wheatgrass, Arizona fescue, and Letterman's needlegrass. Other common plants that characterize this unit are muttongrass, prairie Junegrass, and rabbitbrush. The average annual production of air-dry vegetation is about 2,000 pounds per acre for the Narraguinnep soil and 1,100 pounds per acre for the Bradfield soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated very low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the low strength and the high shrink-swell potential.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and range quality. More uniform use of rangeland is aided by properly locating salt and by herding. If the range vegetation is seriously deteriorated, seeding is needed. The main limitation for seeding is the clayey soils. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

If this map unit is used for recreational development, the main limitations are the slow permeability and the clayey soils.

This map unit is in capability subclass 4c, nonirrigated.

2—Hesperus loam, 0 to 3 percent slopes

Map Unit Description

This very deep, moderately well drained soil is in drainageways and on low terraces. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Hesperus loam

The Hesperus soil formed in alluvium derived from mixed sources. Typically, the surface layer is very dark grayish brown loam 8 inches thick. The upper 20 inches of the subsoil are very dark grayish brown loam. The lower 12 inches of subsoil are very dark grayish brown clay loam. The substratum is dark grayish brown to very dark grayish brown clay loam to a depth of 60 inches or more.

The permeability of the Hesperus soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is low, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 42 to 72 inches from April through July. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Fughes loam on fans and drainageways and about 5 percent Fughes loam, extremely stony on hills. The Fughes soils are well drained and have fine textured subsoils.

Vegetation

The dominant plant association is *Deschampsia cespitosa/Carex spp.* Some *Muhlenbergia montana/Festuca arizonica* also occurs on areas that have better drainage. The native vegetation on this unit consists of tufted hairgrass, sedge, Rocky Mountain iris, cinquefoil, and shrubby cinquefoil in the lower part of the drainageways. Mountain muhly, Arizona fescue, and bluegrass are on well drained areas. The average annual production of air-dry vegetation is about 3,000 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated very low for this unit because of the slope.

The main limitation to the building of unsurfaced roads on Hesperus soil is frost action.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range plants. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

This unit is well suited to most recreational development.

This map unit is in capability subclass 4c, nonirrigated.

10—Lillings silty clay loam, 0 to 5 percent slopes

Map Unit Description

This very deep, well drained soil is on flood plains and in drainageways. The elevation is 6,500 to 7,200 feet. The average annual precipitation is 12 to 13 inches, the average annual air temperature is 47 to 52 degrees F., and the average frost-free period is 110 to 135 days. The moisture regime is ustic-aridic and the temperature regime is mesic.

Brief Soil Description

Lillings silty clay loam

The Lillings soil formed in alluvium derived from shale and sandstone. Typically, the surface layer is grayish brown silty clay loam about 8 inches thick. The underlying

material is pale brown silty clay loam stratified with thin layers of very fine sandy loam and silt loam to a depth of 60 inches or more.

The permeability of the Lillings soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is severe. Deep, wide gullies occur in most drainageways. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Sili clay loam on the upper parts of drainageways and on fans and about 5 percent gullied land along drainage channels. Sili soils have clay loam or clay subsoils.

Vegetation

The dominant plant association is *Sarcobatus vermiculatus/Sporobolus airoides*. The native vegetation on this unit consists mainly of greasewood, basin big sagebrush, and fourwing saltbush. Other important plants that characterize this unit are alkali sacaton, western wheatgrass, galleta, bottlebrush squirreltail, bluegrass, and needleandthread. The average annual production of air-dry vegetation is about 700 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated very low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on Lillings soil are the low strength and excess fines. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and range production. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

If this map unit is used for recreational development, the main limitations are the excess salt and dusty conditions that may develop under intensive use. Most areas have gullies and are not subject to flooding. Gullies may limit path and trail development.

This map unit is in capability subclass 6s, nonirrigated.

12—Shawa loam, 0 to 5 percent slopes

Map Unit Description

This very deep, well drained soil is on terraces and alluvial fans. The elevation is 7,200 to 7,500 feet. The average annual precipitation is 15 to 20 inches, the mean annual air temperature is 41 to 46 degrees F. and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Shawa loam

The Shawa soil formed in alluvium derived dominantly from sandstone and shale. Typically, the surface layer is brown loam about 19 inches thick. The upper 19 inches of the subsoil are brown clay loam; the lower part consists of brown cobbly clay loam to a depth of 60 inches or more.

The permeability is moderately slow. The available water-holding capacity is high. The effective rooting depth is more than 60 inches. The hydrologic group is B. Runoff is medium and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 15 percent of soils that have thinner dark surface layers on the upper part of fans; about 5 percent of soils that are somewhat poorly drained in swales; and small areas of soils with fine textured subsoils in drainageways.

Vegetation

The dominant plant association is *Artemisia tridentata/Elytrigia smithii*. Some *Quercus gambelii/Symphoricarpos oreophilus* also occurs on ridges. The native vegetation on this unit consists mainly of Arizona fescue, western wheatgrass, needleandthread, and Indian ricegrass. Other important plants that characterize this unit are Gambel oak, Basin big sagebrush, common snowberry, muttongrass, and mountain brome. The average annual production of air-dry vegetation is about 1,300 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated very low for this unit because of the slope.

The soils have a high productive capability and have few limitations for intensive management. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation.

Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and range vegetation. If the condition of the range deteriorates, Gambel oak and sagebrush increases. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

This unit is well suited to recreational development.

This map unit is in capability subclass 4c, nonirrigated.

13—Fughes Loam, 1 to 12 percent slopes

Map Unit Description

This very deep, well drained soil is on hills and in drainageways. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 41 to 46 degrees F, and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not affect the use or management of the unit. These include a soil similar to Fughes except it has bedrock above 60 inches. These similar soils make up about 5 percent of the total acreage. The percentage varies from one area to another.

Brief Soil Description

Fughes loam

The Fughes soil formed in slope alluvium and alluvium derived dominantly from sedimentary rocks. Typically, the surface layer is dark brown loam 7 inches thick. The upper 19 inches of the subsoil are brown clay loam, and the lower 18 inches are brown clay. The substratum is strong brown clay to a depth of 60 inches or more.

The permeability of the Fughes soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 3 percent Granath loam on hillslopes; 5 percent Hesperus loam in drainageways; and 2 percent Nortez loam on hillslopes. Granath soils have dark surface layers less than 16 inches thick. Hesperus soils are somewhat poorly drained. Nortez soils have bedrock at a depth of 20 to 40 inches.

Vegetation

The dominant plant association is *Muhlenbergia montana/Festuca arizonica*. Some *Deschampsia cespitosa/Carex spp.* also occurs in drainageways and swales. The native vegetation on this unit is mountain muhly, Arizona fescue, Parry's danthonia, tufted hairgrass, and sedge. Other important plants that characterize this unit include needlegrass, slender wheatgrass, and western wheatgrass. The average annual production of air-dry vegetation is about 1,800 pounds per acre (Fig. 2).

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.



Figure 2.—Shown is a Loamy Park rangesite on Fughes loam, 1 to 12 percent slopes.

The main limitations to the building of unsurfaced roads on the Fughes soil are the low strength and the shrink-swell potential.

More uniform distribution of grazing is aided by properly locating stock water development and salt, and by fencing and herding. If the condition of the range deteriorates, woody shrubs and annuals increase. If the range vegetation is seriously deteriorated, seeding is needed. The main limitation for reseeding is the limited amount of rainfall. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

This map unit is well suited to recreational development, especially on the lower slopes. The main limitations are the slow permeability and slopes that are over 8 percent. Paths and trails can be developed.

This map unit is in capability subclass 4e, nonirrigated and irrigated.

14—Dalmatian-Apmay-Schrader complex, 0 to 5 percent slopes

Map Unit Description

This map unit is a complex of very deep, moderately well drained to poorly drained soils on flood plains and valley floors. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 41 to 45 degrees F., and the average frost-free period is 75 to 100 days. The moisture regimes are ustic for the Dalmatian and Apmay soils and aquic for the Schrader soil. The temperature regime is frigid for all the soils.

This map unit consists of 35 percent Dalmatian loam, 35 percent Apmay loam, 15 percent Schrader loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Dalmatian loam

The Dalmatian soil formed in alluvium derived from mixed sources. It is moderately well drained. Typically, the surface layer is dark grayish brown loam about 13 inches thick. The subsoil is dark grayish brown loam about 12 inches thick. The upper 14 inches of the underlying material are dark brown loam. The next 10 inches are dark grayish brown to dark gray sandy clay loam, and the lower part is dark gray gravelly sandy loam to a depth of 60 inches.

The permeability of the Dalmatian soil is moderate. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is low, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 36 to 60 inches from April through July. This soil is subject to brief periods of flooding from March through June. The potential of shrink-swell is low.

Apmay loam

The Apmay soil is somewhat poorly drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is brown loam about 4 inches thick. The subsurface layer is brown clay loam about 6 inches thick. The upper 8 inches of the subsoil are brown clay loam, and the lower 4 inches are dark yellowish brown sandy loam. The substratum is brown extremely gravelly loamy sand and sandy loam to a depth of 60 inches or more.

The permeability of the Apmay soil is moderately slow to a depth of 20 to 40 inches and moderately rapid below this depth. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 12 to 36 inches in May and June. The soil is subject to brief periods of flooding from March through June. The potential of shrink-swell is low.

Schrader loam

The Schrader soil is poorly drained. It formed in alluvium derived from mixed sources. Typically, the surface layer is dark grayish brown loam about 13 inches thick. The subsurface layer is brown fine sandy loam about 4 inches thick. The next layer is brown sandy clay loam about 7 inches thick. The substratum is brown fine sandy loam to a depth of 60 inches or more.

The permeability of the Schrader soil is moderate. The available water capacity is moderate. The hydrologic group is D. The effective rooting depth is 60 inches or more. Runoff is low, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 12 to 24 inches in May and June. The soil is subject to brief periods of flooding from March through June. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent open water and Riverwash in the stream courses, and about 10 percent Ustifluents on low terraces and floodplains. Ustifluents contain stratified layers throughout most of the profile. Included areas make up about 15 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Deschampsia cespitosa/Carex spp.* The dominant native vegetation consists of tufted hairgrass, mountain brome, elk sedge, Rocky Mountain iris, western yarrow, and other perennial grasses, forbs, and shrubs. The potential production of native vegetation on these soils is about 2,000 pounds of air-dry vegetation per acre.

Soil Management Implications

This unit is used for livestock grazing, wildlife habitat, recreation, and hay production.

The mass movement potential is rated very low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the depth to a high water table and the rare hazard of flooding. Proper design of road drainage systems and care in the placement of culverts help to control erosion.

This unit is moderately well suited to pasture and hayland. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range plants. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

If this map unit is used for recreational development, the main limitations are the hazard of flooding and the depth to a high water table. Drainage should be provided for paths and trails.

The Dalmatian and Apmay soils are in capability subclass 4c, nonirrigated and irrigated. The Schrader soil is in capability subclass 4w, nonirrigated and irrigated.

15—Umbarg loam, 0 to 5 percent slopes

Map Unit Description

This very deep, moderately well drained soil is on low terraces. The elevation is 6,300 to 6,800 feet. The average annual precipitation is 13 to 15 inches, the average annual air temperature is 47 to 50 degrees F., and the average frost-free period is 110 to 125 days. The moisture regime is ustic and the temperature regime is mesic.

Brief Soil Description

Umbarg loam

The Umbarg soil formed in alluvium derived from mixed sources. Typically, the surface layer is grayish brown loam about 18 inches thick. The next layer is brown loam about 7 inches thick. The subsoil is black clay loam about 9 inches thick. The upper part of the substratum is brown clay loam about 14 inches thick; the lower part is brown silty clay loam to a depth of 60 inches or more.

The permeability of the Umbarg soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is low, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 36 to 60 inches in May and June. This soil is subject to brief periods of flooding from March through June. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Payter sandy loam on alluvial fans; 5 percent Fluvaquents in drainageways; and 5 percent Haplustolls on low terraces. Payter soils are moderately coarse textured throughout. Fluvaquents are somewhat poorly drained. Haplustolls have an extremely cobbly substratum. These inclusions make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Artemisia tridentata/Elytrigia smithii*. The native vegetation on this unit consists mainly of Basin big sagebrush, western wheatgrass, needleandthread, Indian ricegrass, muttongrass, and prairie Junegrass. The average annual production of air-dry vegetation is about 1,500 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated very low for this unit because of the slope.

The main limitations to building unsurfaced roads on the Umbarg soils are the hazard of flooding and the frost action.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. More uniform distribution of grazing is aided by properly locating stock water development and salt, and by fencing and herding.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this unit is used for recreational development, the main limitation is the hazard of flooding. Picnic areas and playgrounds can be developed.

This map unit is in capability subclass 3c, nonirrigated.

16—Payter sandy loam, 3 to 15 percent slopes

This very deep, well drained soil is on alluvial fans. The elevation is 6,300 to 6,800 feet. The average annual precipitation is 13 to 15 inches, the average annual air temperature is 47 to 50 degrees F, and the average frost-free period is 110 to 125 days. The moisture regime is ustic and the temperature regime is mesic.

Brief Soil Description

Payter sandy loam

The Payter soil formed in alluvium derived from sandstone. Typically, the surface layer is brown to yellowish brown sandy loam about 6 inches thick. The subsoil is brown sandy loam about 5 inches thick. The upper part of the substratum is yellowish brown and grayish brown sandy loam about 28 inches thick. The underlying material to a depth of 60 inches is brown sandy loam.

The permeability of the Payter soil is moderately rapid. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is low, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Umbarg loam on low terraces and 5 percent Wauquie soils on hillslopes. Umbarg soils are moderately well drained and have moderately fine textured subsoils. Wauquie soils have more than 35 percent rock fragments throughout the profile. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Artemisia tridentata/Elytrigia smithii*. Another common plant association in the area is *Quercus gambelii/Amelanchier alnifolia*. The native vegetation consists of basin big sagebrush, western wheatgrass, prairie Junegrass, blue grama, and skunkbush sumac. Other common plants that characterize this unit include Gambel oak, Utah serviceberry, needleandthread, bottlebrush squirreltail, twoneedle pinyon, and Utah juniper. The potential production of native understory vegetation on the Payter soil is about 1,200 pounds of air-dry vegetation per acre.

Soil Management Implications

This map unit is used for livestock grazing, wildlife habitat, and recreation.

The mass movement potential is rated low for this unit because of the slope.

This soil is well suited to the building of unsurfaced roads.

Careful management is needed to prevent excessive grazing on this unit because it is difficult to revegetate. More uniform distribution of grazing is aided by properly locating stock water development and salt, and by fencing and herding. If the condition of the range deteriorates, sagebrush increases. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribing burning or by chemical or mechanical methods may be subject to a greater hazard of erosion.

If this map unit is used for recreation development, the main limitation is the presence of slopes that are over 8 percent. Camp areas and picnic areas, as well as paths and trails, can be developed.

This map unit is in capability subclass 4e, nonirrigated and irrigated.

17—Fluvaquents-Haplustolls complex, 0 to 5 percent slopes

Map Unit Description

This map unit is a complex of very deep, somewhat poorly drained to well drained soils on floodplains and in drainageways. The elevation is 5,800 to 7,400 feet. The average annual precipitation is 13 to 20 inches, the average annual air temperature is 47 to 52 degrees F., and the average frost-free period is 100 to 130 days. The moisture regimes are aquic and ustic, respectively, and the temperature regime is mesic for both soils.

This map unit consists of 55 percent Fluvaquents, 30 percent Haplustolls, and 15 percent included areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Fluvaquents

The Fluvaquents soil is on the lower positions in the map unit. It formed in alluvium derived from mixed sources. It is somewhat poorly drained. These soils are extremely variable. In a reference pedon, the surface layer is light yellowish brown sand about 6 inches thick. The underlying material is stratified sandy loam to very gravelly loamy sand to a depth of 60 inches or more.

The permeability of the Fluvaquents soil is moderately slow to rapid. The available water capacity is low. The hydrologic group is D. The effective rooting depth is 60 inches or more. Runoff is very low, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 12 to 24 inches in May and June. This soil is subject to brief periods of flooding from March through June. The potential of shrink-swell is low.

Haplustolls

The Haplustolls soil is on the slightly higher positions in the map unit. It formed in alluvium derived from mixed sources. It is well drained to moderately well drained. These soils are extremely variable. In a representative pedon, the surface layer is grayish brown sandy loam about 4 inches thick. The subsoil is dark grayish brown to brown loam about 15 inches thick. The substratum is brown to very pale brown gravelly loamy sand to extremely cobbly sand to a depth of 60 inches or more.

The permeability of the Haplustolls soil is moderate in the upper part and rapid in the lower part. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is low, and the hazard of water erosion is slight. This soil is subject to brief periods of flooding from March through June. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Payter loam on fans; 5 percent Umbarg loam on terraces; and 5 percent open water and Riverwash in the stream course. Included areas make up about 15 percent of the total acreage; the percentage varies from one area to another. Payter soils are moderately coarse textured throughout. Umbarg soils have deep loamy profiles and lack the gravelly and cobbly substratum.

Vegetation

The dominant plant association is *Populus angustifolia/Salix exigua*. The native vegetation on this map unit consists of narrowleaf cottonwood, willow, western wheatgrass, needleandthread, and alkali sacaton. Other common plants that characterize this unit include muttongrass, prairie Junegrass, mountain brome, sedge, rush, inland salt grass, and Indian ricegrass. The potential production of native

understory vegetation on the Fluvaquents soil is about 2,000 pounds of air-dry vegetation per acre, and on the Haplustolls it is about 900 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated very low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the wetness and the hazard of flooding.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range plants. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

If this map unit is used for recreational development, the main limitations are the hazard of flooding and the depth to a high water table on the Fluvaquents soil. The Haplustolls soil is well suited to most recreational development.

The Fluvaquents soil is in capability subclass 7w, nonirrigated. The Haplustolls soil is in capability subclass 4s, nonirrigated and irrigated.

18—Endoaquolls-Ustifluvents complex, 0 to 5 percent slopes

Map Unit Description

The map unit is a complex of very deep, poorly drained to well drained soils on flood plains. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is 43 to 47 degrees F., and the average frost-free period is 75 to 100 days. The moisture regime is aquic for the Endoaquolls and ustic for the Ustifluvents. The temperature regime is frigid for both soils.

This map unit consists of 45 percent Endoaquolls, 40 percent Ustifluvents, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Endoaquolls

The Endoaquolls soil is in the lower positions in the map unit. It is poorly drained. It formed in alluvium derived from mixed sources. These soils are extremely variable. In a representative pedon, the surface layer is grayish brown loam about 4 inches thick. The next layer is brown fine sandy loam about 8 inches thick. The upper part of the underlying material is brown fine sandy loam and loam about 16 inches thick; the lower part is dark yellowish brown extremely cobbly sand to a depth of 60 inches or more.

The permeability of the Endoaquolls soil is moderate in the surface layer and moderately rapid in the next layer. The available water capacity is low. The hydrologic group is D. The effective rooting depth is 20 to 60 inches. Runoff is low, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 6 to 18 inches in May and June. This soil is subject to long periods of flooding from April through June. The potential of shrink-swell is low.

Ustifluvents

The Ustifluvents soil is on the slightly higher positions in the map unit. It is moderately well drained or well drained. It formed in alluvium derived from mixed

sources. In a representative pedon, the surface layer is reddish brown loam about 6 inches thick. The subsurface layer is yellowish red and reddish gray stratified loam and fine sandy loam about 11 inches thick. The next layers are light reddish brown and reddish gray stratified sandy loam, loam, and fine sandy loam about 13 inches thick. This overlies cobbles, gravel, and sand that extends to 60 inches or more.

The permeability of the Ustifluvents soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is low, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 36 to 60 inches from April through June. This soil is subject to brief periods of flooding from April through June. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Riverwash and open water in the stream courses; 5 percent Dalmatian loam and 5 percent Apmay loam, both on river terraces. Dalmatian soils and Apmay soils have dark colored surface layers more than 16 inches thick. Inclusions make up about 15 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Populus angustifolia/Salix exigua. Deschampsia cespitosa/Carex spp.* occurs in the wetter areas. The native vegetation consists of narrow leaf cottonwood, willows, blue spruce, and common snowberry. Other important plants that characterize this unit are tufted hairgrass, redtop, bluegrass, mountain brome, sedge, Baltic rush, and Woods' rose. The potential production of native understory vegetation on the Endoaquolls soil is about 2,000 pounds of air-dry vegetation per acre, and on the Ustifluvents it is about 1,000 pounds per acre.

Soil Management Implications

This unit is used for wildlife habitat, livestock grazing, and recreation.

The mass movement potential is rated very low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the hazard of flooding and the depth to a high water table.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. More uniform distribution of livestock is aided by properly locating stock water development and salt, and by fencing and herding.

This map unit is poorly suited to recreational development. The main limitations are the hazard of flooding and the depth to a high water table.

The Endoaquolls soil is in capability subclass 6w, nonirrigated and 4w irrigated. The Ustifluvents soil is in capability subclass 3c, nonirrigated and irrigated.

20—Mavreeso loam, 5 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on fan remnants and mountain slopes. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is 43 to 46 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include soils with thick dark surface layers. These similar soils make up about 15 percent of the total acreage; the percentage varies from one area to another.

Brief Soil Description

Mavreeso loam

The Mavreeso soil formed in alluvium and slope alluvium derived dominantly from red sedimentary rocks. Typically, the surface layer is reddish brown loam about 10 inches thick. The upper part of the subsoil is yellowish red loam about 8 inches thick. The middle part of the subsoil is yellowish red channery loam about 10 inches thick. The lower part of the subsoil is yellowish red loam about 14 inches thick. The upper 8 inches of the substratum are yellowish red channery loam; the lower part consists of yellowish red loam to a depth of 60 inches or more.

The permeability of the Mavreeso soil is moderate. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent soils with over 35 percent rock fragments in the control section on the upper end of alluvial fans.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation consists mainly of ponderosa pine, Gambel oak, Kentucky bluegrass, nodding brome, elk sedge, common snowberry, Oregon grape, slender cinquefoil, prairie Junegrass, Rocky Mountain Douglas-fir, and western yarrow. The potential production of native understory vegetation on the Mavreeso soil is about 750 pounds of air-dry vegetation per acre.

Soil Management Implications

This unit is used for livestock grazing, woodland, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 88 on the Mavreeso soil. It can produce about 82 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 40 years old. Although most areas have a thin stand of trees, the soil is generally not used for timber production.

The mass movement potential is rated low for this unit.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of vegetation for grazing. More uniform use of rangeland is aided by properly locating salt and by herding.

If this map unit is used for recreational development the main limitation is the slope, which limits the use of most areas of this soil mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

51—Clayburn-Hourglass complex, 5 to 25 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 8,500 to 10,500 feet. The average annual precipitation is 30 to 40

inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 60 to 75 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 55 percent Clayburn loam, 35 percent Hourglass loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Clayburn loam

The Clayburn soil formed in slope alluvium derived mostly from sandstone and shale. Typically, the surface layer is grayish brown and dark grayish brown loam about 13 inches thick. The upper 5 inches of the subsoil are brown clay loam. The middle part is brown clay loam about 18 inches thick. The lower 12 inches are light brown sandy clay loam. The substratum is light brown sandy clay loam to a depth of 60 inches or more.

The permeability of the Clayburn soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Hourglass loam

The Hourglass soil formed in slope alluvium derived mostly from sandstone, limestone, shale, and from mixed sources. Typically, the surface layer is dark grayish brown loam about 11 inches thick. The upper part of the subsoil is brown clay loam about 7 inches thick. The middle part is brown gravelly clay loam about 13 inches thick, and the lower part is brown very stony clay loam about 15 inches thick. The substratum is brown very stony clay loam to a depth of 60 inches or more.

The permeability of the Hourglass soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Wander extremely stony loam on alluvial fans; about 4 percent Runlett loam on structural benches; and about 1 percent soils that have an extremely bouldery surface. Inclusions make up about 10 percent of the map unit. Wander soils have more than 35 percent rock fragments in the control section. Runlett soils are moderately deep over limestone or sandstone.

Vegetation

The dominant plant associations are *Festuca thurberi*/*Festuca arizonica* and *Festuca thurberi*/*Vicia americana*-*Lathyrus leucanthus* in open areas. *Populus tremuloides*/*Symphoricarpos oreophilus* occurs in quaking aspen groves. The native vegetation on this unit consists mainly of Thurber's fescue, mountain brome, Letterman's needlegrass, and bluegrass. Other important plants that characterize this unit are Parry's danthonia, spike trisetum, American vetch, Richardson's geranium, slender cinquefoil, Nevada pea, and California false hellebore. Quaking aspen, mountain snowberry, and Nevada pea occur in small patches. The average annual production of air-dry vegetation is about 2,800 pounds per acre on both soils (*Fig. 3*).

Soil Management Implications

This unit is used for livestock grazing, wildlife habitat, and recreation.

The mass movement potential is rated low for this unit.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition.



Figure 3.—Shown is a Subalpine Loam range site on Clayburn-Hourglass complex, 5 to 25 percent slopes.

Stock water development and fencing will help to improve livestock distribution and the growth of vegetation for grazing. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Range seeding is suitable if the range is in poor condition.

Wildlife such as elk, mule deer, coyotes, hawks, and eagles utilize this unit. Management for wildlife should include protection from overgrazing by livestock and maintenance of adequate plant cover. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitation is the slope, which limits development of most areas to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

52—Ohwiler loam, 12 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 7,700 to 8,500 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 80 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Ohwiler loam

The Ohwiler soil formed in slope alluvium derived from mixed sources, mostly sandstone and shale. Typically, the surface layer is dark grayish brown loam about 15 inches thick. The upper 15 inches of the subsoil are dark grayish brown clay loam.

The next part is grayish brown clay loam about 10 inches thick. The lower 12 inches of the subsoil are brown loam. The substratum is pale brown loam to a depth of 60 inches or more.

The permeability of the Ohwiler soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Nordicol very stony loam on ridges and 10 percent Herm loam on mountain slopes. Nordicol soils have more than 35 percent rock fragments in the profile. Herm soils have fine textured subsoils.

Vegetation

The dominant plant association is *Danthonia parryi/Festuca arizonica*. *Quercus gambelii/Symphoricarpos oreophilus-Amelanchier alnifolia* occurs in some areas. The native vegetation on this unit consists mainly of Arizona fescue, Parry's danthonia, needleandthread, and western wheatgrass. Other important plants that characterize this unit are Gambel oak, common snowberry, Utah serviceberry, antelope bitterbrush, mountain brome, prairie Junegrass, and mountain muhly. The average annual production of air-dry vegetation is about 1,800 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing, wildlife habitat, and recreation.

The mass movement potential is rated low for this unit because of the slope.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of range vegetation. If the condition of the range deteriorates, Gambel oak increases. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitation is the slope, which limits development of most areas to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

53—Cryaquolls-Typic Cryaquents complex, 1 to 5 percent slopes

Map Unit Description

This map unit is a complex of very deep, poorly drained soils on flood plains and valley floors of major drainage ways. The elevation is 8,500 to 10,000 feet. The average annual precipitation is 20 to 40 inches, the average annual air temperature is 34 to 38 degrees F, and the average frost-free period is 50 to 75 days. The moisture and temperature regimes are aquic and cryic, respectively.

This map unit consists of 50 percent Cryaquolls, 35 percent Typic Cryaquents, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Cryaquolls

The Cryaquolls soil formed in alluvium derived from mixed sources. In a reference pedon, the surface layer is very dark grayish brown and grayish brown loam about 12 inches thick. The underlying material is pale brown and yellowish brown stratified extremely gravelly loam and sandy loam that has iron concentrations throughout to a depth of 60 inches or more.

The permeability of the Cryaquolls soil is moderate. The available water capacity is moderate. The hydrologic group is D. The effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 6 to 20 inches in May and June. The available water capacity is high. Runoff is low, and the hazard of water erosion is slight. The potential of shrink-swell is low. This soil is subject to brief periods of flooding from April through July.

Typic Cryaquents

The Typic Cryaquents soil formed in alluvium derived from mixed sources. In a reference pedon, the surface has a layer of organic material about 3 inches thick. The surface layer is brown loam about 8 inches thick. The underlying material to a depth of 63 or more inches is light brownish gray very gravelly sandy loam stratified with loamy sand, loam and sandy clay loam and has iron concentrations throughout. This stratified material is variable ranging from sandy loam to sandy clay loam with variable amounts and sizes of rock fragments.

The permeability of the Typic Cryaquents soil is moderate in the surface layer and moderately slow to moderately rapid below the surface, depending on soil texture. The available water capacity is low to high. The hydrologic group is D. The effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 6 to 20 inches in May and June. Runoff is low, and the hazard of water erosion is slight. This soil is subject to brief periods of flooding from April through July. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Quazar extremely stony loam on alluvial fans; 4 percent Howardsville gravelly loam on alluvial fans; and small areas of Riverwash. Quazar and Howardsville soils are well drained. Included soils make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Deschampsia cespitosa/Carex spp.* The native vegetation on this unit consists mainly of tufted hairgrass, sedge, slender wheatgrass, and willow. Other important plants that characterize this unit are Baltic rush, cinquefoil, shrubby cinquefoil, narrowleaf cottonwood, and California false hellebore. The potential production of native vegetation on the Cryaquolls soil is about 3,700 pounds of air-dry vegetation per acre, and on the Typic Cryaquents it is about 3,000 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing, recreation, and wildlife habitat.

The mass movement potential is rated very low for this unit because of the slope.

The high water table promotes the vigorous growth of water tolerant plants. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Livestock grazing is limited by the short growing season. Deferred grazing will help to hasten revegetation

and to improve range areas in poor condition. The main limitations for seeding are the depth to a high water table and the hazard of flooding.

Wildlife such as elk, mule deer, coyote, beaver, and waterfowl utilize this unit. Management for wildlife should include protection from overgrazing by livestock and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover. Nearby forested areas provide cover for some of the wildlife.

This map unit is poorly suited to recreational development. The main limitations are the depth to a high water table and the hazard of flooding.

This map unit is in capability subclass 6w, nonirrigated.

54—Quazar very cobbly loam, 5 to 25 percent slopes

Map Unit Description

This very deep, well drained soil is on alluvial fans (*Fig. 4*).

The surface of this unit is covered with about 3 to 15 percent stones. The elevation is 9,000 to 10,700 feet. The average annual precipitation is 26 to 40 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 65 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Quazar very cobbly loam

The Quazar soil formed in alluvium derived dominantly from rhyolite and tuff. Typically, the surface layer is dark grayish brown very cobbly loam about 12 inches thick. The subsoil is light brown extremely gravelly clay loam about 14 inches thick. The substratum is brown extremely gravelly clay loam to a depth of 60 inches or more.



Figure 4.—Quazar very cobbly loam, 5 to 25 percent slopes, is on alluvial fans and in Subalpine Loam rangesites.

The permeability of the Quazar soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The surface is covered with about 5 percent stones. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Needleton stony loam on mountain slopes; and 3 percent Clayburn loam and 2 percent Hourglass loam, both on the lower parts of alluvial fans. Needleton soils have light colored surface layers. Clayburn and Hourglass soils have less than 35 percent rock fragments in the profile.

Vegetation

The dominant plant associations on this unit are *Festuca thurberi*/*Festuca arizonica* and *Festuca thurberi*/*Vicia americana*-*Lathyrus leucanthus*. The native vegetation on this unit consists mainly of Thurber's fescue, Arizona fescue, nodding brome, mountain brome, and needlegrass. Other common plants that characterize this unit are bluegrass, western wheatgrass, American vetch, and sedge. The average annual production of air-dry vegetation is about 2,400 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing, recreation, and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope and rock fragments.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. If the range vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the stony and cobbly surfaces and the steep slopes. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Wildlife such as elk, mule deer, rabbits, bear, coyotes, hawks, and eagles utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the stones, cobbles, and steep slopes. Camp areas and picnic areas may be developed on the less cobbly, more gently sloping parts of this map unit.

This map unit is in capability subclass 7s, nonirrigated.

56—Typic Cryaquents-Cryaquolls-Cryofibrists complex, 0 to 5 percent slopes

Map Unit Description

This map unit is a complex of very deep, very poorly drained soils on flood plains, drainageways, in valley bottoms, and in depressions on mesas. The elevation is 9,100 to 13,000 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 28 to 38 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are aquic and cryic, respectively.

This map unit consists of 35 percent Typic Cryaquents, 30 percent Cryaquolls, 25 percent Cryofibrists, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Typic Cryaquents

The Typic Cryaquents soil formed in alluvium derived from mixed sources. In a reference pedon, the surface has a layer of organic material about 3 inches thick. The

surface layer is brown loam about 8 inches thick. The underlying material is light brownish gray very gravelly sandy loam stratified with loamy sand, loam, and sandy clay loam and has iron concentrations throughout to a depth of 63 inches or more. This stratified material is variable ranging from loamy sand to sandy clay loam with variable amounts and sizes of rock fragments.

The permeability of the Typic Cryaquents soil is moderate in the surface layer and moderately slow to moderately rapid below the surface, depending on soil texture. The available water capacity is low to high. The hydrologic group is D. The effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 6 to 20 inches in May and June. Runoff is low, and the hazard of water erosion is slight. This soil is subject to brief periods of flooding from April through July. The potential of shrink-swell is low.

Cryaquolls

The Cryaquolls soil formed in alluvium derived from mixed sources. In a reference pedon, the surface layer is very dark grayish brown and grayish brown loam about 12 inches thick. The underlying material is pale brown and yellowish brown stratified extremely gravelly loam and extremely gravelly sandy loam that has iron concentrations throughout to a depth of 60 inches or more.

The permeability of the Cryaquolls soil is moderate. The available water capacity is moderate. The hydrologic group is D. The effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 6 to 20 inches in May and June. The available water capacity is high. Runoff is low, and the hazard of water erosion is slight. The potential of shrink-swell is low. This soil is subject to brief periods of flooding from April through July.

Cryofibrists

The Cryofibrists soil formed in organic material, and in some pedons overlies alluvium derived from mixed sources. In a reference pedon, the soil is slightly decomposed organic material to a depth of 60 inches or more.

The permeability of the Cryofibrists soil is moderate to moderately rapid. The available water capacity is very high. The hydrologic group is D. The effective rooting depth is 60 inches or more. A high water table is at a depth of 0 to 36 inches from January through December. Runoff is very low, and the hazard of water erosion is slight. This soil is subject to long periods of flooding from April through September. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Quazar very stony loam on alluvial fans; 2 percent Whitecross stony loam on alpine valley floors; small areas of Howardsville gravelly loam on terraces; and small areas of Henson very gravelly loam on the more sloping areas along the edge of valleys. All are well drained. Whitecross soils are shallow. Included soils make up about 10 percent of the acreage; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Deschampsia cespitosa*/*Carex spp.* and *Salix planifolia*/*Carex aquatilis*-*Deschampsia cespitosa*. The native vegetation on this unit consists mainly of oval-leaf willow, tufted hairgrass, sedges, alpine timothy, Baltic rush, and Parry's clover. Other important plants that characterize this unit are bluegrass, alpine fescue, spike trisetum, shrubby cinquefoil, and white marsh marigold. The high water table promotes the vigorous growth of water tolerant plants. The average annual production of air-dry vegetation is about 2,800 pounds per acre on the Typic Cryaquents and Cryofibrists soils, and about 3,700 pounds per acre on the Cryaquolls soil (Fig. 5).



Figure 5—The high water table in Typic Cryaquents-Cryaquolls-Cryofibrists complex, 0 to 5 percent slopes, provides plentiful moisture for plant growth. The soils of this map unit can produce about 2,800 to 3,700 pounds of vegetation per acre. These soils are in the Alpine Meadow range site.

Soil Management Implications

This unit is used for limited livestock grazing and wildlife habitat.

The mass movement potential is rated very low for this unit because of the slope.

Management practices suitable for use on this unit are proper grazing use, deferred grazing, rotation grazing, and in some locations spraying for brush management. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. If the condition of the range deteriorates, willows increase. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. The suitability of this unit for rangeland seeding is poor. The main limitation for seeding is the depth to a high water table.

Wildlife such as elk, mule deer, coyotes, and various bird species utilize this unit. Management for wildlife should include protection from overgrazing by livestock and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover. Nearby forested areas provide cover for some of the wildlife.

This map unit is poorly suited to recreational development. The main limitations are the depth to a high water table and the hazard of flooding.

This map unit is in capability subclass 6w, nonirrigated.

57—Howardsville gravelly loam, 1 to 6 percent slopes

Map Unit Description

This very deep, well drained soil is on fan remnants and river terraces. The elevation is 8,300 to 10,000 feet. The average annual precipitation is 20 to 30 inches, the average annual air temperature is 35 to 38 degrees F, and the average frost-free period is 45 to 65 days. The moisture and temperature regimes are ustic-udic and cryic, respectively.

Brief Soil Description

Howardsville gravelly loam

The Howardsville soil formed in alluvium derived dominantly from rhyolite, tuff, and similar volcanic rocks. Typically, the surface layer is dark grayish brown gravelly loam about 2 inches thick. The upper 8 inches of the underlying material are brown very gravelly sandy loam; and the lower part is light brown extremely cobbly loamy sand to a depth of 60 inches.

The permeability of the Howardsville soil is rapid below the surface layer. The available water capacity is very low. The hydrologic group is A. The effective rooting depth is 60 inches or more. Runoff is low, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Quazar extremely stony loam on alluvial fans; 5 percent Needleton stony loam on toeslopes; and small areas of Cryaquolls and Cryaquents in valley bottoms. Quazar soils have dark colored surface layers. Needleton soils have argillic horizons. Cryaquolls and Cryaquents are poorly drained or very poorly drained. Included soils make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Muhlenbergia montana/Festuca arizonica*. The native vegetation on this unit consists mainly of Arizona fescue, mountain muhly, Parry's danthonia, and needlegrass. Other important plants that characterize this unit are prairie Junegrass, sheep fescue, and western wheatgrass. The average annual production of air-dry vegetation is about 600 pounds per acre.

Soil Management Implications

This unit is used for urban development, recreation, wildlife habitat, and limited livestock grazing.

The mass movement potential is rated very low for this unit because of the slope.

The production of vegetation suitable for livestock grazing is limited by a short growing season and the droughty nature of the soil.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. If the range vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the droughty soil and a short growing season. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Wildlife such as elk, mule deer, rabbits, squirrels, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

This map unit is moderately suited to recreational development. Camp areas and picnic areas may be developed on this unit.

If this unit is used for urban development, the main limitation is the rapid permeability. Effluent from septic tank absorption fields can surface in down-slope areas and thus create a hazard to health. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability subclass 6s, nonirrigated.

58—Fughes-Herm complex, 5 to 25 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on hills and mesas. The elevation is 8,000 to 9,000 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 40 to 44 degrees F., and the average frost-free period is 80 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 55 percent Fughes loam, 35 percent Herm loam, and 10 percent included areas. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Descriptions

Fughes loam

The Fughes soil formed in slope alluvium derived dominantly from shale and sandstone. Typically, the surface layer is dark brown loam about 8 inches thick. The subsurface layer is dark brown clay loam about 12 inches thick. The upper part of this subsoil is dark grayish brown clay loam about 6 inches thick. The next part is pale brown clay about 18 inches thick. The lower part of the subsoil is pale brown cobbly clay extending to 60 inches or more.

The permeability of the Fughes soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Herm loam

The Herm soil formed in slope alluvium derived dominantly from shale and sandstone. Typically, the surface layer is dark grayish brown loam about 6 inches thick. The subsurface layer is dark brown clay loam about 7 inches thick. The upper 4 inches of the subsoil are grayish brown heavy clay loam, and the lower 28 inches are brown heavy clay loam. The substratum is grayish brown clay loam to a depth of 60 inches or more.

The permeability of the Herm soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 5 percent Fardraw stony loam on mesas; small areas of Hesperus loam in drainageways; and small areas of Goldbug very stony fine sandy loam on ridges. Fardraw soils have more than 35 percent rock fragments in the subsoil. Hesperus soils have fine-loamy subsoils. Goldbug soils have light colored surface layers. Inclusions make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Quercus gambelii/Symphoricarpos oreophilus*. Some *Festuca arizonica/Festuca thurberi* may also occur on the highest parts of the unit. The native vegetation on this unit consists mainly of Gambel oak, common snowberry, Arizona fescue, and mountain brome. Other important plants that characterize this unit are Saskatoon serviceberry, mountain muhly, needlegrass, elk sedge, slender wheatgrass, western wheatgrass, prairie Junegrass, and bluegrass. The average annual production of air-dry vegetation on the Fughes soil is about 2,000 pounds per acre, and on the Herm soil it is about 1,800 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on these soils are the high clay content and the shrink-swell potential. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

This unit is well suited to the production of range vegetation.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of range grasses. If the condition of the range deteriorates, Gambel oak and snowberry will increase. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. In areas where brush is managed by prescribed burning, chemical, or mechanical methods may be subject to a greater hazard of erosion. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this unit is used for recreational development, the main limitations are the slope and the slow permeability. The slope limits development of most areas to paths and trails.

Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Fughes soil is in capability subclass 6e, nonirrigated and irrigated. The Herm soil is in capability subclass 6e, nonirrigated.

59—Fughes-Herm complex, 25 to 45 percent slopes**Map Unit Description**

This map unit is a complex of very deep, well drained soils on hills. The surface of this unit is covered with about 1 to 3 percent stones. The elevation is 8,000 to 9,000 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 40 to 44 degrees F., and the average frost-free period is 80 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 45 percent Fughes stony loam, 35 percent Herm stony loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description**Fughes stony loam**

The Fughes soil formed in slope alluvium derived dominantly from shale, sandstone, and quartz diorite. Typically, the surface layer is dark brown stony loam about 20 inches thick. The upper part of the subsoil is dark grayish brown clay loam about 6 inches thick. The next part is pale brown clay about 18 inches thick. The lower part of the subsoil is pale brown cobbly clay extending to 60 inches or more.

The permeability of the Fughes soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is

high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Herm stony loam

The Herm soil formed in slope alluvium derived dominantly from shale, sandstone, and quartz diorite. Typically, the surface layer is dark grayish brown stony loam about 6 inches thick. The subsurface layer is dark brown stony clay loam about 7 inches thick. The upper 4 inches of the subsoil are grayish brown heavy clay loam, and the lower 28 inches are brown heavy clay loam. The substratum is grayish brown clay loam to a depth of 60 inches or more.

The permeability of the Herm soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 10 percent Fardraw stony loam on ridges and about 10 percent Hesperus loam in swales. Fardraw soils have more than 35 percent rock fragments in the subsoil. Hesperus soils have fine-loamy subsoils.

Vegetation

The dominant plant association is *Quercus gambelii/Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of Gambel oak, common snowberry, Arizona fescue, and mountain brome. Other important plants that characterize this unit are bluegrass, needlegrass, western wheatgrass, slender wheatgrass, elk sedge, prairie Junegrass, and Saskatoon serviceberry. The average annual production of air-dry vegetation on the Fughes soil is about 2,000 pounds per acre, and on the Herm soil it is about 1,800 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated moderate for this unit because of the slope and the high clay content of the soils.

This unit is poorly suited to the building of unsurfaced roads. The main limitations to the building of unsurfaced roads on this unit are the high clay content, the shrink-swell potential, and the slope. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

This unit is moderately suited to the production of range vegetation. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of range grasses.

If the condition of the range deteriorates, oakbrush and snowberry will increase. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribing burning or by chemical or mechanical methods may be subject to a greater hazard of erosion. Mechanical treatment practices are not practical, because the surface is stony and the slopes are steep. If the range vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the steep slopes and the content of stones. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock,

prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes, stony surface soils, and the slow permeability. The slopes limit use of the unit mainly to a few paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

60—Grimes very cobbly sandy loam, 0 to 3 percent slopes

Map Unit Description

This very deep, somewhat excessively drained soil is on alluvial fans, fan remnants, and river terraces. The elevation is 7,800 to 8,200 feet. The average annual precipitation is 24 to 30 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 90 to 100 days. The moisture and temperature regimes are udic-ustic and frigid, respectively.

Brief Soil Description

Grimes very cobbly sandy loam

The Grimes soil formed in alluvium derived dominantly from granitic rocks. Typically, the surface layer is grayish brown very cobbly sandy loam about 5 inches thick. The underlying material is pale brown extremely cobbly sandy loam about 17 inches thick over extremely cobbly sand that extends to a depth of 60 inches or more.

The permeability of the Grimes soil is rapid below the surface layer. The available water capacity is very low. The hydrologic group is A. The effective rooting depth is 60 inches or more. Runoff is very low, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Quazar very stony loam on alluvial fans and about 5 percent Frisco very cobbly loam on toeslopes. Quazar soils have dark colored surface layers. Frisco soils have argillic horizons of extremely stony sandy clay loam.

Vegetation

The dominant plant association is *Pinus ponderosa/Festuca arizonica*. The native vegetation on this unit consists mainly of ponderosa pine, Rocky Mountain Douglas-fir, Arizona fescue, and western wheatgrass. Other important plants that characterize this unit are mountain brome, bluegrass, prairie Junegrass, pine dropseed, blue spruce, elk sedge, rose, willow, and Saskatoon serviceberry. The average annual understory production of air-dry vegetation is about 250 pounds per acre.

Soil Management Implications

This unit is used for urban development, recreation, wildlife habitat, woodland, and limited livestock grazing.

A representative site index for this map unit for ponderosa pine is 73 on the Grimes soil. It can produce about 59 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated very low for this unit because of the slope.

The production of vegetation suitable for livestock grazing is limited by the droughty nature of the soil. Although most areas have trees, they are not used for timber production.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. If the range

vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the droughty soil and the content of cobbles in the surface. The plants selected for seeding should meet the seasonal requirements of livestock or wildlife, or both.

Wildlife such as elk, mule deer, rabbits, squirrels, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock and maintenance of adequate plant cover. Native vegetation and other forested areas provide cover for some of the wildlife.

This map unit is poorly suited to recreational development. The main limitation is the very cobbly surface. By carefully selecting sites and removing some of the surface cobbles, campgrounds and picnic areas may be developed on this unit. Paths and trails can be developed.

If this unit is used for urban development, the main limitation is the rapid permeability. Effluent from septic tank absorption fields can surface in downslope areas and thus create a hazard to health. If the density of housing is moderate to high, community sewage systems are needed to prevent contamination of water supplies as a result of seepage from onsite sewage disposal systems.

This map unit is in capability subclass 7s, nonirrigated.

110—Sheek-Ormiston complex, 3 to 30 percent slopes

Map Unit Description

This map unit is a complex of deep and very deep, well drained soils, on mesas, hills, and canyon side slopes. The surface of this map unit is covered with about 1 to 3 percent stones. The elevation is 7,100 to 7,600 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 44 to 45 degrees F, and the frost-free period is 80 to 110 days. The moisture and temperature regimes are ustic and frigid, respectively.

This unit consists of 45 percent Sheek very cobbly clay loam, 35 percent Ormiston loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Sheek very cobbly clay loam

The Sheek soil is very deep. It formed in slope alluvial and colluvium derived dominantly from sandstone and shale. Typically, the surface layer is dark brown very cobbly clay loam about 2 inches thick. The upper 5 inches of the subsoil are dark yellowish brown gravelly clay loam. The lower 13 inches are brown very cobbly clay loam. The upper 9 inches of the substratum are very pale brown very cobbly loam; the next 17 inches are light gray cobbly clay loam; and the lower part consists of white very cobbly loam to a depth of 60 inches or more.

The permeability of the Sheek soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Ormiston loam

The Ormiston soil is deep. It formed in slope alluvium and colluvium derived dominantly from sandstone.

Typically, the surface layer is brown loam about 7 inches thick. The upper part of the subsoil is reddish brown very stony clay loam about 17 inches thick. The lower part of the subsoil is reddish brown stony clay loam about 8 inches thick. The

substratum is pinkish white stony clay loam about 12 inches thick. Sandstone bedrock is at a depth of 44 inches. The depth to bedrock ranges from 40 to 60 inches or more.

The permeability of the Ormiston soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 40 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 8 percent Nortez loam on mesas; 6 percent Fivepine flaggy loam on low ridges of mesas; 3 percent Granath loam on mesas; and 3 percent Fughes loam in drainageways. Fivepine soils are shallow and clayey. Fughes and Granath soils are very deep and have less than 35 percent rock fragments in the profile. These inclusions make up about 20 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus edulis-Juniperus osteosperma/Cercocarpus montanus*. Some *Pinus edulis/Quercus gambelii* may also occur on north aspects. The native vegetation on this unit consists mainly of twoneedle pinyon, Utah juniper, true mountain mahogany, and Gambel oak. Other important plants that characterize this unit are prairie Junegrass, western wheatgrass, Indian ricegrass, bottlebrush squirreltail, muttongrass, blue grama, Utah serviceberry, squaw apple, and black sagebrush. The average annual understory production of air-dry vegetation on the Sheek soil is about 950 pounds per acre and on the Ormiston soil it is about 1,000 pounds per acre.

Soil Management Implications

This map unit is used for livestock grazing, wildlife habitat, and recreation.

The mass movement potential is rated low for this unit because of the slope and the high rock fragment content.

The main limitation to the building of unsurfaced roads on this unit is the content of large stones in the soil. To stabilize grades, road cuts and fills, and other disturbed areas should be provided with water bars and reseeded.

Removal of pinyon and juniper increases the production of understory forage. Range seeding should be done in conjunction with removal of the overstory. More uniform distribution of grazing is aided by properly location stock water development and salt, and by fencing and herding. If the range vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the limited rainfall and the content of large stones. Seeding late in the fall helps to ensure that the content of moisture in the soil will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreation development, the main limitations are the content of large stones and slopes that are over 8 percent. The slopes limit the use of the unit mainly to a few paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7s, nonirrigated.

111—Fardraw loam, 3 to 15 percent slopes

Map Unit Description

This very deep, well drained soil is on high mesas and structural benches. The elevation is 8,000 to 9,000 feet. The average annual precipitation is 20 to 26 inches, the average annual air temperature is 40 to 44 degrees F., and the average frost-free period is 80 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include soils that have dark surface layers more than 16 inches thick. These similar soils make up about 10 percent of the total acreage; the percentage varies from one area to another.

Brief Soil Description

Fardraw loam

The Fardraw soil formed in outwash and till derived from mixed sources. Typically, the surface layer is very dark gray loam about 8 inches thick. The subsurface layer is dark grayish brown loam about 3 inches thick. The upper part of the subsoil is brown very gravelly clay loam about 4 inches thick; and the lower part is light brown very cobbly sandy clay about 36 inches thick. The substratum is reddish yellow very cobbly sandy clay to a depth of 60 inches or more.

The permeability of this Fardraw soil is slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is slight. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit is about 10 percent Herm loam on mesas. Herm soils have less than 35 percent rock fragments in the control section.

Vegetation

The dominant plant association is *Quercus gambelii/Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of Gambel oak, mountain snowberry, Arizona fescue, muttongrass, and mountain brome. Other important plants that characterize this unit are elk sedge, needleandthread, Kentucky bluegrass, and ring muhly. The average annual production of air-dry vegetation is about 2,200 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope and the high rock fragment content.

The main limitation to the building of unsurfaced roads on Fardraw soils is the high content of rock fragments. To stabilize grades, road cuts and fills, and other disturbed areas should be provided with water bars and reseeded.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and the growth of range production. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. If the range vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the shrubs and stones. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, bear, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are slopes that are over 8 percent and the slow permeability. Paths and trails can be developed.

This map unit is in capability subclass 6s, nonirrigated.

113—Dolores loam, 30 to 65 percent slopes

Map Unit Description

This very deep, well drained soil is on the edges of mesas and hills. The elevation is 8,200 to 8,600 feet. The average annual precipitation is 20 to 25 inches, the mean annual air temperature is 40 to 45 degrees F., and the average frost-free period is 75 to 100 days. The soil moisture and temperature regimes are ustic and frigid, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include Fardraw loam on structural benches. Similar inclusions make up about 5 percent of the map unit.

Brief Soil Description

Dolores loam

The Dolores soil formed in slope alluvium, colluvium, and alluvium derived from mixed sources. Typically, the surface has a layer of organic material 1 inch thick. The surface layer is reddish brown loam about 7 inches thick with about 1 to 3 percent stones on the surface. The upper part of the subsoil is reddish brown to yellowish red extremely stony clay loam about 16 inches thick. The next part is yellowish red extremely stony clay about 25 inches thick. The lower part of the subsoil is brown extremely stony clay to a depth of 61 inches or more.

The permeability of the Dolores soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Intermixed throughout the unit are Typic Argiustolls and Pachic Argiustolls. These inclusions are fine textured in places and clayey skeletal in other places. Included are a few areas with shale at depths of 30 to 60 inches. Also included are small areas with 10 to 40 percent surface cobbles, stone, and boulders. Also included are about 5 percent Hesperus soils in swales. Hesperus soils have less than 35 percent rock fragments in the profile. These inclusions make up about 15 percent of the map unit.

Vegetation

The dominant plant association is *Quercus gambelii/Symphoricarpos oreophilus*. The native vegetation consists of Gambel oak and common snowberry, Arizona fescue, needlegrass, and bluegrass. Other common plants that characterize this soil are western wheatgrass, mountain brome, prairie Junegrass, and Utah serviceberry. The average annual production of air-dry vegetation is about 2,000 pounds per acre.

Soil Management Implications

This map unit is used for livestock grazing and wildlife habitat. The present use of forage production and watershed values should be continued to ensure slope stability.

The mass movement potential is rated moderate for this unit.

More uniform distribution of grazing is aided by properly locating stock water development and salt, and by fencing and herding. The slope limits access by livestock and results in overgrazing of less sloping areas. If the range vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the content of large stones and the steep slopes. The slopes limit the kind of equipment that can be used in reseeding. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, bear, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitation is the steepness of the slopes, which limit development mainly to a few paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

150—Silex-Rock outcrop complex, 10 to 20 percent slopes**Map Unit Description**

This map unit is a complex of a shallow and very shallow, well drained soil and Rock outcrop on mountain slopes, mesas and structural benches. The elevation is 10,000 to 11,000 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 36 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 70 percent Silex loam, 20 percent Rock outcrop, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description**Silex loam**

The Silex loam formed in slope alluvium derived dominantly from limestone and sandstone. Typically, the surface is covered with a mat of decomposed organic material about 1 inch thick. The surface layer is pinkish gray loam about 3 inches thick. The upper part of the subsoil is brown clay loam about 6 inches thick. The lower part of the subsoil is light brown sandy clay loam about 8 inches thick. Sandstone is at a depth of 18 inches. The depth to bedrock ranges from 7 to 20 inches from the mineral soil surface.

The permeability of the Silex soil is moderately slow. The available water capacity is low. The hydrologic group is D. The effective rooting depth is 7 to 20 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of sandstone, limestone, or rhyolite on cliffs, breaks, and mesas.

Contrasting Inclusions

Included in this unit are small areas of Needleton loam and Haviland loam, both on mountain slopes; and small areas of Snowdon stony loam on structural benches. Needleton and Haviland soils are deeper than 60 inches to bedrock. Snowdon soils have more than 35 percent rock fragments in the profile. Included areas make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, whortleberry, Thurber's fescue, and mountain brome. Other important plants that characterize this unit are Kentucky bluegrass, Columbia needlegrass, elk sedge, tufted hairgrass, timber oatgrass, whitestem gooseberry, and spike trisetum. Much of this unit was burned in the past and has been replanted with lodgepole pine. The potential production of native understory vegetation is about 500 pounds of air-dry vegetation per acre.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and limited livestock grazing.

A representative site index for this map unit for Englemann's spruce is 61 on the Silex soil. It can produce about 51 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 120 years old.

The mass movement potential is rated low for this unit because of the slope and bedrock.

The main concerns in producing and harvesting timber are reforestation and road construction due to the limited depth to bedrock and the rock outcrops. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitations to reforestation on this unit are the shallow depth to bedrock and the rock outcrops. The shallow depth to bedrock can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations for building unsurfaced roads on this unit are the depth to bedrock and the rock outcrops. Proper design of road drainage systems and care in the placement of culverts help to control erosion.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of understory plants.

Wildlife such as elk, mule deer, squirrel, blue grouse, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the slope, depth to bedrock, and rock outcrops. The slope limits development of most areas to paths and trails. Drainage should be provided for paths and trails.

The Silex soil is in capability subclass 6e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

151—Frisco Loam, 10 to 25 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 8,800 to 11,000 feet. The average annual precipitation is 30 to 40 inches, the average annual air temperature is 34 to 38 degrees F, and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Frisco loam

The Frisco soil formed in outwash, till, and slope alluvium derived dominantly from granite, volcanic, and sedimentary rocks. Typically, the surface is covered with a mat of twigs, needles, and bark about 2 inches thick. The surface layer is brown loam about 3 inches thick. The subsurface layer is light brown loam about 6 inches thick. The next layer is brown cobbly loam about 8 inches thick. The upper part of the subsoil is brown extremely stony sandy clay loam about 29 inches thick; the lower part is brown extremely stony loam extending to 62 inches or more.

The permeability of the Frisco soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this map unit are small areas of soil with bedrock above 60 inches, small areas of soils with fewer rock fragments in the control section, and small areas with dark surface layers, all on mountain slopes. Included soils make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, Rocky Mountain Douglas-fir, white fir, quaking aspen, and subalpine fir. Other important plants that characterize this unit are whortleberry, mountain snowberry, nodding brome, bluegrass, Arizona fescue, Thurber's fescue, Parry's danthonia, elk sedge, gooseberry currant, and creeping juniper. The average annual understory production of air-dry vegetation is about 700 pounds per acre.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 80 on the Frisco soil. It can produce about 76 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope and the high content of rock fragments.

The main concerns in producing and harvesting timber are reforestation and road construction in the stony soils. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitation to reforestation on this unit is the content of stones in the soil. Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitation to the building of unsurfaced roads on this unit is the content of stones in the soil. Proper design of road drainage systems and care in the placement

of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitation is the slope, which limits development of most areas to paths and trails. Drainage should be provided for paths and trails.

This map unit is in capability subclass 6e, nonirrigated.

152—Frisco Loam, 25 to 45 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 8,800 to 11,000 feet. The average annual precipitation is 30 to 40 inches, the average annual air temperature is 34 to 38 degrees F, and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Frisco loam

The Frisco soil formed in outwash, till, and slope alluvium derived dominantly from granitic, volcanic, and sedimentary rocks. Typically, the surface is covered with a mat of twigs, needles, and bark about 2 inches thick. The surface layer is brown loam about 3 inches thick. The subsurface layer is light brown loam about 6 inches thick. The next layer is brown cobbly loam about 8 inches thick. The upper part of the subsoil is brown extremely stony sandy clay loam about 29 inches thick; the lower part is brown extremely stony loam extending to 62 inches or more.

The permeability of the Frisco soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this map unit are small areas with bedrock above 60 inches, small areas with fewer rock fragments in the control section, and small areas with dark surface layers, all on mountain slopes. Included soils make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa*-*Picea engelmannii*/*Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, Rocky Mountain Douglas-fir, white fir, quaking aspen, and subalpine fir. Other important plants that characterize this unit are whortleberry, mountain snowberry, nodding brome, bluegrass, Arizona fescue, Thurber's fescue, Parry's danthonia, elk sedge, creeping juniper, and gooseberry currant. The average annual understory production of air-dry vegetation is about 700 pounds per acre.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 80 on the Frisco soil. It can produce about 76 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the high content of rock fragments.

The main concerns in producing and harvesting timber are reforestation and road construction in the stony soils. Conventional methods of harvesting timber can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitation to reforestation on this unit is the content of stones in the soil. Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations to the building of unsurfaced roads on this unit are the slope and the content of stones in the soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of vegetation for grazing.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitation is the steep slope, which restricts development of most areas to a few paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

153—Frisco-Horsethief complex, 10 to 30 percent slopes**Map Unit Description**

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 9,000 to 11,000 feet. The average annual precipitation is 25 to 45 inches, the average annual air temperature is 34 to 38 degrees F, and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 50 percent Frisco loam, 30 percent Horsethief loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description**Frisco loam**

The Frisco soil formed in outwash and slope alluvium derived dominantly from granitic, volcanic, and sedimentary rocks. Typically, the surface is covered with a mat

of decomposing twigs, needles, and bark about 2 inches thick. The surface layer is brown loam about 3 inches thick. The subsurface layer is light brown loam about 6 inches thick. The next layer is brown cobbly loam about 8 inches thick. The upper part of the subsoil is brown extremely stony sandy clay loam about 29 inches thick; the lower part is brown extremely stony loam extending to 62 inches or more.

The permeability of the Frisco soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Horsethief loam

The Horsethief soil formed in slope alluvium derived dominantly from sandstone, and volcanic and igneous rocks. Typically, the surface is covered with a mat of needles, twigs, and bark about 2 inches thick. The surface layer is pale brown loam about 3 inches thick. The subsurface layer is pale brown and light yellowish brown fine sandy loam about 19 inches thick. The upper 8 inches of the subsoil are very pale brown fine sandy loam and brown sandy clay loam; the lower 17 inches are brown very stony clay loam. The substratum is brown very stony clay loam to a depth of 62 inches or more.

The permeability of the Horsethief soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 15 percent Quazar stony loam on footslopes and about 5 percent Snowdon stony loam on mountain slopes. Quazar soils have a dark surface layer. Snowdon soils are shallow over bedrock. In the Needle Creek area and the Elk Creek area the Frisco and Horsethief soils are formed in mostly granitic materials and range from very stony or very bouldery to extremely stony or extremely bouldery.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. Some *Populus tremuloides/Symphoricarpos oreophilus* may also occur. The native vegetation on this unit consists mainly of Englemann's spruce, Rocky Mountain Douglas-fir, subalpine fir, and quaking aspen. Other important plants that characterize this unit are whortleberry, mountain snowberry, Thurber's fescue, nodding brome, mountain brome, Arizona fescue, bluegrass, elk sedge, Parry's danthonia, and spike trisetum. The average annual understory production of air-dry vegetation is about 700 pounds per acre on the Frisco soil, and about 800 pounds per acre on the Horsethief soil.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 80 on the Frisco soil. It can produce about 76 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope and the high content of rock fragments.

The main concerns in producing and harvesting timber are reforestation and road construction in the stony soils. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitation to reforestation on this soil is the content of stones in the surface layer. Large stones limit rooting space and soil moisture, and interfere with planting operations. After harvest, reforestation must be carefully managed to reduce

competition from undesirable understory plants. The high content of rock fragments can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitation to the building of unsurfaced roads on this unit is the content of stones in the soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, squirrel, blue grouse, hawks, bighorn sheep, eagles, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover.

If this map unit is used for recreational development the main limitation is the slope, which restricts development of most areas to paths and trails. Drainage should be provided for paths and trails.

This map unit is in capability subclass 6e, nonirrigated.

154—Frisco-Horsethief complex, 30 to 75 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. This map unit typically has .1 to 3 percent stones on the surface. The elevation is 8,400 to 11,500 feet. The average annual precipitation is 25 to 45 inches, the average annual air temperature is 34 to 38 degrees F, and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 60 percent Frisco loam, 25 percent Horsethief loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Frisco loam

The Frisco soil formed in outwash and slope alluvium derived dominantly from granitic, volcanic, and sedimentary rocks. Typically, the surface is covered with a mat of decomposing twigs, needles, and bark about 2 inches thick. The surface layer is brown loam about 3 inches thick. The subsurface layer is light brown loam about 6 inches thick. The next layer is brown cobbly loam about 8 inches thick. The upper part of the subsoil is brown extremely stony sandy clay loam about 29 inches thick; the lower part is brown extremely stony loam extending to 62 inches or more.

The permeability of the Frisco soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Horsethief loam

The Horsethief soil formed in colluvium and slope alluvium derived dominantly from sandstone, volcanic, and igneous rocks. Typically, the surface is covered with a mat of needles, twigs, and bark about 2 inches thick. The surface layer is pale brown

loam about 3 inches thick. The subsurface layer is pale brown and light yellowish brown fine sandy loam about 19 inches thick. The upper 8 inches of the subsoil are very pale brown fine sandy loam and brown sandy clay loam. The lower 17 inches of the subsoil are brown very stony clay loam. The substratum is brown very stony clay loam to a depth of 62 inches or more.

The permeability of the Horsethief soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Quazar stony loam in swales and 10 percent Snowdon soils on mountain slopes. Quazar soils have a dark surface layer. Snowdon soils are shallow over bedrock. In the Needle Creek area and the Elk Creek area the Frisco and Horsethief soils are formed mostly in granitic materials and range from very stony or very bouldery to extremely stony or extremely bouldery.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. Some *Populus tremuloides/Symphoricarpos oreophilus* may also occur. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, Rocky Mountain Douglas-fir, white fir, and quaking aspen. Other important plants that characterize this unit are whortleberry, mountain snowberry, mountain brome, nodding brome, bluegrass, Arizona fescue, Thurber's fescue, gooseberry currant, elderberry, elk sedge, Parry's danthonia, spike trisetum, and creeping juniper. The average annual understory production of air-dry vegetation is about 700 pounds per acre on the Frisco soil, and about 800 pounds per acre on the Horsethief soil.

Soil Management Implications

This unit is used for timber production, wildlife habitat, recreation, and limited livestock grazing.

A representative site index for this map unit for Englemann's spruce is 80 on the Frisco soil. It can produce about 76 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated high for this unit because of the steep slopes.

The main concerns in producing and harvesting timber are steep slopes, reforestation, stones on the surface, and road construction due to stones and steep slopes. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall. Conventional methods of harvesting timber are difficult to use because of the slope.

The main limitations to reforestation on this soil are the stones in the soil and on the surface. Large stones limit rooting space and soil moisture, and interfere with planting operations. After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. The high content of rock fragments can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations to the building of unsurfaced roads on this unit are the stones in the soil and the steep slopes. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. The slope limits access by livestock and results in overgrazing of the less sloping areas. Proper use of grazing lands and of a planned grazing system are important practices to

ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, mountain goats, bighorn sheep, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes and the stones on the surface. The slopes limit use of the unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

155—Tuckerville-Rock outcrop complex, 30 to 60 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils and Rock outcrop on mountain slopes. The elevation is 8,800 to 10,000 feet. The average annual precipitation is 25 to 32 inches, the average annual air temperature is 36 to 42 degrees F, and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 70 percent Tuckerville stony loam, 20 percent Rock outcrop, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Tuckerville stony loam

The Tuckerville soil formed in slope alluvium, colluvium, and outwash derived dominantly from granite and sandstone. Typically, the surface is covered with a mat of leaves, needles, and partly decomposed organic material about 3 inches thick. The surface layer is brown stony loam about 3 inches thick. The subsurface layer is pinkish gray very stony sandy loam about 15 inches thick. The upper part of the subsoil is pinkish gray very stony sandy loam and reddish brown very stony sandy clay loam about 5 inches thick. The lower part of the subsoil is reddish brown very stony sandy clay loam about 21 inches thick. The substratum is light reddish brown extremely stony sandy loam to a depth of 63 inches or more.

The permeability of the Tuckerville soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of bedrock as cliffs, knobs, and breaks.

Contrasting Inclusions

Included in this unit are about 5 percent Haviland loam and 5 percent Scotch loam, both on mountain slopes. Haviland soils have less than 35 percent rock fragments in the profile. Scotch soils are shallow over bedrock.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Mahonia repens*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, Rocky Mountain Douglas-fir, and white fir. Other important plants that characterize this unit are Thurber's fescue, mountain brome, prairie Junegrass, spike

trisetum, elk sedge, bluegrass, Arizona fescue, russet buffaloberry, common snowberry, boxleaf myrtle, common juniper, and Saskatoon serviceberry. The average annual understory production of air-dry vegetation is about 800 pounds per acre.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and limited livestock grazing.

A representative site index for this map unit for Rocky Mountain Douglas-fir is 84 on the Tuckerville soil. It can produce about 75 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 40 years old.

The mass movement potential is rated low for this unit because of the high content of rock fragments.

The main concerns in producing and harvesting timber are steep slopes, reforestation, road construction, and preventing erosion along roads and other areas where vegetation has been removed. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Rocky Mountain Douglas-fir, Englemann's spruce, and Lodgepole pine.

The main limitations to the building of unsurfaced roads on this unit are the stones in the soil and the slope. Careful consideration of road systems and harvesting methods should be made to minimize erosion. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The slope limits access by livestock and results in overgrazing of the less sloping areas. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Fencing will help to improve livestock distribution and production of understory vegetation.

Wildlife such as elk, mule deer, bear, coyote, squirrels, rabbits, and blue grouse, eagles, and hawks utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes and the rock outcrops. The slopes limit development of most areas to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Tuckerville soil is in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

156—Sponsor-Tuckerville complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 8,800 to 10,000 feet. The average annual precipitation is 25 to 35 inches, the average annual air temperature is 36 to 42 degrees F, and the average

frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively, for both soils.

This unit consists of 60 percent Sponsor loam, 30 percent Tuckerville loam, and 10 percent included soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include Clayburn loam on less sloping areas. These similar soils make up about 5 percent of the total acreage; the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Sponsor loam

The Sponsor soil formed in outwash, slope alluvium, and colluvium derived dominantly from granite and sandstone. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is dark reddish gray loam about 11 inches thick. The upper part of the subsoil is reddish brown cobbly clay loam about 31 inches thick; the lower part is reddish brown very stony clay loam extending to 61 inches or more.

The permeability of the Sponsor soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Tuckerville loam

The Tuckerville soil formed in outwash, slope alluvium, and colluvium derived dominantly from granite and sandstone. Typically, the surface is covered with a mat of leaves, needles, and partly decomposed organic material about 3 inches thick. The surface layer is brown loam about 3 inches thick. The subsurface layer is pinkish gray stony loam about 15 inches thick. The upper part of the subsoil is pinkish gray very stony sandy loam and reddish brown very stony sandy clay loam about 5 inches thick; the lower part is reddish brown very stony sandy clay loam about 21 inches thick. The substratum is light reddish brown extremely stony sandy loam to a depth of 63 inches or more.

The permeability of the Tuckerville soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit is about 5 percent Wander loam on mountain slopes. Wander soils have dark surface layers and more than 35 percent rock fragments in the subsoil.

Vegetation

The dominant plant associations are *Abies concolor-Pseudotsuga menziesii/Symphoricarpos oreophilus* and *Abies lasiocarpa-Picea engelmannii/Carex geyeri*. Some *Populus tremuloides/Symphoricarpos oreophilus* occurs in quaking aspen areas. The native vegetation on this unit consists mainly of quaking aspen, white fir, Rocky Mountain Douglas-fir, Englemann's spruce, subalpine fir, and common snowberry. Other important plants that characterize this unit are Thurber's fescue, mountain brome, elk sedge, needlegrass, western wheatgrass, bluegrass, spike trisetum, Nevada pea, and russet buffaloberry. The average annual understory production of air-dry vegetation is about 2,100 pounds per acre on the Sponsor soil, and about 800 pounds per acre on the Tuckerville soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 80 on the Sponsor soil. It can produce about 48 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated moderate for this unit.

The main concerns in producing and harvesting timber are reforestation and preventing erosion along roads and other areas where vegetation has been removed. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are white fir, lodgepole pine and Rocky Mountain Douglas-fir. Quaking aspen will usually regenerate from roots after harvest.

The main limitations for building unsurfaced roads on this unit are the stones in the Tuckerville soil, the low strength of the Sponsor soil, and the slopes in the unit. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, blue grouse, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover.

If this map unit is used for recreational development, the main limitation is the slope, which limits development mainly to a few paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

157—Sponsor-Tuckerville complex, 15 to 30 percent slopes, very bouldery

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 8,800 to 10,000 feet. The average annual precipitation is 25 to 35 inches, the average annual air temperature is 36 to 42 degrees F, and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively, for both soils.

This unit consists of 60 percent Sponsor loam, very bouldery; 30 percent Tuckerville stony loam, very bouldery; 5 percent similar included soils; and 5 percent contrasting included soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include Clayburn loam on less sloping areas. These similar soils make up about 5 percent of the total acreage; the

percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Sponsor loam, very bouldery

The Sponsor soil formed in outwash, slope alluvium, and colluvium derived dominantly from granite and sandstone. Boulders on the surface are 4 to 15 feet in diameter and spaced 15 to 50 feet apart. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is dark reddish gray loam about 11 inches thick. The upper part of the subsoil is reddish brown cobbly clay loam about 31 inches thick; the lower part is reddish brown very stony clay loam extending to 61 inches or more.

The permeability of the Sponsor soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Tuckerville stony loam, very bouldery

The Tuckerville soil formed in outwash, slope alluvium, and colluvium derived dominantly from granite and sandstone. Boulders on the surface are 5 to 15 feet in diameter and spaced 15 to 50 feet apart. Typically, the surface is covered with a mat of leaves, needles, and partly decomposed organic material about 3 inches thick. The surface layer is brown stony loam about 3 inches thick. The subsurface layer is pinkish gray stony loam about 15 inches thick. The upper part of the subsoil is pinkish gray very stony sandy loam and reddish brown very stony sandy clay loam about 5 inches thick; the lower part is reddish brown very stony sandy clay loam about 21 inches thick. The substratum is light reddish brown extremely stony sandy loam to a depth of 63 inches or more.

The permeability of the Tuckerville soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit is about 5 percent Wander loam on mountain slopes. Wander soils have dark surface layers and more than 35 percent rock fragments in the subsoil.

Vegetation

The dominant plant associations are *Abies concolor-Pseudotsuga menziesii/Symphoricarpos oreophilus* and *Abies lasiocarpa-Picea engelmannii/Carex geyeri*. Some *Populus tremuloides/Symphoricarpos oreophilus* occurs in quaking aspen areas. The native vegetation on this unit consists mainly of quaking aspen, white fir, Rocky Mountain Douglas-fir, Englemann's spruce, subalpine fir, and common snowberry. Other important plants that characterize this unit are Thurber's fescue, mountain brome, needlegrass, western wheatgrass, bluegrass, elk sedge, spike trisetum, Nevada pea, and russet buffaloberry. The average annual understory production of air-dry vegetation is about 2,100 pounds per acre on the Sponsor soil, and about 800 pounds per acre on the Tuckerville soil.

Soil Management Implications

This unit is used for wildlife habitat, livestock grazing, and timber production.

A representative site index for this map unit for white fir is 50 on the Tuckerville soil. It can produce about 91 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 70 years old.

The mass movement potential is rated low for this unit because of the slope and boulders.

The main concerns in producing and harvesting timber are preventing erosion and equipment limitations due to the many large surface boulders. Boulders on the surface can interfere with felling, yarding, and other operations involving the use of equipment. Most areas of this unit should not be logged.

The main limitations to reforestation on this soil are the content of boulders and stones. Large stones limit rooting space and soil moisture, and interfere with planting operations. After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. The high content of rock fragments can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Rocky Mountain Douglas-fir, white fir, and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

Usually, these areas should be avoided in road construction because of large boulders.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of understory plants.

Wildlife such as elk, mule deer, bear, blue grouse, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover.

This map unit is poorly suited to recreational development. If this map unit is used for recreational development, the main limitations are the slope and the surface boulders.

This map unit is in capability subclass 7s, nonirrigated.

158—Sponsor-Tuckerville complex 30 to 60 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 8,800 to 10,000 feet. The average annual precipitation is 25 to 35 inches, the average annual air temperature is 36 to 42 degrees F, and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively, for both soils.

This unit consists of 60 percent Sponsor loam, 30 percent Tuckerville loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Sponsor loam

The Sponsor soil formed in outwash, slope alluvium, and colluvium derived dominantly from granite and sandstone. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is dark reddish gray loam about 11 inches thick. The upper part of the subsoil is reddish brown cobbly clay loam about 31 inches thick; the lower part is reddish brown very stony clay loam extending to 61 inches or more.

The permeability of the Sponsor soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Tuckerville loam

The Tuckerville soil formed in outwash, slope alluvium, and colluvium derived dominantly from granite and sandstone. Typically, the surface is covered with a mat of leaves, needles, and partly decomposed organic material about 3 inches thick. The surface layer is brown loam about 3 inches thick. The subsurface layer is pinkish gray stony loam about 15 inches thick. The upper part of the subsoil is pinkish gray very stony sandy loam and reddish brown very stony sandy clay loam about 5 inches thick; the lower part is reddish brown very stony sandy clay loam about 21 inches thick. The substratum is light reddish brown extremely stony sandy loam to a depth of 63 inches or more.

The permeability of the Tuckerville soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Wander stony loam and 5 percent Snowdon stony loam, both on mountain slopes. Wander soils have dark surface layers and more than 35 percent rock fragments throughout the subsoil. Snowdon soils are shallow over bedrock.

Vegetation

The dominant plant associations are *Abies concolor-Pseudotsuga menziesii/Symphoricarpos oreophilus* and *Abies lasiocarpa-Picea engelmannii/Carex geyeri*. The native vegetation on this unit consists mainly of quaking aspen, white fir, Rocky Mountain Douglas-fir, Englemann's spruce, subalpine fir, and common snowberry. Other important plants that characterize this unit are Thurber's fescue, mountain brome, elk sedge, needlegrass, western wheatgrass, bluegrass, spike trisetum, Nevada pea, and russet buffaloberry. The average annual understory production of air-dry vegetation is about 2,100 pounds per acre on the Sponsor soil, and about 800 pounds per acre on the Tuckerville soil.

Soil Management Implications

This unit is used mainly for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 80 on the Sponsor soil. It can produce about 48 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated high for this unit because of the steep slopes and the lack of rock fragments in the Sponsor soil.

The main concerns in producing and harvesting timber are equipment limitations due to the steep slopes; reforestation; and preventing erosion along roads and other areas where vegetation has been removed. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock will hasten reforestation. The steepness of slope limits the kinds of equipment that can be used in forest management. Among the trees that are suitable for planting are white fir, lodgepole pine, and Rocky Mountain Douglas-fir. Quaking aspen will usually regenerate from roots after harvest.

The main limitations for building unsurfaced roads on this unit are the steep slopes and the mass movement potential. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. The slope limits access by livestock and results in overgrazing of the less sloping areas.

Wildlife such as elk, mule deer, bear, blue grouse, squirrels, and rabbit utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this unit is used for recreational development, the main limitation is the steep slopes, which limit development of the unit mainly to a few paths and trails that should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

159—Tuckerville very stony sandy loam, 15 to 55 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 8,800 to 10,000 feet. The average annual precipitation is 25 to 32 inches, the average annual air temperature is 36 to 42 degrees F, and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Tuckerville very stony sandy loam

The Tuckerville soil formed in outwash, slope alluvium, and colluvium derived dominantly from granite and sandstone. Typically, the surface is covered with a mat of leaves, needles, and partly decomposed organic material about 3 inches thick. The surface layer is brown very stony sandy loam about 3 inches thick. The subsurface layer is pinkish gray very stony sandy loam about 15 inches thick. The upper part of the subsoil is pinkish gray very stony sandy loam and reddish brown very stony sandy clay loam about 5 inches thick; the lower part is reddish brown very stony sandy clay loam about 21 inches thick. The substratum is light reddish brown extremely stony sandy loam to a depth of 63 inches or more.

The permeability of the Tuckerville soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Anvik loam, 5 percent Horsethief stony fine sandy loam, and 5 percent Weminuche loam, all on mountain slopes. Anvik and Weminuche soils have less than 35 percent rock fragments in the profile. The upper boundary of the subsoil in the Horsethief soils is deeper than two feet.

Vegetation

The dominant plant associations are *Abies concolor-Pseudotsuga menziesii/Symphoricarpos oreophilus* and *Abies lasiocarpa-Picea engelmannii/Carex geyeri*.

The native vegetation on this unit consists mainly of white fir, Rocky Mountain Douglas-fir, Englemann's spruce, subalpine fir, and quaking aspen. Other important plants that characterize this unit are Thurber's fescue, nodding brome, prairie Junegrass, spike trisetum, elk sedge, bluegrass, Arizona fescue, common snowberry, boxleaf myrtle, common juniper, and Saskatoon serviceberry. The average annual understory production of air-dry vegetation is about 800 pounds per acre.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Rocky Mountain Douglas-fir is 84 on the Tuckerville soil. It can produce about 75 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 40 years old.

The mass movement potential is rated low for this unit because of the high content of rock fragments.

The main concerns in producing and harvesting timber are reforestation, road construction and preventing erosion along roads and other areas where vegetation has been removed. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Rocky Mountain Douglas-fir, white fir, Englemann's spruce, and lodgepole pine.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Fencing will help to improve livestock distribution and the production of understory plants.

Wildlife such as elk, mule deer, bear, blue grouse, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this map unit is used for recreational development, the main limitations are the steep slopes and the content of stones. The slopes limit development of the unit mainly to paths and trails that should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

160—Anvik-Tuckerville complex, 10 to 45 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 8,500 to 10,000 feet. The average annual precipitation is 25 to 32 inches, the average annual air temperature is 36 to 42 degrees F., and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively, for both soils.

This unit consists of 40 percent Anvik loam, 35 Tuckerville stony loam, and 25 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Anvik loam

The Anvik soil formed in slope alluvium derived dominantly from sandstone and shale. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark grayish brown loam about 10 inches thick. The subsurface layer is light yellowish brown loam about 11 inches thick. The upper 9 inches of the subsoil are brown clay loam, and the lower 14 inches are yellowish brown clay loam. The substratum is yellowish brown sandy clay loam to a depth of 61 inches or more.

The permeability of the Anvik soil is moderate. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Tuckerville stony loam

The Tuckerville soil formed in slope alluvium and colluvium derived dominantly from sandstone. Typically, the surface is covered with a mat of leaves, needles, and partly decomposed organic material about 3 inches thick. The surface layer is brown stony loam about 3 inches thick. The subsurface layer is pinkish gray stony loam about 15 inches thick. The upper part of the subsoil is pinkish gray very stony sandy loam and reddish brown very stony sandy clay loam about 5 inches thick; the lower part is reddish brown very stony sandy clay loam about 21 inches thick. The substratum is light reddish brown extremely stony sandy loam to a depth of 63 inches or more.

The permeability of the Tuckerville soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Weminuche loam, 10 percent Horsethief stony fine sandy loam, and 5 percent Scotch loam, all on mountain slopes. Also included are small areas of Rock outcrop. Weminuche soils have less than 35 percent rock fragments in the profile. The upper boundary of the subsoil in the Horsethief soil is deeper than two feet. Scotch soils are shallow over bedrock.

Vegetation

The dominant plant associations are *Abies concolor-Pseudotsuga menziesii/Symphoricarpos oreophilus* and *Abies lasiocarpa-Picea engelmannii/Carex geyeri*. Some *Populus tremuloides/Symphoricarpos oreophilus* occurs in quaking aspen areas that lack evergreen trees. The native vegetation consists mainly of quaking aspen, white fir, Rocky Mountain Douglas-fir, subalpine fir, Englemann's spruce, and common snowberry. Other important plants that characterize this unit are Thurber's fescue, mountain brome, Arizona fescue, bluegrass, elk sedge, spike trisetum, prairie Junegrass, Oregon grape, and common juniper. The average annual understory production of air-dry vegetation is about 1,000 pounds per acre on the Anvik soil, and about 800 pounds per acre on the Tuckerville soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 66 on the Anvik soil. It can produce about 36 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other places where vegetative cover has been removed. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Rocky Mountain Douglas-fir, Englemann's spruce, and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, blue grouse, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover

If this map unit is used for recreational development, the main limitation is the steep slopes over most of the area, which restrict development most of the unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

161—Needleton stony loam, 5 to 15 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes and fan remnants. The elevation is 9,000 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 75 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Needleton stony loam

The Needleton soil formed in alluvium and slope alluvium derived dominantly from rhyolite and sandstone. Typically, the surface is covered with a mat of organic material about 2 inches thick. The surface layer is light reddish brown stony loam about 14 inches thick. The subsurface layer is reddish brown very cobbly sandy clay loam and light reddish brown very cobbly loam about 10 inches thick. The upper part of the subsoil is reddish brown very stony sandy clay loam about 22 inches thick; the lower part is reddish brown very cobbly clay loam extending to 62 inches or more.

The permeability of the Needleton soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or

more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Haviland loam on mountain slopes and 5 percent Wander extremely stony loam on alluvial fans. Haviland soils have less than 35 percent rock fragments in the profile. Wander soils have dark surface layers. Included soils make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, and quaking aspen. Other important plants that characterize this unit are whortleberry, Thurber's fescue, mountain brome, bluegrass, Richardson's geranium, spike trisetum, snowberry, elk sedge, and common juniper. The average annual understory production of air-dry vegetation is about 800 pounds per acre.

Soil Management Implications

This unit is used for timber production, recreation, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 84 on the Needleton soil. It can produce about 82 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concern in producing and harvesting timber is reforestation. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitation to reforestation on this soil is the content of stones in the surface layer. Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitation for building unsurfaced roads on this unit is the content of stones in the soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, coyote, and blue grouse utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover.

If this map unit is used for recreational development, the main limitations are the stones on the surface and the slopes that are over 8 percent. Paths and trails can be developed.

This map unit is in capability subclass 7s, nonirrigated.

162—Quazar-Varden complex, 15 to 65 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes and alluvial fans. The surface of this unit is covered with 3 to 15 percent stones. The elevation is 9,000 to 11,500 feet. The average annual precipitation is 25 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 65 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 45 percent Quazar very cobbly loam, 40 percent Varden very cobbly loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Quazar very cobbly loam

The Quazar soil formed in alluvium and slope alluvium derived dominantly from rhyolite, tuff, and similar volcanic rocks. Typically, the surface layer is dark grayish brown very cobbly loam about 12 inches thick. The subsoil is light brown extremely gravelly clay loam about 14 inches thick. The substratum is brown extremely gravelly clay loam to a depth of 60 inches or more.

The permeability of the Quazar soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Varden very cobbly loam

The Varden soil formed in colluvium, alluvium, and slope alluvium derived dominantly from rhyolite, tuff, and sandstone. Typically, the surface layer is dark grayish brown very cobbly loam about 15 inches thick. The underlying material is brown extremely cobbly loam with many voids to a depth of 60 inches or more.

The permeability of the Varden soil is moderate to a depth of 15 inches and moderately rapid to very rapid below this depth. The available water capacity is very low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Needleton stony loam and 5 percent Snowdon stony loam, both on mountain slopes. Needleton soils lack the dark colored surface layers. Snowdon soils are shallow over bedrock.

Vegetation

The dominant plant associations are *Festuca thurberi*/*Festuca arizonica* and *Festuca thurberi*/*Vicia americana*-*Lathyrus leucanthus*. The native vegetation on this unit consists mainly of Thurber's fescue, Parry's danthonia, Letterman's needlegrass, and nodding brome. Other important plants that characterize this unit are American vetch, Arizona fescue, slender wheatgrass, bluegrass, elk sedge, and quaking aspen. The average annual production of air-dry vegetation is about 2,400 pounds per acre on both soils.

Soil Management Implications

This unit is used for livestock grazing, recreation, and wildlife habitat.

The mass movement potential is rated low for this unit because of the high content of rock fragments.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and vegetation for grazing. If the condition of the range deteriorates, aspen increase. The slope limits access by livestock and results in overgrazing of the less sloping areas.

Wildlife such as elk, mule deer, bear, bighorn sheep, rabbits, squirrels, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this map unit is used for recreational development, the main limitations are the content of stones and the steep slopes. The slopes limit the use of the map unit mainly to a few paths and trails, which should extend across the slope. Cuts and fills should be seeded or mulched.

The Quazar soil is in capability subclass 7e, nonirrigated. The Varden soil is in capability subclass 7s, nonirrigated.

163—Clayburn-Hourglass complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 8,000 to 10,000 feet. The average annual precipitation is 30 to 40 inches, the average annual air temperature is 32 to 36 degrees F., and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 50 percent Clayburn loam, 35 percent Hourglass loam, 10 percent similar soils, and 5 percent contrasting soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include Sessions loam. These similar soils make up about 10 percent of the total acreage; the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Clayburn loam

The Clayburn soil formed in slope alluvium derived dominantly from sandstone and shale. Typically, the surface layer is grayish brown and dark grayish brown loam about 13 inches thick. The upper 5 inches of the subsoil are brown clay loam. The middle part is brown clay loam about 18 inches thick. The lower 12 inches are light brown sandy clay loam. The substratum is light brown sandy clay loam to a depth of 60 inches or more.

The permeability of the Clayburn soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Hourglass loam

The Hourglass soil formed in slope alluvium derived dominantly from sandstone, limestone, and shale. Typically, the surface layer is dark grayish brown loam about 11 inches thick. The upper part of the subsoil is brown clay loam about 7 inches thick. The middle part is brown gravelly clay loam about 13 inches thick. The lower part of

the subsoil is brown very stony clay loam about 15 inches thick. The substratum is brown very stony clay loam to a depth of 60 inches or more.

The permeability of the Hourglass soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

There are 5 percent inclusions of Frisco soils on mountain slopes. Frisco soils lack the dark colored surface layers of the Clayburn and Hourglass soils.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of quaking aspen, snowberry, bluegrass, mountain brome, and Thurber's fescue. Other important plants that characterize this unit are Fendler's meadow-rue, elk sedge, American vetch, Richardson's geranium, and white fir. The average annual understory production of air-dry vegetation is about 3,000 pounds per acre on the Clayburn soil, and about 3,000 pounds per acre on the Hourglass soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, wildlife habitat, and recreation.

A representative site index for this map unit for quaking aspen is 70 on the Clayburn soil. It can produce about 39 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit.

The main concerns in producing and harvesting timber are reforestation and preventing erosion along roads and other disturbed areas. Conventional methods of harvesting timber generally can be used. Minimizing the risk of erosion is essential in harvesting timber. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitation to reforestation on these soils is the plant competition if trees other than quaking aspen are to be grown. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Planting nursery stock will hasten reforestation. Other trees that are suitable for planting are Englemann's spruce and subalpine fir. Quaking aspen will usually regenerate from roots after harvest.

The main limitations to building unsurfaced roads are the low strength and the slope. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and moist forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of understory vegetation. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitation is the slope, which restricts development of the unit mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

164—Hourglass-Bucklon-Wander complex, 30 to 60 percent slopes

Map Unit Description

This map unit is a complex of very deep and shallow, well drained soils on mountain slopes. The elevation is 8,000 to 10,600 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 36 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 50 percent Hourglass loam, 25 percent Bucklon loam, 15 percent Wander very cobbly loam, and 10 percent included soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include Clayburn loam. These similar soils make up about 5 percent of the total acreage; the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Hourglass loam

The Hourglass soil is very deep. It formed in slope alluvium derived dominantly from sandstone, limestone, and shale. Typically, the surface layer is dark grayish brown loam about 11 inches thick. The upper part of the subsoil is brown clay loam about 7 inches thick. The middle part is brown gravelly clay loam about 13 inches thick. The lower part of the subsoil is brown very stony clay loam about 15 inches thick. The substratum is brown very stony clay loam to a depth of 60 inches or more.

The permeability of the Hourglass soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Bucklon loam

The Bucklon soil is shallow. It formed in residuum derived dominantly from shale and sandstone. Typically, the surface layer is dark grayish brown loam about 12 inches thick. Bedrock generally is a depth of 12 inches, but the depth to bedrock ranges from 10 to 20 inches.

The permeability of the Bucklon soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high and the hazard of water erosion is severe. The potential of shrink-swell is low.

Wander very cobbly loam

The Wander soil is very deep. It formed in colluvium and slope alluvium derived dominantly from sandstone and shale. Typically, the surface layer is dark grayish brown very cobbly loam about 14 inches thick. The subsoil is brown very cobbly clay loam about 26 inches thick. The substratum is mixed materials of light brown and reddish brown very cobbly clay loam to a depth of 60 inches or more.

The permeability of the Wander soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 4 percent Frisco loam and about 1 percent Tamarron loam, both on mountain slopes. Frisco soils have light colored surface layers and more than 35 percent rock fragments. Tamarron soils are moderately deep over shale.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. Some *Festuca thurberi/Vicia americana-Lathyrus leucanthus* may also occur in open parks. The native vegetation on this unit consists mainly of quaking aspen, snowberry, Thurber's fescue, mountain brome, bluegrass, western wheatgrass, and Fendler's meadow-rue. Other important plants that characterize this unit are white fir, elk sedge, American vetch, and shrubby cinquefoil. The average annual understory production of air-dry vegetation is about 3,000 pounds per acre on the Hourglass soil, about 1,200 pounds per acre on the Bucklon soil, and about 2,200 pounds per acre on the Wander soil.

Soil Management Implications

This unit is used for livestock grazing, wildlife habitat, timber production, and recreation.

A representative site index for this map unit for quaking aspen is 68 on the Hourglass soil. It can produce about 38 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated moderate for this unit.

The main concerns in producing and harvesting timber are reforestation and preventing erosion along roads and other areas that have been disturbed. The steepness of slope limits the kinds of equipment that can be used in forest management. Careful consideration of road systems and harvesting methods should be taken to minimize erosion. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitations to reforestation on this unit are plant competition if trees other than quaking aspen are to be grown, the shallow Bucklon soils, and stones in the Wander soils. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Among the trees that are suitable for planting are Englemann's spruce and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

The main limitations for building unsurfaced roads on this unit are the shallow depth to bedrock in the Bucklon soil and the steep slopes in the unit. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Fencing will help to improve livestock distribution and the growth of understory vegetation. The slope limits access by livestock and results in overgrazing of the less sloping areas. Reseeding generally is limited to broadcasting because of the steep slopes.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from

overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes in the unit, stones in the Wander soil, and the depth to bedrock in the Bucklon soil. The slopes limit use of the unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

165—Pinacol loam, 1 to 12 percent slopes

Map Unit Description

This very deep, well drained soil is on mesas and structural benches. The elevation is 7,200 to 8,500 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 90 to 110 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Pinacol loam

The Pinacol soil formed in slope alluvium and outwash derived from mixed sources; some pedons have eolian influences also. Typically, the surface is covered with a mat of needles and leaves about 1 inch thick. The surface layer is grayish brown loam about 3 inches thick. The subsurface layer is light brown loam about 9 inches thick. The upper part of the subsoil is brown stony clay loam about 7 inches thick; the lower part is reddish brown very stony clay loam about 29 inches thick. The substratum is reddish brown very stony clay loam to a depth of 61 inches or more.

The permeability of this Pinacol soil is slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is slight. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 5 percent Goldbug very stony fine sandy loam on hillslopes; 9 percent Fardraw loam on mesas; and small areas of Hesperus loam in drainageways. Goldbug soils have less than 35 percent rock fragments in the subsoil. Fardraw soils have dark colored surface layers. Hesperus soils have dark colored surface layers and less than 35 percent rock fragments in the subsoil. Included areas make up about 15 percent of the map unit.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa pine, Gambel oak, Arizona fescue, and mountain brome. Other plants that characterize this unit are bluegrass, prairie Junegrass, western wheatgrass, snowberry, true mountain mahogany, Saskatoon serviceberry, mountain muhly, and elk sedge. The average annual understory production of air-dry vegetation is about 1,100 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing, timber production, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 88 on the Pinacol soil. It can produce about 82 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 40 years old.

The mass movement potential is rated low for this unit because of the slope.

The Pinacol soil is well suited to the production of Ponderosa pine. The main concerns in producing and harvesting timber are reforestation.

The main limitations to reforestation on this soil are the stones in the soil and the plant competition. Large stones limit rooting space and soil moisture, and interfere with planting operations. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Competing vegetation can be controlled by properly preparing the site and by burning to eliminate unwanted weeds, brush, or trees. Brushy plants such as Gambel oak limit natural regeneration of Ponderosa pine. The high content of rock fragments can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting is ponderosa pine.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of native vegetation. If the condition of the range or understory vegetation deteriorates, gamble oak increases. Brush management improves areas that are producing more woody shrubs than were present in the potential plant community. If the vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

This map unit is well suited to recreational development on the lower slopes. The main limitation is the slopes that are over 8 percent. Paths and trails can be developed. Drainage should be provided for paths and trails.

This map unit is in capability subclass 4e, nonirrigated.

166—Pinacol loam, 12 to 40 percent slopes

Map Unit Description

This very deep, well drained soil is on hills. The elevation is 7,200 to 8,500 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 90 to 110 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Pinacol loam

The Pinacol soil formed in outwash and slope alluvium derived from mixed sources and have eolian influence in some pedons. Typically, the surface is covered with a mat of needle and leaves about 1 inch thick. The surface layer is grayish brown loam about 3 inches thick. The subsurface layer is light brown loam about 9 inches thick. The upper part of the subsoil is brown stony clay loam about 7 inches thick; the lower part is reddish brown very stony clay loam about 29 inches thick. The substratum is reddish brown very stony clay loam to a depth of 61 inches or more.

The permeability of the Pinacol soil is slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 5 percent Goldbug very stony fine sandy loam on hillslopes; 10 percent Nordicol stony loam on hillslopes; small areas of Archuleta stony clay loam on hills; and small areas of Hesperus loam in drainageways. Goldbug soils have less than 35 percent rock fragments in the subsoil. Nordicol soils have dark surface layers. Archuleta soils are shallow over bedrock. Hesperus soils have dark colored surface layers and less than 35 percent rock fragments in the profile. Included soils make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa pine, Gambel oak, Arizona fescue, and mountain brome. Other important plants that characterize this unit are bluegrass, prairie Junegrass, western wheatgrass, Saskatoon serviceberry, true mountain mahogany, snowberry, mountain muhly, and elk sedge. The average annual understory production of air-dry vegetation is about 1,100 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing, timber production, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 76 on the Pinacol soil. It can produce about 63 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the high content of rock fragments and the slope.

The Pinacol soil is well suited to the production of ponderosa pine. The main concerns in producing and harvesting timber are preventing erosion along roads and other disturbed areas and reforestation.

The main limitation to reforestation on this soil is the content of stones in the soil. Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Competing vegetation can be controlled by properly preparing the site and by burning to eliminate unwanted weeds, brush, or trees. Brushy plants such as Gambel oak limit natural regeneration of Ponderosa pine. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting is Ponderosa pine.

The main limitations to the building of unsurfaced roads on Pinacol are the low strength, the shrink-swell potential, and the slope. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of native vegetation. If the condition of the range or understory deteriorates, gambel oak increases. Brush management improves areas that are producing more woody shrubs than were present in the potential plant community. If the range or understory vegetation is seriously deteriorated, seeding is needed. The main limitation for seeding is the slope. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

If this map unit is used for recreational development, the main limitation is the slope, which restricts development of most of the unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

250—Snowdon-Rock outcrop complex, 30 to 65 percent slopes

Map Unit Description

This map unit is a complex of shallow, well drained soils and Rock outcrop on mountain slopes. The surface of this unit is covered with 3 to 15 percent stones. The elevation is 8,300 to 11,500 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is 30 to 38 degrees F, and the average frost-free period is 40 to 75 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 55 percent Snowdon very stony loam, 25 percent Rock outcrop, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Snowdon very stony loam

The Snowdon soil formed in residuum and slope alluvium derived mostly from rhyolite, sandstone, and limestone. Typically, the surface is covered with a mat of needles, twigs, and leaves about 2 inches thick. The surface layer is light reddish brown very stony loam about 4 inches thick. The subsurface layer is pinkish gray very stony sandy loam about 7 inches thick. The subsoil is reddish brown extremely stony sandy clay loam about 7 inches thick. Hard bedrock generally is at a depth of 20 inches; however, the depth to bedrock ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Snowdon soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of rhyolite, tuff, and sandstone as cliffs, breaks, and escarpments.

Contrasting Inclusions

Included in this unit are about 10 percent Needleton stony loam, 5 percent Quazar extremely stony loam, both on mountain slopes; small areas of Henson very gravelly loam on mountain slopes at the higher elevations; and small areas of Rubble land. Needleton, Quazar, and Henson soils are very deep. Included soils make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Juniperus communis*. Also, some *Populus tremuloides/Symphoricarpos oreophilus* may occur on similar landscapes. The native vegetation on this unit consists mainly of Englemann's spruce, Rocky Mountain Douglas-fir, subalpine fir, and quaking aspen. Other important plants that characterize this unit are common juniper, mountain snowberry, whortleberry, Thurber's fescue, mountain brome, bluegrass, elk sedge, and spike trisetum. The average annual understory production of air-dry vegetation is about 500 pounds per acre on the Snowdon soil.

Soil Management Implications

This unit is used for recreation, wildlife habitat, woodland, and scenic attractions. The mass movement potential is rated moderate for this unit because of the hazard of rockfall.

Wildlife such as elk, mule deer, bear, coyote, bighorn sheep, hawks, eagles, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this map unit is used for recreational development, the main limitations are the steep slopes, the content of stones, the depth to bedrock, and rock outcrops. The slopes limit the use of the map unit mainly to a few paths and trails, which should extend across the slope. Areas of the unit are valuable for their scenic attractions.

The Snowdon soil is in capability subclass 7s, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

251—Rock outcrop-Snowdon complex, 45 to 75 percent slopes**Map Unit Description**

This map unit is a complex of Rock outcrop and shallow, well drained soils on mountain slopes. The surface of this unit is covered with 3 to 15 percent stones. The elevation is 8,300 to 11,500 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is 30 to 38 degrees F, and the average frost-free period is 40 to 75 days. The moisture and temperature regimes are udic and cryic, respectively (*Fig. 6*).

This unit consists of 60 percent Rock outcrop, 25 percent Snowdon very stony loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.



Figure 6.—Rock outcrop-Snowdon complex, 45 to 75 percent slopes, is used mostly for wildlife habitat.

Brief Soil Description

Rock outcrop

Rock outcrop consists of exposures of rhyolite, tuff, and sandstone as breaks, cliffs and escarpments.

Snowdon very stony loam

The Snowdon soils formed in residuum and colluvium derived mostly from rhyolite, sandstone, and limestone. Typically, the surface is covered with a mat of needles, twigs, and leaves about 2 inches thick. The surface layer is light reddish brown very stony loam about 4 inches thick. The subsurface layer is pinkish gray very stony sandy loam about 7 inches thick. The subsoil is reddish brown extremely stony sandy clay loam about 7 inches thick. Hard bedrock is at a depth of 20 inches; however, the depth to bedrock ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Snowdon soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Needleton stony loam and 5 percent Quazar extremely stony loam, both on mountain slopes; small areas of Whitecross extremely stony loam on mountain slopes at the higher elevations; and small areas of Rubble land. Inclusions make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Juniperus communis*. *Populus tremuloides/Symphoricarpos oreophilus* also occurs in areas that lack evergreen trees. Vegetation is sparse on much of this unit. The native vegetation consists mainly of Englemann's spruce, subalpine fir, quaking aspen, and Rocky Mountain Douglas-fir. Other important plants that characterize this unit are common juniper, mountain snowberry, Thurber's fescue, mountain brome, bluegrass, whortleberry, elk sedge, and spike trisetum. The average annual understory production of air-dry vegetation is about 500 pounds per acre on the Snowdon soil.

Soil Management Implications

This unit is used for recreation, wildlife habitat, woodland, and scenic attractions.

The mass movement potential is rated moderate for this unit because of the hazard of rock fall and the steep slopes.

Wildlife such as elk, mule deer, bear, coyote, bighorn sheep, hawks, eagles, and squirrels utilize this unit. Areas of natural vegetation and nearby areas provide food and cover.

If this map unit is used for recreational development, the main limitations are the steep slopes, the content of stones, the depth to bedrock, and rock outcrops. Areas of this unit are valuable for their scenic attractions. They offer opportunities for mountain climbing.

Rock outcrop is in capability subclass 8s, nonirrigated. The Snowdon soil is in capability subclass 7s, nonirrigated.

254—Typic Cryorthents-Rubble land complex, 30 to 75 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils and Rubble land on mountain slopes and alluvial fans at the base of cliffs and ridges. The elevation is 9,000 to 11,500 feet. The average annual precipitation is 20 to 35 inches, the average annual air temperature is 30 to 40 degrees F, and the average frost-free period is 40 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 50 percent Typic Cryorthents, 30 percent Rubble land, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Typic Cryorthents

The Typic Cryorthents soil formed in colluvium and slope alluvium derived dominantly from rhyolite. These soils vary considerably in soil properties, but the surface layer generally is a brown extremely stony loam about 5 inches thick. The underlying material is extremely stony or extremely cobbly loam or sandy loam to a depth of 60 inches or more.

The permeability of the Typic Cryorthents soil is moderate or moderately rapid. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Rubble land

Rubble land consists of exposures of slide rock formed on steep and very steep mountain slopes, and at the bases of cliffs and ridges. It consists primarily of rock material ranging from gravel to boulders.

Contrasting Inclusions

Included in this unit are about 10 percent Quazar extremely stony loam and about 5 percent Needleton stony loam, both on mountain slopes; 3 percent Henson very gravelly loam on mountain slopes at the higher elevations; and small areas of Rock outcrop. Quazar soils have dark colored surface layers. Needleton soils have developed subsoils. Henson soils have weakly developed subsoils. Included soils make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

No plant association is assigned to this map unit. Native vegetation is sparse and occurs mostly on the Typic Cryorthents soils. Vegetation varies largely with elevation and consists mostly of grasses, shrubs, quaking aspen, subalpine fir, and Englemann's spruce. Some of the common plants are Thurber's fescue, Arizona fescue, bluegrass, mountain brome, and willow. The average annual production of air-dry vegetation is about 350 pounds per acre on the Typic Cryorthents soil (*Fig. 7*).

Soil Management Implications

This unit is used for wildlife habitat, water catchment areas, and for construction material.

The mass movement potential is rated high for this unit because of the steep slopes and the poor stability.

The poor stability, content of stones, and slopes are severe limitations for road construction and other engineering uses of this unit. Some of the more accessible areas of this unit are used as a source of construction materials for road building.



Figure 7.—A snow slide from the steep mountain side above destroyed these quaking aspen trees on an alluvial fan on Typic Cryorthents-Rubble land complex, 30 to 75 percent slopes.

Wildlife such as marmots, eagles, hawks, pikas, and squirrels utilize this unit. It provides concealment and nesting areas for many species. Areas of natural vegetation provide good food and cover.

This map unit is poorly suited to recreational development. If this map unit is used for recreational development, the main limitations are the content of stones and the steep slopes.

The Typic Cryorthents soil is in capability subclass 7s, nonirrigated. Rubble land is in capability subclass 8s, nonirrigated.

330—Needleton stony loam, 15 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 8,800 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Needleton stony loam

The Needleton soil formed in slope alluvium derived dominantly from rhyolite and sandstone. Typically, the surface is covered with a mat of needles, twigs, and partly decomposed organic material about 2 inches thick. The surface layer is light reddish brown stony loam about 14 inches thick. The subsurface layer is reddish brown very cobbly sandy clay loam and light reddish brown very cobbly loam about 10 inches

thick. The upper part of the subsoil is reddish brown very stony sandy clay loam about 22 inches thick; the lower part is reddish brown very cobbly clay loam extending to 62 inches or more.

The permeability of the Needleton soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 8 percent Snowdon extremely stony loam and about 5 percent Haviland loam, both on mountain slopes; and small areas of Quazar extremely stony loam on alluvial fans. Snowdon soils are shallow. Haviland soils have less than 35 percent rock fragments in the subsoil. Quazar soils have dark colored surface layers. Included soils make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, and quaking aspen. Other important plants that characterize this unit are whortleberry, Thurber's fescue, mountain brome, snowberry, Richardson's geranium, bluegrass, elk sedge, spike trisetum, and common juniper. The average annual understory production of air-dry vegetation is about 800 pounds per acre.

Soil Management Implications

This unit is used mainly for timber production, recreation, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 84 on the Needleton soil. It can produce about 82 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope and the high content of rock fragments.

The main concerns in producing and harvesting timber are reforestation and preventing erosion by water along roads and other areas where vegetative cover has been removed. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitation to reforestation on this soil is the content of stones in the surface layer. Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitation to building unsurfaced roads on this unit is the content of stones in the soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of the production of range and understory plants.

Wildlife such as elk, mule deer, bear, coyotes, squirrels, rabbits, and blue grouse utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover.

If this map unit is used for recreational development, the main limitations are the slope and the content of stones. It is limited mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7s, nonirrigated.

331—Needleton stony loam, 30 to 65 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 8,800 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Needleton stony loam

The Needleton soil formed in colluvium and slope alluvium derived dominantly from rhyolite and sandstone. Typically, the surface is covered with a mat of needles, twigs, and partly decomposed material about 2 inches thick. The surface layer is light reddish brown stony loam about 14 inches thick. The subsurface layer is reddish brown very cobbly sandy clay loam and light reddish brown very cobbly loam about 10 inches thick. The upper part of the subsoil is reddish brown very stony sandy clay loam about 22 inches thick; the lower part is reddish brown very cobbly clay loam extending to 62 inches or more.

The permeability of the Needleton soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Snowdon extremely stony loam on mountain slopes and structural benches; 5 percent Haviland loam on mountain slopes; small areas of Quazar extremely stony loam on toeslopes; and small areas of Rock outcrop. Snowdon soils are shallow. Haviland soils have less than 35 percent rock fragments in the subsoil. Quazar soils have dark colored surface layers. Included soils make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Abies lasiocarpa-Picea engelmannii/Juniperus communis* and *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, quaking aspen, and common juniper. Other important plants that characterize this unit are whortleberry, Thurber's fescue, mountain brome, bluegrass, Richardson's geranium, elk sedge, snowberry, and spike trisetum. The average annual understory production of air-dry vegetation is about 800 pounds per acre.

Soil Management Implications

This unit is used mainly for timber production, recreation, wildlife habitat, and limited livestock grazing.

A representative site index for this map unit for Englemann's spruce is 84 on the Needleton soil. It can produce about 82 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the high content of rock fragments.

The main concerns in producing and harvesting timber are reforestation and preventing erosion by water along roads and other places where vegetation has been removed. Minimizing the risk of erosion is essential in harvesting timber. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitation to reforestation on this soil is the content of stones in the surface layer. Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations to the building of unsurfaced roads on this unit are the content of stones in the soil and the steep slopes. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of the production of range and understory plants.

Wildlife such as elk, mule deer, bear, coyotes, squirrels, rabbits, and blue grouse utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover.

If this map unit is used for recreational development, the main limitations are the steep slopes and the content of stones. The slopes limit use of the map unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

332—Horsethief-Needleton complex, 30 to 60 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The surface of this unit is covered with 1 to 3 percent stones. The elevation is 9,000 to 11,000 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 55 percent Horsethief extremely stony loam, 35 percent Needleton stony loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Horsethief extremely stony loam

The Horsethief soil formed in slope alluvium and colluvium derived from sandstone and rhyolite. Typically, the surface is covered with a mat of organic material about 2 inches thick. The surface layer is pinkish gray extremely stony loam about 19 inches thick. The subsurface layer is pinkish gray extremely stony sandy loam about 9 inches

thick. The upper 8 inches of the subsoil are very pale brown very stony fine sandy loam and brown very stony sandy clay loam. The lower 17 inches are brown very stony clay loam. The substratum is brown very stony clay loam to a depth of 62 inches or more.

The permeability of the Horsethief soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Needleton stony loam

The Needleton soil formed in slope alluvium and colluvium derived from sandstone and rhyolite. Typically, the surface is covered with a mat of organic material about 2 inches thick. The surface layer is light reddish brown stony loam about 14 inches thick. The subsurface layer is reddish brown very cobbly sandy clay loam and light reddish brown very cobbly loam about 10 inches thick. The upper part of the subsoil is reddish brown very stony sandy clay loam about 22 inches thick; the lower part is reddish brown very cobbly clay loam extending to 62 inches or more.

The permeability of the Needleton soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Haviland loam and 5 percent Graysill loam, both on mountain slopes. Haviland soils have less than 35 percent rock fragments in the subsoil. Graysill soils are moderately deep over sandstone.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, quaking aspen, and whortleberry. Other important plants that characterize this unit are Thurber's fescue, mountain brome, bluegrass, heartleaf arnica, Richardson's geranium, snowberry, gooseberry currant, spike trisetum, and elk sedge. The average annual understory production of air-dry vegetation is about 1,650 pounds per acre on the Horsethief soil, and about 800 pounds per acre on the Needleton soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, wildlife habitat, and recreation.

A representative site index for this map unit for Englemann's spruce is 80 on the Horsethief soil. It can produce about 76 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the high content of rock fragments.

The main concerns in producing and harvesting timber are reforestation and road construction in the stony soils. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock will hasten reforestation. Tree planting is difficult due to the stony surface textures. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and Lodgepole pine.

The main limitations to the building of unsurfaced roads on this unit are the content of stones in the soil and the steep slopes. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, coyote, and blue grouse utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover.

If this map unit is used for recreational development, the main limitations are the steep slopes and the content of surface stones. The slopes limit use of the map unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Horsethief soil is in capability subclass 7s, nonirrigated. The Needleton soil is in capability subclass 7e, nonirrigated.

333—Henson very gravelly loam, south aspect, 10 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on alpine valley fills and mountain slopes. The dominant aspect is south. The elevation is 11,000 to 12,000 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 30 to 34 degrees F., and the average frost-free period is 30 to 40 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Henson very gravelly loam, south aspect

The Henson soil formed in slope alluvium derived dominantly from red bed sandstone and rhyolite. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is brown very gravelly loam about 4 inches thick. The upper 8 inches of the subsoil are reddish brown very cobbly loam; the lower 12 inches are light reddish brown very stony sandy clay loam. The substratum is brown extremely stony sandy loam to a depth of 61 inches or more.

The permeability of the Henson soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 4 percent Whitecross very stony sandy loam on mountain slopes; 10 percent Moran very gravelly loam on valley fills; and small areas of Rock outcrop. Whitecross soils are shallow over bedrock. Moran soils have dark colored surface layers. Also included are some areas, in the vicinity of Kennebeck Pass, that are redder than normal for the Henson series. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Festuca thurberi/Oreoxis alpina*. Some *Acomastylis rossii/Trifolium sp.-Deschampsia cespitosa* may also be present. The native vegetation on this unit consists mainly of Thurber's fescue, sedge, alpine fescue, alpine bluegrass, Ross' avens, and American bistort. Other important plants that characterize this unit are Baker's wheatgrass, spreading wheatgrass, spike trisetum, willow, tufted hairgrass, and scattered Englemann's spruce. The average annual production of air-dry vegetation is about 3,000 pounds per acre.

Soil Management Implications

This unit is used mainly for livestock grazing, wildlife habitat, recreation, and scenic attraction.

The mass movement potential is rated low for this unit because of the slope.

This unit is well suited to range production. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of range vegetation. Livestock grazing is limited by the short growing season. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. More uniform use of rangeland is aided by properly locating salt and by herding.

If this map unit is used for recreational development, the main limitations are the slope and the gravelly surface layers. The slope limits development of most areas to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

This map unit is in capability subclass 6e, nonirrigated.

334—Henson very gravelly loam, south aspect, 30 to 60 percent slopes

Map Unit Description

This very deep, well drained soil is on south facing alpine mountain slopes. The dominant aspect is south. The elevation is 11,500 to 12,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 30 to 34 degrees F, and the average frost-free period is less than 40 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description**Henson very gravelly loam, south aspect**

The Henson soil formed in colluvium and slope alluvium derived dominantly from rhyolite. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is brown very gravelly loam about 4 inches thick. The upper 8 inches of the subsoil are reddish brown very cobbly loam; the lower 12 inches are light reddish brown very stony sandy clay loam. The substratum is brown extremely stony sandy loam to a depth of 61 inches or more.

The permeability of the Henson soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Whitecross very stony sandy loam and about 4 percent Telluride very cobbly loam, both on mountain slopes and ridges; 5

percent Moran very gravelly loam in valley fills; and small areas of Rock outcrop. Whitecross and Telluride soils are shallow. Moran soils have a dark colored surface layer. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Festuca thurberi/Oreoxis alpina*. Some *Acomastylis rossii/Trifolium sp.-Deschampsia cespitosa* may also be present. The native vegetation on this unit consists mainly of Thurber's fescue, alpine fescue, sedge, alpine bluegrass, Ross' avens, and tufted hairgrass. Other important plants that characterize this unit are Baker's wheatgrass, spreading wheatgrass, spike trisetum, American bistort, and scattered Englemann's spruce. The average annual production of air-dry vegetation is about 2,800 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing, recreation, scenic attraction, and wildlife habitat.

The mass movement potential is rated moderate for this unit.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. The slope limits access by livestock and results in overgrazing of the less sloping areas. More uniform use of rangeland is aided by properly locating salt and by herding. Livestock grazing is limited by the short growing season. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce plants suitable for grazing.

Wildlife such as elk, mule deer, coyote, ptarmigan, marmots, and pika utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes, gravelly surface layers, and the hazard of erosion. The slopes limit use of the map unit mainly to a few paths and trails, which should extend across the slope. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintenance of adequate plant cover. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

This map unit is in capability subclass 7e, nonirrigated.

335—Whitecross-Rock outcrop complex, 15 to 45 percent slopes

Map Unit Description

This map unit is a complex of shallow or very shallow, well drained soils and Rock outcrop on alpine valley floors, mountain slopes and ridges. The elevation is 11,500 to 13,500 feet. The average annual precipitation is 35 to 60 inches, the average annual air temperature is 28 to 34 degrees F, and the average frost-free period is less than 40 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 55 percent Whitecross very stony sandy loam, 30 percent Rock outcrop, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Whitecross very stony sandy loam

The Whitecross soil formed in slope alluvium and colluvium derived from rhyolite, tuff, and similar volcanic rocks, and in some places from granite and similar rocks. Typically, surface has an organic layer about 1 inch thick. The surface layer is brown very stony sandy loam about 3 inches thick. The upper 6 inches of the subsoil are reddish brown very gravelly loam; the lower 9 inches are light reddish brown extremely gravelly sandy loam. Bedrock is at a depth of 19 inches; however, the depth to bedrock ranges from 7 to 20 inches from the mineral soil surface.

The permeability of the Whitecross soil is moderately rapid. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 7 to 20 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists mostly of exposures of rhyolite, tuff, and similar volcanic rocks as breaks and escarpments.

Contrasting Inclusions

Included in this unit are about 5 percent Henson very gravelly loam on mountain slopes; 5 percent Telluride very cobbly loam on alpine valley floors and ridges; small areas of Needleton stony loam on mountain slopes at lower elevations; small areas of Cryaquents and Cryofibrists in drainageways and depressions; and small areas of Rubble land. Henson and Needleton soils are very deep. Telluride soils have dark colored surface layers. Cryaquents and Cryofibrists are wet. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Danthonia intermedia/Potentilla diversifolia* on the shallower areas and *Acomastylis rossii/Trifolium sp.-Deschampsia cespitosa* in depressional areas. The native vegetation on this unit consists mainly of Ross' avens, alpine bluegrass, tufted hairgrass, kobresia, timber oatgrass, and Baker's wheatgrass. Other important plants that characterize this unit are alpine timothy, alpine fescue, American bistort, and sedge. The average annual production of air-dry vegetation is about 800 pounds per acre on the Whitecross soil (Fig. 8).

Soil Management Implications

This unit is used for sheep grazing, recreation, scenic attraction, and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope and bedrock.

Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. More uniform use of rangeland is aided by properly locating salt and by herding. Livestock grazing is limited by the short growing season. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce plants suitable for grazing.

Wildlife such as elk, mule deer, coyotes, ptarmigan, mountain goats, marmots, and pika utilize this unit. Management for wildlife should include protection from overgrazing by livestock, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes, the content of stones, the depth to bedrock, and rock outcrops. The slopes limit use of the map unit mainly to paths and trails. Cuts and fills should be



Figure 8.—Whitecross-Rock outcrop complex, 15 to 45 percent slopes, is above timberline and supports alpine vegetation. The range site is Shallow Alpine. The road is between Red Mountain Pass and Telluride.

seeded or mulched. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

The Whitecross soil is in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

336—Whitecross-Rock outcrop complex, south aspect, 30 to 75 percent slopes

Map Unit Description

This map unit is a complex of shallow, well drained soils and Rock outcrop on south facing alpine mountain slopes and ridges. The surface of this unit is covered with 3 to 15 percent stones. The elevation is 11,500 to 12,500 feet. The average annual precipitation is 35 to 50 inches, the average annual air temperature is 30 to 34 degrees F, and the average frost-free period is less than 40 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 50 percent Whitecross very stony sandy loam, 25 percent Rock outcrop, and 25 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Whitecross very stony sandy loam, south aspect

The Whitecross soil formed in slope alluvium and colluvium derived from rhyolite, tuff, and similar volcanic rocks. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is brown very stony sandy loam about 3 inches thick. The upper 6 inches of the subsoil are reddish brown very gravelly loam; the lower 9 inches are light reddish brown extremely gravelly sandy loam. Bedrock is

at a depth of 19 inches; however, the depth to bedrock ranges from 7 to 20 inches from the mineral soil surface.

The permeability of the Whitecross soil is moderately rapid. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 7 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of rhyolite, tuff, and similar volcanic rocks as cliffs, breaks, and escarpments.

Contrasting Inclusions

Included in this unit are about 10 percent Henson very gravelly loam on mountain slopes; 5 percent Telluride very cobbly loam on mountain slopes and ridges; 5 percent Needleton stony loam on mountain slopes at lower elevations; small areas of Snowdon very stony loam on mountain slopes and benches at lower elevations; and small areas of Rubble land. Henson and Needleton soils are very deep. Telluride soils have a dark colored surface layer. Snowdon soils have sandy clay loam subsoils. Included areas make up about 25 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Festuca thurberi/Oreoxis alpina*. Some *Danthonia intermedia/Potentilla diversifolia* can also be found at the higher elevations on the shallowest areas. The native vegetation on this unit consists mainly of Thurber's fescue, alpine bluegrass, sedge, alpine fescue, Ross' avens, and tufted hairgrass. Other important plants that characterize this unit are Baker's wheatgrass, timber oatgrass, spike trisetum, American bistort, and scattered Englemann's spruce. The average annual production of air-dry vegetation is about 2,100 pounds per acre on the Whitecross soil.

Soil Management Implications

This unit is used for sheep grazing, recreation, scenic attraction, and wildlife habitat.

The mass movement potential is rated moderate for this unit.

Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. More uniform use of rangeland is aided by properly locating salt and by herding. Livestock grazing is limited by the short growing season.

The slope limits access by livestock and results in overgrazing of the less sloping areas. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce plants suitable for grazing.

Wildlife such as elk, mule deer, coyotes, marmots, pika, and ptarmigan utilize this unit. Management for wildlife should include protection from overgrazing by livestock, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes, surface stones, the depth to bedrock, the hazard of erosion, and rock outcrops. The slopes limit use of the map unit mainly to a few paths and trails, which should extend across the slope. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintenance of adequate plant cover. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

The Whitecross soil is in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

337—Whitecross-Rock outcrop complex, 45 to 75 percent slopes

Map Unit Description

This map unit is a complex of shallow or very shallow, well drained soils and Rock outcrop on alpine mountain slopes and ridges. The surface of this unit is covered with 3 to 15 percent stones. The elevation is 11,500 to 13,800 feet. The average annual precipitation is 35 to 60 inches, the average annual air temperature is 28 to 34 degrees F, and the average frost-free period is less than 40 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 60 percent Whitecross very stony sandy loam, 25 percent Rock outcrop, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used (*Fig. 9*).

Brief Soil Description

Whitecross very stony sandy loam

The Whitecross soil formed in slope alluvium and colluvium derived from rhyolite, tuff, and similar volcanic rocks, and in some places from granite and similar rocks. Typically, the surface has an organic layer about 1 inch thick. The surface layer is brown very stony sandy loam about 3 inches thick. The upper 6 inches of the subsoil are reddish brown very gravelly loam; the lower 9 inches are light reddish brown extremely gravelly sandy loam. Bedrock is at a depth of 19 inches; however, the depth to bedrock ranges from 7 to 20 inches from the mineral soil surface.

The permeability of the Whitecross soil is moderately rapid. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 7 to 20



Figure 9.—Clear Lake is surrounded by soils in Whitecross-Rock outcrop complex, 45 to 75 percent slopes. It is one of many cirque lakes in the survey area.

inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists mostly of exposures of rhyolite, tuff, and similar volcanic rocks as cliffs, breaks, and escarpments, and in some places it consists of granitic rocks.

Contrasting Inclusions

Included in this unit are about 10 percent Henson very gravelly loam on mountain slopes; small areas of Snowdon very stony loam on mountain slopes and benches at lower elevations; small areas of Needleton stony loam on mountain slopes at lower elevations; small areas of Cryaquents and Cryofibrists in drainageways and depressions; and small areas of Rubble land. Henson and Needleton soils are very deep. Snowdon soils have sandy clay loam subsoils. Cryaquents and Cryofibrists are wet. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Danthonia intermedia/Potentilla diversifolia* on the shallowest soils and *Acomastylis rossii/Trifolium sp.-Deschampsia cespitosa* in depressional areas. The native vegetation on this unit consists mainly of Ross' avens, alpine bluegrass, tufted hairgrass, kobresia, timber oatgrass, and Baker's wheatgrass. Other important plants that characterize this unit are alpine fescue, alpine timothy, American bistort, and sedge. The average annual production of air-dry vegetation is about 800 pounds per acre.

Soil Management Implications

This unit is used mainly for recreation, scenic attraction, wildlife habitat, and limited sheep grazing.

The mass movement potential is rated moderate for this unit.

Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. More uniform use of rangeland is aided by properly locating salt and by herding. Livestock grazing is limited by the short growing season. The slope limits access by livestock and results in overgrazing of the less sloping areas. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce plants suitable for grazing.

Wildlife such as elk, mule deer, coyotes, ptarmigan, mountain goats, marmots, and pika utilize this unit. Areas of natural vegetation provide good food and cover. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are the very steep slopes, surface stones, the depth to bedrock, the hazard of erosion, and rock outcrops. The slopes limit use of the map unit mainly to a few paths and trails, which should extend across the slope. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintenance of adequate plant cover. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

The Whitecross soil is in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

338—Henson very gravelly loam, 10 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on alpine valley fills and mountain slopes. The elevation is 11,500 to 13,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 28 to 34 degrees F, and the average frost-free period is less than 40 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Henson very gravelly loam

The Henson soil formed in colluvium and slope alluvium derived dominantly from rhyolite. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is brown very gravelly loam about 4 inches thick. The upper 8 inches of the subsoil are reddish brown very cobbly loam; the lower 12 inches are light reddish brown very stony sandy clay loam. The substratum is brown extremely stony sandy loam to a depth of 61 inches or more.

The permeability of the Henson soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Whitecross very stony sandy loam on mountain slopes and valley floors; 5 percent Moran very gravelly loam on valley fills; 5 percent Telluride gravelly loam on valley floors; small areas of Cryaquents and Cryofibrists in drainageways and depressions; and small areas of Rock outcrop. Whitecross and Telluride soils are shallow. Moran soils have dark colored surface layers. Cryaquents and Cryofibrists are wet. Included soils make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Acomastylis rossii/Bistorta bistortoides*. The native vegetation on this unit consists mainly of Ross' avens, alpine fescue, tufted hairgrass, kobresia, American bistort, alpine bluegrass, and spike trisetum. Other important plants that characterize this unit are Baker's wheatgrass, alpine timothy, sedge, and slender cinquefoil. The average annual production of air-dry vegetation is about 2,000 pounds per acre.

Soil Management Implications

This unit is used for sheep grazing, recreation, scenic attraction, and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. More uniform use of rangeland is aided by properly locating salt and by herding. Livestock grazing is limited by the short growing season. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce plants suitable for grazing.

Wildlife such as elk, mule deer, coyotes, ptarmigan, marmots, and pika utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural

vegetation provide good food and cover. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are the slope and the gravelly surface layers. Paths and trails can be developed; drainage should be provided for them. Cuts and fills should be seeded or mulched. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

This map unit is in capability subclass 6e, nonirrigated.

339—Henson very gravelly loam, 30 to 60 percent slopes

Map Unit Description

This very deep, well drained soil is on alpine valley fills and mountain slopes. The elevation is 11,500 to 13,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 28 to 34 degrees F, and the average frost-free period is less than 40 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Henson very gravelly loam

The Henson soil formed in colluvium and slope alluvium derived dominantly from rhyolite. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is brown very gravelly loam about 4 inches thick. The upper 8 inches of the subsoil are reddish brown very cobbly loam; the lower 12 inches are light reddish brown, very stony sandy clay loam. The substratum is brown extremely stony sandy loam to a depth of 61 inches or more.

The permeability of the Henson soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Whitecross very stony sandy loam on mountain slopes and ridges; 5 percent Moran very gravelly loam on mountain slopes; 5 percent Telluride gravelly loam on ridges; small areas of Cryaquents and Cryofibrists in drainageways and depressions; and small areas of Rock outcrop. Whitecross and Telluride soils are shallow. Moran soils have dark colored surface layers. Cryaquents and Cryofibrists soils are wet. Included soils make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Acomastylis rossii/Trifolium sp.-Deschampsia cespitosa*. The native vegetation on this unit consists mainly of Ross' avens, alpine fescue, tufted hairgrass, kobresia, and alpine bluegrass. Other important plants that characterize this unit are spike trisetum, Baker's wheatgrass, American bistort, alpine timothy, sedge, and slender cinquefoil. The average annual production of air-dry vegetation is about 1,600 pounds per acre.

Soil Management Implications

This unit is used for sheep grazing, recreation, scenic attraction, and wildlife habitat.

The mass movement potential is rated moderate for this unit.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Careful

management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. More uniform use of rangeland is aided by properly locating salt and by herding. The short growing season and the slopes limit livestock grazing. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce plants suitable for grazing.

Wildlife such as elk, mule deer, coyotes, ptarmigan, marmots, and pika utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes, gravelly surface layers, and the hazard of erosion. The slopes limit use of the map unit to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintenance of adequate plant cover. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

This map unit is in capability subclass 7e, nonirrigated.

340—Moran very gravelly loam, 10 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on alpine valley fills and mountain slopes. The elevation is 11,500 to 13,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 28 to 34 degrees F, and the average frost-free period is less than 40 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Moran very gravelly loam

The Moran soil formed in colluvium and slope alluvium derived dominantly from rhyolite, tuff, and similar volcanic rock. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is reddish gray very gravelly loam about 9 inches thick. The subsoil is reddish brown extremely gravelly loam about 17 inches thick. The substratum to a depth of 61 inches or more is pinkish gray extremely gravelly loam.

The permeability of the Moran soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Whitecross very stony sandy loam on valley floors and ridges; 5 percent Telluride gravelly loam on ridges; 5 percent Henson very gravelly loam on valley fills; small areas of Cryaquents and Cryofibrists in drainageways and depressions; and small areas of Rock outcrop. Whitecross and Telluride soils are shallow. Henson soils have light colored surface layers. Cryaquents and Cryofibrists soils are wet. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Acomastylis rossii/Trifolium sp.-Deschampsia cespitosa*. Small areas of *Festuca thurberi/Oreoxis alpina* occur on some of the south slopes at lower elevations. The native vegetation on this unit consists mainly of Ross' avens, sedge, kobresia, alpine bluegrass, alpine fescue, and tufted hairgrass. Other important plants that characterize this unit are spike trisetum, slender cinquefoil, alpine timothy, Baker's wheatgrass, and American bistort. Thurber's fescue occurs on some of the south slopes of lower elevations. The average annual production of air-dry vegetation is about 2,200 pounds per acre.

Soil Management Implications

This unit is used for sheep grazing, recreation, scenic attraction, and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. More uniform use of rangeland is aided by properly locating salt and by herding. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce plants suitable for grazing.

Wildlife such as elk, mule deer, coyotes, ptarmigan, marmots, and pika utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are the slope and the gravelly surface layers. Paths and trails can be developed. Cuts and fills should be seeded or mulched. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

This map unit is in capability subclass 6e, nonirrigated.

341—Moran very gravelly loam, 30 to 65 percent slopes**Map Unit Description**

This very deep, well drained soil is on alpine valley fills and mountain slopes. The elevation is 11,500 to 13,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 28 to 34 degrees F., and the average frost-free period is less than 40 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description**Moran very gravelly loam**

The Moran soil formed in colluvium and alluvium derived dominantly from rhyolite, tuff, and similar volcanic rocks. Typically, the surface is covered with organic mat about 1 inch thick and has 3 to 15 percent stones on the surface. The surface layer is reddish gray very gravelly loam about 9 inches thick. The subsoil is reddish brown extremely gravelly loam about 17 inches thick. The substratum is pinkish gray extremely gravelly loam to a depth of 61 inches or more.

The permeability of the Moran soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Whitecross very stony sandy loam on mountains and ridges; 5 percent Telluride gravelly loam on ridges; 5 percent Henson very gravelly loam on mountain slopes; small areas of Cryaquents and Cryofibrists in drainageways and depressions; and small areas of Rock outcrop. Whitecross and Telluride soils are shallow. Henson soils have light colored surface layers. Cryaquents and Cryofibrists are wet. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Acomastylis rossii/Trifolium sp.-Deschampsia cespitosa*. Small areas of *Festuca thurberi/Oreoxis alpina* occur on some of the south slopes of lower elevations. The native vegetation on this unit consists mainly of Ross' avens, sedge, kobresia, alpine bluegrass, alpine fescue, and tufted hairgrass. Other important plants that characterize this unit are Baker's wheatgrass, alpine fescue, spike trisetum, alpine timothy, and American Bistort. Thurber's fescue occurs on some of the lower south slopes. The average annual production of air-dry vegetation is about 2,000 pounds per acre.

Soil Management Implications

This unit is used for sheep grazing, recreation, scenic attraction, and wildlife habitat.

The mass movement potential is rated moderate for this unit.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. The slope limits access by livestock and results in overgrazing of less sloping areas. More uniform use of rangeland is aided by properly locating salt and by herding. Livestock grazing is limited by the short growing season. Mechanical treatment is not practical, because the surface is stony and the slopes are steep. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce plants suitable for grazing.

Wildlife such as elk, mule deer, coyotes, ptarmigan, marmots, and pika utilize this unit. Management for wildlife should include protection from overgrazing by livestock, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes, surface stones, and the hazard of erosion. The slopes limit use of the map unit mainly to a few paths and trails, which should extend across the slope. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintenance of adequate plant cover. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

This map unit is in capability subclass 7e, nonirrigated.

342—Telluride-Rock outcrop complex, 15 to 45 percent slopes

Map Unit Description

This map unit is a complex of shallow, well drained soils and Rock outcrop on alpine valley floors, mountain slopes and ridges. The elevation is 11,500 to 13,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air

temperature is 28 to 34 degrees F., and the average frost-free period is less than 40 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 60 percent Telluride very cobbly loam, 20 percent Rock outcrop, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Telluride very cobbly loam

The Telluride soil formed in slope alluvium and colluvium weathered from rhyolite, tuff, and similar volcanic rocks. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is brown very cobbly loam about 6 inches thick. The subsurface layer is brown stony loam about 5 inches thick. The subsoil is pinkish gray very stony loam to a depth of 19 inches. Bedrock is at a depth of 19 inches; however, the depth to bedrock ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Telluride soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of rhyolite, tuff, and similar volcanic rocks as cliffs, breaks, escarpments, and other rock exposures.

Contrasting Inclusions

Included in this unit are about 10 percent Moran very gravelly loam on valley fills; 5 percent Whitecross very stony loam on valley floors; small areas of Henson very gravelly loam on valley fills; and small areas of Rubble land. Moran and Henson soils are very deep. Whitecross soils have light colored surface layers. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Acomastylis rossii/Bistorta bistortoides* on the shallowest areas and *Carex rupestris/Trifolium dasyphyllum* in the depressional areas. The native vegetation on this unit consists mainly of Ross' avens, sedge, kobresia, American bistort, tufted hairgrass, and Baker's wheatgrass. Other important plants that characterize this unit are alpine bluegrass, alpine timothy, alpine fescue, slender cinquefoil, and spike trisetum. The average annual production of air-dry vegetation is about 1,200 pounds per acre.

Soil Management Implications

This unit is used for sheep grazing, recreation, scenic attraction, and wildlife habitat.

The mass movement potential is rated low for this unit because of bedrock.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. More uniform use of rangeland is aided by properly locating salt and by herding. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce plants suitable for grazing.

Wildlife such as elk, mule deer, coyotes, ptarmigan, marmots, and pika utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural

vegetation provide good food and cover. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are the slope, the content of stones, the depth to bedrock, and rock outcrops. Paths and trails can be developed; drainage should be provided for them. Cuts and fills should be seeded or mulched. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

The Telluride soil is in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

343—Telluride-Rock outcrop complex, 45 to 75 percent slopes

Map Unit Description

This map unit is a complex of shallow, well drained soils and Rock outcrop on alpine mountain slopes and ridges. The elevation is 11,500 to 13,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 28 to 34 degrees F., and the average frost-free period is less than 40 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 60 percent Telluride very cobbly loam, 25 percent Rock outcrop, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Telluride very cobbly loam

The Telluride soil formed in slope alluvium and colluvium weathered from rhyolite, tuff, and similar volcanic rocks. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is brown very cobbly loam about 6 inches thick. The subsurface layer is brown stony loam about 5 inches thick. The underlying material is pinkish gray very stony loam to a depth of 19 inches. Bedrock is at a depth of 19 inches; however, the depth to bedrock ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Telluride soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of rhyolite, tuff, and similar volcanic rocks as cliffs, breaks, escarpments, and other rock exposures.

Contrasting Inclusions

Included in this unit are about 10 percent Moran very gravelly loam on mountain slopes; 4 percent Whitecross very stony sandy loam on ridges; small areas of Henson very gravelly loam on mountain slopes; and small areas of Rubble land. Moran and Henson soils are very deep. Whitecross soils have light colored surface layers. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Acomastylis rossii/Bistorta bistortoides* on the shallowest areas, and *Carex rupestris/Trifolium dasyphyllum* in depressional areas. The native vegetation on this unit consists mainly of Ross' avens, sedge, tufted hairgrass, kobresia, American bistort, and Baker's wheatgrass. Other important plants that characterize this unit are alpine fescue, alpine bluegrass, alpine timothy, spike

trisetum, and slender cinquefoil. The average annual production of air-dry vegetation is about 1,200 pounds per acre.

Soil Management Implications

This unit is used for recreation, scenic attraction, wildlife habitat, and limited sheep grazing.

The mass movement potential is rated moderate for this unit.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. More uniform use of rangeland is aided by properly locating salt and by herding. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The slope limits access by livestock and results in overgrazing of the less sloping areas. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce plants suitable for grazing.

Wildlife such as elk, mule deer, coyotes, mountain goats, ptarmigan, marmots, and pika utilize this unit. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are the very steep slopes, the content of stones, the depth to bedrock, the hazard of erosion, and rock outcrops. The slope limits use of the map unit mainly to a few paths and trails that should extend across the slope. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintenance of adequate plant cover. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

The Telluride soil is in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

345—Papaspila loam, 0 to 15 percent slopes

Map Unit Description

This very deep, well drained soil is on mesas and structural benches. The elevation is 8,500 to 10,000 feet. The average annual precipitation is 25 to 35 inches, the average annual air temperature is 34 to 40 degrees F., and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

There are some soils within the map unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include soils with a thinner mollic surface. Similar inclusions make up about 5 percent of the map unit; the percentage varies from one area to another.

Brief Soil Description

Papaspila loam

The Papaspila formed in slope alluvium derived dominantly from diorite. Typically, the upper part of the surface layer is grayish brown loam about 18 inches thick; the lower part is grayish brown gravelly loam about 7 inches thick. The upper part of the subsurface layer is very pale brown very cobbly silt loam about 8 inches thick; the lower part is very pale brown extremely stony clay loam about 6 inches thick. The subsoil is reddish yellow and pink extremely stony clay loam about 15 inches thick. The substratum is reddish yellow extremely stony clay loam to a depth of 60 inches or more.

The permeability of the Papaspila soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit is about 10 percent soils with less than 35 percent rock fragments. This inclusion is on the same landform as the Papaspila soils.

Vegetation

The dominant plant association is *Festuca thurberi/Vicia americana-Lathyrus leucanthus*. The native vegetation on this map unit consists of Thurber's fescue, Letterman's needlegrass, mountain brome, and Kentucky bluegrass. Other plants that characterize this unit are western wheatgrass, American vetch, geranium, slender cinquefoil, and shrubby cinquefoil. The average annual production of air-dry vegetation is about 3,000 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

The main limitation to the building of unsurfaced roads on this unit is the content of stones in the soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stockwater development and fencing will help to improve livestock distribution and forage quality. More uniform use of rangeland is aided by properly locating salt and by herding. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall will help ensure that soil moisture will be adequate in the spring for germination.

Wildlife such as elk, mule deer, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitation is the presence of slopes that are over 8 percent. Paths and trails can be developed.

This map unit is in capability subclass 6c, nonirrigated.

350—Flygare-Foidel complex, 0 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mesas and structural benches. The elevation is 8,500 to 10,000 feet. The average annual precipitation is 25 to 30 inches, the average annual air temperature is 34 to 40 degrees F., and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 45 percent Flygare gravelly loam, 40 percent Foidel loam, 10 percent similar soils, and 5 percent dissimilar soils. There are some soils within the map unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include Behanco loam. These similar soils make up about 10 percent of the map unit;

the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Flygare gravelly loam

The Flygare soil formed in alluvium and slope alluvium derived dominantly from diorite. Typically, the surface is covered with a mat of intermediately decomposed leaves and twigs about 1 inch thick. The upper part of the surface layer is dark grayish brown gravelly loam about 4 inches thick. The next part is very dark grayish brown cobbly loam 4 inches thick. The lower part of the surface layer is dark grayish brown and brown extremely stony loam about 14 inches thick. The subsurface layer is light yellowish brown very cobbly loam about 5 inches thick. The upper part of the subsoil is light yellowish brown very cobbly clay loam about 10 inches thick; the lower part is light brown extremely cobbly clay loam to a depth of 61 inches or more.

The permeability of the Flygare soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Foidel loam

The Foidel soil formed in alluvium and slope alluvium derived dominantly from diorite. Typically, the surface layer is dark grayish brown loam about 32 inches thick. The subsurface layer is pale brown gravelly loam 6 inches thick. The upper part of the subsoil is pink clay loam and very pale brown loam 7 inches thick; the next part is pink gravelly clay loam about 11 inches thick; and the lower part of the subsoil is brown gravelly clay loam to a depth of 60 inches or more.

The permeability of the Foidel soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit is about 5 percent of soils with a high water table in depressions.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation on this map unit consists of quaking aspen, snowberry, Thurber's fescue, nodding brome, Kentucky bluegrass, Columbia needlegrass, American vetch, and geranium. The average annual understory production of air-dry vegetation is about 3,000 pounds per acre on both soils.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for aspen is 70 on the Flygare soil. It can produce about 39 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope.

Timber productivity is estimated to be moderately high. The main concerns in producing and harvesting timber are reforestation and road construction due to large stones in the soil. Conventional methods of harvesting timber generally can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitations to reforestation on this soil are the stones in the Flygare soil. Large stones limit rooting space and soil moisture, and interfere with planting

operations. The high content of rock fragments can make the planting of seedlings difficult. After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants if trees other than aspen are to be grown. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest. Grazing in harvested areas should be deferred for at least 2 years to assure development of sufficient plant cover to protect the soil from erosion.

The main limitations to the building of unsurfaced roads on this unit are the stones and cobbles in the Flygare soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and forage quality. More uniform use of range and understory vegetation is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the gravelly surface of the Flygare soil and the slopes that are over 8 percent in the unit. Paths and trails can be developed.

This map unit is in capability subclass 6c, nonirrigated.

355—Flygare-Foidel complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on structural benches and mountain slopes. The elevation is 8,500 to 10,000 feet. The average annual precipitation is 25 to 30 inches, the average annual air temperature is 34 to 40 degrees F., and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 45 percent Flygare gravelly loam, 40 percent Foidel loam, 10 percent similar soils, and 5 percent dissimilar soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include Behanco loam. Similar inclusions make up about 10 percent of the map unit; the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Flygare gravelly loam

The Flygare soil formed in alluvium and slope alluvium derived dominantly from diorite. Typically, the surface is covered with a mat of intermediately decomposed leaves and twigs about 1 inch thick. The upper part of the surface layer is dark grayish brown gravelly loam about 4 inches thick; the next part is very dark grayish brown cobbly loam 4 inches thick and the lower part of the surface layer is dark grayish brown and brown extremely stony loam about 14 inches thick. The subsurface layer is light yellowish brown very cobbly loam about 5 inches thick. The upper part of the

subsoil is light yellowish brown very cobbly clay loam about 10 inches thick. The lower part of the subsoil is light brown extremely cobbly clay loam to a depth of 61 inches or more.

The permeability of the Flygare soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Foidel loam

The Foidel soil formed in alluvium and slope alluvium derived dominantly from diorite. Typically, the surface layer is dark grayish brown loam about 32 inches thick. The subsurface layer is pale brown gravelly loam 6 inches thick. The upper part of the subsoil is pink clay loam and very pale brown loam 7 inches thick; the next part is pink gravelly clay loam about 11 inches thick; and the lower part is brown gravelly clay loam to a depth of 60 inches or more.

The permeability of the Foidel soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit is about 5 percent of soils with a high water table on less sloping areas. The percentage varies from one area to another.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation consists of quaking aspen, snowberry, nodding brome, Thurber's fescue, Kentucky bluegrass, Columbia needlegrass, American vetch, and geranium. The average annual understory production of air-dry vegetation is about 3,000 pounds per acre on both soils.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 78 on the Foidel soil. It can produce about 46 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope and the rock fragments in the Flygare soil.

Timber productivity is estimated to be moderately high. The main concerns in producing and harvesting timber are reforestation and road construction due to large stones in the soil. Conventional methods of harvesting timber generally can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitation to reforestation on this soil is the content of stones in the surface layer. Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult. After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants if trees other than quaking aspen are to be grown. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest. Grazing in harvested areas should be deferred for at least 2 years to assure development of sufficient plant cover to protect the soil from erosion.

The main limitations to the building of unsurfaced roads on this unit are the stones and cobbles in the Flygare soil and the slopes in the unit. Proper design of road

drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and forage quality.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the slope and the gravelly surface of the Flygare soil. Development is limited mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

360—Blacksnag-Peeler complex, 2 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mesas and structural benches. The elevation is 10,000 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 45 percent Blacksnag very cobbly loam and 40 percent Peeler silt loam. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include about 10 percent Storm soils. The percentage varies from one area to another. Also included are 5 percent contrasting soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Blacksnag very cobbly loam

The Blacksnag soil formed in slope alluvium derived dominantly from diorite. Typically, the surface layer is brown very cobbly loam about 8 inches thick. The upper 20 inches of the subsoil are brown and strong brown extremely cobbly loam; the next 8 inches are strong brown very cobbly sandy loam; and the lower part of the subsoil is strong brown and light brown very cobbly sandy clay loam to a depth of 60 inches or more.

The permeability of the Blacksnag soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Peeler silt loam

The Peeler soil formed in slope alluvium derived dominantly from diorite. Typically, the surface is covered with a mat of partially decomposed needles and twigs about 2 inches thick. The surface layer is grayish brown and brown silt loam about 8 inches thick. The upper 8 inches of the subsurface layer are light brown loam; the lower 6

inches are reddish yellow cobbly loam. The upper 11 inches of the subsoil are reddish yellow and light brown stony loam; the lower part consists of reddish yellow and strong brown loam to a depth of 62 inches or more.

The permeability of the Peeler soil is moderate. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is moderate, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit is about 5 percent of soils with a high water table in depressions.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. Another common plant association is *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation consists mainly of Englemann's spruce, subalpine fir, and quaking aspen. Other common plants that characterize this unit are whortleberry, nodding brome, Kentucky bluegrass, sheep fescue, heartleaf arnica, elderberry, gooseberry currant, slender wheatgrass, alpine timothy, snowberry, Richardson's geranium, Columbian monkshood, and aster. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Blacksnag soil, and about 700 pounds per acre on the Peeler soil.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 82 on the Blacksnag soil. It can produce about 79 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope.

Timber productivity is estimated to be moderately high. The main concerns in producing and harvesting timber are large stones in the soil. Conventional methods of harvesting timber generally can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall. Harvesting some of the mature trees for lumber and thinning dense stands of younger trees for use as poles increases the growth rate of the rest of the stand and increases the understory vegetation.

The main limitation to reforestation on this unit is the content of large stones in the Blacksnag soil. Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult on the Blacksnag soil. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock will hasten reforestation. Among the trees suitable for planting are Englemann's spruce and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

The main limitation to the building of unsurfaced roads on this unit is the content of large stones in the Blacksnag soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. More uniform distribution of livestock is aided by properly locating stock water development and salt, and by fencing and herding. Grazing in harvested areas should be deferred for at least 2 years to assure development of sufficient plant cover to protect the soil from erosion.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the content of stones in the Blacksnag soil and slopes in the unit that are over 8 percent. Paths and trails can be developed.

The Blacksnag soil is in capability subclass 7s, nonirrigated. The Peeler soil is in capability subclass 6c, nonirrigated.

361—Blacksnag-Peeler complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 10,000 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 45 percent Blacksnag very cobbly loam and 40 percent Peeler silt loam. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include about 10 percent Storm extremely flaggy loam. The percentage varies from one area to another. Also included are 5 percent contrasting soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Blacksnag very cobbly loam

The Blacksnag soil formed in slope alluvium and colluvium derived dominantly from diorite. Typically, the surface layer is brown very cobbly loam about 8 inches thick. The upper 20 inches of the subsoil are brown and strong brown extremely cobbly loam; the next 8 inches are strong brown very cobbly sandy loam; and the lower part of the subsoil is strong brown and light brown very cobbly sandy clay loam to a depth of 60 inches or more.

The permeability of the Blacksnag soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Peeler silt loam

The Peeler soil formed in slope alluvium and colluvium derived dominantly from diorite. Typically, the surface is covered with a mat of partially decomposed needles and twigs about 2 inches thick. The surface layer is grayish brown and brown silt loam about 8 inches thick. The upper 8 inches of the subsurface layer are light brown loam. The lower 6 inches are reddish yellow cobbly loam. The upper 11 inches of the subsoil are reddish yellow and light brown stony loam; the lower part consists of reddish yellow and strong brown loam to a depth of 62 inches or more.

The permeability of the Peeler soil is moderate. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. Shrink- swell potential is low.

Contrasting Inclusions

Included in this unit is about 5 percent of soils with a high water table in depressions.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. Another common plant association is *Populus tremuloides/Symphoricarpos oreophilus*. The dominant native vegetation consists of Englemann's spruce, subalpine fir, and quaking aspen. Other plants that characterize this unit are whortleberry, nodding brome, Kentucky bluegrass, sheep fescue, slender wheatgrass, alpine timothy, heartleaf arnica, snowberry, Richardson's geranium, elderberry, gooseberry currant, Columbian monkshood, and aster. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Blacksnag soil, and about 700 pounds per acre on the Peeler soil.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 82 on the Blacksnag soil. It can produce about 79 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the high content of rock fragments.

Timber productivity is estimated to be moderately high. Conventional methods of harvesting timber generally can be used. Careful consideration of road systems and harvesting methods should be made to minimize erosion. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall. Harvesting some of the mature trees for lumber and thinning dense stands of younger trees increase the growth rate of the rest of the stand and increase the understory vegetation.

The main limitation to reforestation on this unit is the content of large stones in the Blacksnag soil. Large stones limit rooting space and soil moisture, and interfere with planting operations. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. The high content of rock fragments can make the planting of seedlings difficult. Hand planting of nursery stock is usually necessary to establish or improve a stand. This unit is well suited to Englemann's spruce and subalpine fir.

The main limitations to the building of unsurfaced roads on this unit are the content of large stones in the Blacksnag soil and the slopes in the unit. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

To stabilize grades, cut and fills, and other disturbed areas, roads, landings and skid trails should be provided with water bars and reseeded following harvest.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. More uniform distribution of livestock is aided by properly locating stock water development and salt, and by fencing and herding. Grazing in harvested areas should be deferred for at least 2 years to ensure development of sufficient plant cover to protect the soil from erosion.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the content of stones in the Blacksnag soil and the slopes in both soils. The slopes limit use of the unit mainly to a few paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded and mulched.

The Blacksnag soil is in capability subclass 7s, nonirrigated. The Peeler soil is in capability subclass 7e, nonirrigated.

374—Mavreeso-Valto-Rock outcrop complex, 30 to 80 percent slopes

Map Unit Description

This map unit is a complex of shallow and very deep, well drained soils and Rock outcrop on mountain slopes and canyon side slopes. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 20 to 22 inches, the average annual air temperature is 43 to 46 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 35 percent Mavreeso loam, 30 percent Valto very stony fine sandy loam, 20 percent Rock outcrop, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Mavreeso loam

The Mavreeso soil is very deep. It formed in colluvium and slope alluvium derived dominantly from red sedimentary rocks. Typically, the surface layer is reddish brown loam about 10 inches thick. The upper part of the subsoil is yellowish red loam about 8 inches thick. The middle part of the subsoil is yellowish red channery loam about 10 inches thick. The lower part of the subsoil is yellowish red loam about 14 inches thick. The upper 8 inches of the substratum are yellowish red channery loam; the lower part consists of yellowish red loam to a depth of 60 inches or more.

The permeability of the Mavreeso soil is moderate. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Valto very stony fine sandy loam

The Valto soil is shallow. It formed in residuum derived dominantly from sandstone. Typically, the surface is covered with forest litter about 2 inches thick. The surface layer is dark reddish gray very stony fine sandy loam 2 inches thick. The underlying material is light reddish brown very stony fine sandy loam 10 inches thick. Hard fractured sandstone is at a depth of 14 inches. The depth to bedrock ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Valto soil is moderately rapid. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. Depth of hard bedrock ranges from 10 to 20 inches. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of hard sandstone dominantly from the Cutler Formation.

Contrasting Inclusions

Included in this map unit are about 15 percent deep and moderate deep soils with more than 35 percent rock fragments in the profile. These inclusions generally are on

toeslopes below rock escarpments. Also included are small areas of very shallow soils on ridges.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. Some *Populus tremuloides/Symphoricarpos oreophilus* occurs on higher elevations. The dominant native vegetation consists of ponderosa pine, Rocky Mountain Douglas-fir, Gambel oak, and common snowberry. Other common plants that characterize this unit are Arizona fescue, mountain brome, mountain muhly, prairie Junegrass, bluegrass, Parry's danthonia, elk sedge, Oregongrape, Saskatoon serviceberry, slender cinquefoil, and meadow-rue. A few quaking aspen occur at higher elevations. The average annual understory production of air-dry vegetation is about 750 pounds per acre on the Mavreeso soil, and about 500 pounds per acre on the Valto soil.

Soil Management Implications

This unit is used mostly for wildlife habitat and woodland. It is generally too steep and stony for logging.

A representative site index for this map unit for ponderosa pine is 65 on the Valto soil. It can produce about 50 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated moderate for this unit.

This unit is poorly suited to timber production. The main limitations to reforestation on this unit are the steep slopes, large stones, and depth to bedrock in the Valto soil. Large stones limit rooting space and soil moisture, and interfere with planting operations.

The main limitations to the building of unsurfaced roads on this unit are the slopes, the shallow depth to bedrock in the Valto soil, and exposed bedrock in the unit. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations in the Mavreeso soil is subject to rill and gully erosion and to sloughing.

Some of the less sloping areas are used for livestock grazing. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate, especially on the Valto soil. The slope limits access by livestock and results in overgrazing of the less sloping areas.

Wildlife such as elk, mule deer, bear, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include prevention of fire and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes, large stones, the depth to bedrock in the Valto soil, and the hazard of erosion on the unit. The slope limits the use of areas of this unit mainly to a few paths and trails, which should extend across the slope. Cuts and fills should be seeded or mulched.

The Mavreeso soil is in capability subclass 7e, nonirrigated. The Valto soil is in capability subclass 7s, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

375—Needleton-Snowdon complex, 5 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep and shallow, well drained soils on structural benches and mountain slopes. The elevation is 10,000 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is

32 to 38 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 55 percent Needleton stony loam, 30 percent Snowdon loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Needleton stony loam

The Needleton soil is very deep. It formed in slope alluvium derived dominantly from rhyolite, limestone, and sandstone. Typically, the surface is covered with a mat of needles, twigs, and leaves about 2 inches thick. The surface layer is light reddish brown stony loam about 14 inches thick. The subsurface layer is reddish brown very cobbly sandy clay loam and light reddish brown very cobbly loam about 10 inches thick. The upper part of the subsoil is reddish brown very stony sandy clay loam about 22 inches thick; the lower part is reddish brown very cobbly clay loam extending to 62 inches or more.

The permeability of the Needleton soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Snowdon loam

The Snowdon soil is shallow. It formed in residuum or slope alluvium derived dominantly from rhyolite, sandstone, and limestone. Typically, the surface is covered with a mat of needles, twigs, and leaves about 2 inches thick. The surface layer is light reddish brown loam about 4 inches thick. The subsurface layer is pinkish gray very stony sandy loam about 7 inches thick. The subsoil is reddish brown extremely stony sandy clay loam about 7 inches thick. Hard bedrock is at a depth of 20 inches; however, the depth to bedrock ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Snowdon soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Quazar extremely stony loam on alluvial fans; 5 percent Haviland loam on structural benches; and 5 percent Hourglass loam on structural benches. Quazar soils have dark colored surface layers. Haviland and Hourglass soils have less than 35 percent rock fragments in the subsoil.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, quaking aspen, and whortleberry. Other important plants that characterize this unit are Thurber's fescue, mountain brome, bluegrass, snowberry, sedge, smallflowered woodrush, spike trisetum, heartleaf arnica, and Richardson's geranium. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Needleton soil, and about 500 pounds per acre on the Snowdon soil.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 84 on the Needleton soil. It can produce about 82 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concerns in producing and harvesting timber are reforestation and road construction. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitations to reforestation on this soil are the stones in the surface layer and the shallow depth to bedrock in the Snowdon soil. Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations to the building of unsurfaced roads on this unit are the stones in the soil and the depth to bedrock in the Snowdon soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills. Road construction may be restricted in the areas of the shallow Snowdon soil. Careful planning of road systems will help avoid cuts in the shallow soils.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, blue grouse, squirrels, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this map unit is used for recreational development, the main limitations are the stones in the surface of the Needleton soil, the depth to bedrock in the Snowdon soil, and slopes that are over 8 percent. Paths and trails can be developed.

This map unit is in capability subclass 7s, nonirrigated.

376—Needleton loam, 15 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 10,000 to 11,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Needleton loam

The Needleton soil formed in slope alluvium derived dominantly from sandstone, limestone, and rhyolite. Typically, the surface is covered with a mat of needles, twigs, and partly decomposed material about 2 inches thick. The surface layer is light reddish brown loam about 14 inches thick. The subsurface layer is reddish brown very cobbly sandy clay loam and light reddish brown very cobbly loam about 10 inches thick. The upper part of the subsoil is reddish brown very stony sandy clay loam about 22 inches thick; the lower part is reddish brown very cobbly clay loam extending to 62 inches or more.

The permeability of the Needleton soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is medium. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Clayburn loam on the less sloping mountain slopes; 5 percent Haviland loam on mountain slopes; small areas of soil with more than 35 percent clay in the subsoil; and small areas of Snowdon soils on structural benches. Clayburn and Haviland soils have less than 35 percent rock fragments in the subsoil. Snowdon soils are shallow. Included soils make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, quaking aspen, and whortleberry. Other important plants that characterize this unit are Thurber's fescue, mountain brome, bluegrass, smallflowered woodrush, spike trisetum, sedge, heartleaf arnica, snowberry, and Richardson's geranium. The average annual understory production of air-dry vegetation is about 800 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, wildlife habitat, and recreation.

A representative site index for this map unit for Englemann's spruce is 84 on the Needleton soil. It can produce about 82 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the high content of rock fragments.

The main concerns in producing and harvesting timber are reforestation and preventing erosion along roads and other places where vegetation has been removed. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. Planting nursery stock will hasten reforestation. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory vegetation.

Wildlife such as elk, mule deer, bear, coyote, blue grouse, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this map unit is used for recreational development, the main limitation is the slope, which is moderately suited to the development of paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

378—Needleton-Haviland complex, 30 to 60 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 9,000 to 11,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 65 percent Needleton loam, 25 percent Haviland loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Needleton loam

The Needleton soil formed in colluvium and slope alluvium derived dominantly from red bed sandstone and shale, and from rhyolite. Typically, the surface is covered with a mat of needles, twigs, and leaves about 2 inches thick. The surface layer is light reddish brown loam about 14 inches thick. The subsurface layer is reddish brown very cobbly sandy clay loam and light reddish brown very cobbly loam about 10 inches thick. The upper part of the subsoil is reddish brown very stony sandy clay loam about 22 inches thick; the lower part is reddish brown very cobbly clay loam extending to 62 inches or more.

The permeability of the Needleton soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Haviland loam

The Haviland soil formed in colluvium and slope alluvium derived dominantly from red bed sandstone and shale. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is light brown loam about 5 inches thick. The subsurface layer is light reddish brown loam about 13 inches thick. The upper 14 inches of the subsoil are red clay loam; the lower part is reddish brown gravelly clay loam extending to 61 inches or more.

The permeability of the Haviland soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 5 percent Snowdon loam, and small areas of Mollic Haplocryalfs and Typic Palecryalfs, all on mountain slopes. Snowdon soils are shallow. Mollic Haplocryalfs have a dark surface layer. In the Typic Palecryalfs the upper boundary of the subsoil is below two feet. Included soils make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, quaking aspen, and whortleberry (Fig. 10). Other important plants that characterize this unit are Thurber's fescue, mountain brome, bluegrass, heartleaf arnica, Richardson's geranium, sedge, smallflowered woodrush, spike trisetum, and snowberry. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Needleton soil, and about 900 on the Haviland soil.



Figure 10.—Needleton-Haviland complex, 30 to 60 percent slopes, is well suited to the production of Englemann's spruce and subalpine fir.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 84 on the Needleton soil. It can produce about 82 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated moderate for this unit.

The main concerns in producing and harvesting timber are reforestation and preventing erosion along roads and other areas where vegetation has been removed. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The slope limits access by livestock and results in overgrazing of the less sloping areas.

Wildlife such as elk, mule deer, bear, squirrels, coyotes, blue grouse, hawks, and eagles utilize this unit. Management for wildlife should include protection from

overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover.

If this map unit is used for recreational development the main limitation is the slope, which limits use of the unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

380—Snowdon-Rock outcrop, 10 to 30 percent slopes

Map Unit Description

This map unit is a complex of shallow, well drained soils and Rock outcrop on mesas and mountain slopes. There are a few stones on the surface. The elevation is 10,000 to 11,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 50 percent Snowdon loam, 35 percent Rock outcrop, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Snowdon loam

The Snowdon soil formed in residuum weathered from limestone. Typically, the surface is covered with a mat of needles, twigs, and leaves about 2 inches thick. The surface layer is light reddish brown loam about 4 inches thick. The subsurface layer is pinkish gray very cobbly sandy loam about 7 inches thick. The subsoil is reddish brown extremely cobbly sandy clay loam about 7 inches thick. Fractured limestone bedrock is at a depth of 20 inches; however, the depth to bedrock ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Snowdon soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of limestone and sandstone as cliffs, breaks, and escarpments.

Contrasting Inclusions

Included in this unit are about 5 percent Haviland loam on structural benches; 5 percent Needleton loam on mountain slopes; and 5 percent moderately deep Argicryolls in swales and on footslopes. Haviland and Needleton soils are very deep. Argicryolls have a dark surface layer.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, quaking aspen, and whortleberry. Other important plants that characterize this unit are Thurber's fescue, mountain brome, Richardson's geranium, bluegrass, sedge, smallflowered woodrush, and spike trisetum. The average annual understory production of air-dry vegetation is about 500 pounds per acre on the Snowdon soil.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and limited livestock grazing.

A representative site index for this map unit for Englemann's spruce is 72 on the Snowdon soil. It can produce about 65 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 110 years old.

The mass movement potential is rated low for this unit because of the slope and bedrock.

The main concerns in producing and harvesting timber are reforestation and road construction due to the limited depth to bedrock and rock outcrops. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitations to reforestation on this soil are the stones in the soil and the shallow depth to bedrock. Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

Road construction may be restricted on areas of the shallow Snowdon soil and on Rock outcrop. Careful planning of road systems will help avoid cuts in the shallow soils.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, bighorn sheep, blue grouse, coyotes, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this map unit is used for recreational development, the main limitations are the slope, the shallow depth to bedrock, and rock outcrops. Paths and trails can be developed.

The Snowdon soil is in capability subclass 7s, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

381—Needleton-Snowdon-Rock outcrop complex, 30 to 80 percent slopes**Map Unit Description**

This map unit is a complex of very deep and shallow, well drained soils and Rock outcrop on mountain slopes and structural benches. The elevation is 9,000 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 75 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 45 percent Needleton stony loam, 30 percent Snowdon very stony loam, 15 percent Rock outcrop, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Needleton stony loam

The Needleton soil is very deep. It formed in slope alluvium and colluvium derived dominantly from rhyolite, limestone, and sandstone. Typically, the surface is covered with a mat of organic material about 2 inches thick. The surface layer is light reddish brown stony loam about 14 inches thick. The subsurface layer is reddish brown very cobbly sandy clay loam and light reddish brown very cobbly loam about 10 inches thick. The upper part of the subsoil is reddish brown very stony sandy clay loam about 22 inches thick; the lower part is reddish brown very cobbly clay loam extending to 62 inches or more.

The permeability of the Needleton soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Snowdon very stony loam

The Snowdon soil is shallow. It formed in residuum and slope alluvium derived dominantly from rhyolite, sandstone, and limestone. Typically, the surface is covered with a mat of needles, twigs, and leaves about 2 inches thick. The surface layer is light reddish brown very stony loam about 4 inches thick. The subsurface layer is pinkish gray very stony sandy loam about 7 inches thick. The subsoil is reddish brown extremely stony sandy clay loam about 7 inches thick. Hard bedrock is at a depth of 20 inches; however, the depth to bedrock ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Snowdon soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of limestone and sandstone bedrock usually as cliffs and ledges and as bare rock on structural benches. Cliffs range from a few feet to about 100 feet in height.

Contrasting Inclusions

Included in this unit are about 5 percent Horsethief extremely stony loam on mountain slopes and 5 percent Haviland loam on structural benches. The upper boundary of the subsoil in the Horsethief soil is below two feet. The Haviland soil has less than 35 percent rock fragments in the subsoil.

Vegetation

The dominant plant associations are *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*, *Abies lasiocarpa-Picea engelmannii/Carex geyeri*, and *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, and quaking aspen. Other important plants that characterize this unit are whortleberry, snowberry, mountain brome, Thurber's fescue, bluegrass, Richardson's geranium, heartleaf arnica, spike trisetum, sedge, and small flowered woodrush. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Needleton soil, and about 500 pounds per acre on the Snowdon soil.

Soil Management Implications

This unit is used for timber production, wildlife habitat, limited livestock grazing, and recreation.

A representative site index for this map unit for Englemann's spruce is 84 on the Needleton soil. It can produce about 82 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated moderate for this unit.

The main concerns in producing and harvesting timber are reforestation, road construction and the prevention of erosion along roads and other areas where vegetative cover has been removed. Minimizing the risk of erosion is essential in harvesting timber.

The main limitations to reforestation on this soil are the stones in the surface layer, the shallow depth to bedrock in the Snowdon soil, and rock outcrops in the unit. Large stones limit rooting space and soil moisture, and interfere with planting operations. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

Road construction is difficult on much of this unit due to Rock outcrop, rock ledges, shallow soils and steep slopes. Road layout should be carefully planned to avoid these difficult areas. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. The steepness of the slope and rock ledges limit access by livestock and result in overgrazing of the less sloping and more accessible areas.

Wildlife such as elk, mule deer, bear, coyotes, bighorn sheep, hawks, eagles, and blue grouse utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this map unit is used for recreational development, the main limitations are the steep slopes, stones, Rock outcrop, and the depth to bedrock in the Snowdon soil. The slopes limit use of the unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Needleton soil is in capability subclass 7e, nonirrigated. The Snowdon soil is in capability subclass 7s, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

382—Needleton-Snowdon complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep and shallow, well drained soils on structural benches and mountain slopes. The elevation is 9,000 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 75 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 50 percent Needleton stony loam, 30 percent Snowdon very stony loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Needleton stony loam

The Needleton soil is very deep. It formed in slope alluvium derived dominantly from sandstone, limestone, and rhyolite. Typically, the surface is covered with a mat of organic material about 2 inches thick. The surface layer is light reddish brown stony loam about 14 inches thick. The subsurface layer is reddish brown very cobbly sandy clay loam and light reddish brown very cobbly loam about 10 inches thick. The upper part of the subsoil is reddish brown very stony sandy clay loam about 22 inches thick; the lower part is reddish brown very cobbly clay loam extending to 62 inches or more.

The permeability of the Needleton soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Snowdon very stony loam

The Snowdon soil is shallow. It formed in residuum and slope alluvium derived dominantly from sandstone, limestone, and rhyolite. Typically, the surface is covered with a mat of needles, twigs, and leaves about 2 inches thick. The surface layer is light reddish brown very stony loam about 4 inches thick. The subsurface layer is pinkish gray very stony sandy loam about 7 inches thick. The subsoil is reddish brown extremely stony sandy clay loam about 7 inches thick. Hard bedrock is at a depth of 20 inches; however, the depth to bedrock ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Snowdon soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Haviland soils on mountain slopes; 5 percent Rock outcrop; 5 percent Wander stony loam on mountain slopes; and small areas of Scotch loam and Graysill loam, both on structural benches. Inclusions make up about 20 percent of the map unit. Haviland and Graysill soils have less than 35 percent rock fragments in the subsoil. Wander soils have dark colored surface layers. Scotch soils are shallow and have less than 35 percent rock fragments.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, quaking aspen, and whortleberry. Other important plants that characterize this unit are snowberry, Thurber's fescue, mountain brome, bluegrass, heartleaf arnica, Richardson's geranium, smallflowered woodrush, spike trisetum, and sedge. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Needleton soil, and about 500 pounds per acre on the Snowdon soil.

Soil Management Implications

This unit is used timber production, wildlife habitat, livestock grazing, and recreation.

A representative site index for this map unit for subalpine fir is 80 on the Needleton soil. It can produce about 76 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the high content of rock fragments and the bedrock.

The main concerns in producing and harvesting timber are reforestation and prevention of erosion along roads and other places where vegetative cover has been

removed. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitations to reforestation on this soil are the stones in the surface layer and the shallow depth to bedrock in the Snowdon soil. Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine. Quaking Aspen will usually regenerate from roots after harvest.

The main limitations for building unsurfaced roads on this unit are the stones in the soil and the shallow depth to bedrock in the Snowdon soil. Careful planning of road systems will help avoid cuts in the shallow soils. Proper design of road drainage systems and care in the placement of culverts help to control erosion.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, blue grouse, coyotes, hawks, eagles, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover.

If this map unit is used for recreational development, the main limitations are the slope, the depth to bedrock in the Snowdon soil, and stones. The slope limits the unit mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7s, nonirrigated.

383—Haviland-Needleton complex, 10 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 8,500 to 11,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 50 percent Haviland loam, 35 percent Needleton stony loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Haviland loam

The Haviland soil formed in slope alluvium derived dominantly from red bed sandstone and shale. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is light brown loam about 5 inches thick. The subsurface layer is light reddish brown loam about 13 inches thick. The upper 14 inches of the subsoil are red clay loam; the lower part consists of reddish brown gravelly clay loam extending to 61 inches or more.

The permeability of the Haviland soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or

more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Needleton stony loam

The Needleton soil formed in slope alluvium derived dominantly from red bed sandstone and shale and from rhyolite. Typically, the surface is covered with a mat of organic material about 2 inches thick. The surface layer is light reddish brown stony loam about 14 inches thick. The subsurface layer is reddish brown very cobbly sandy clay loam and light reddish brown very cobbly loam about 10 inches thick. The upper part of the subsoil is reddish brown very stony sandy clay loam about 22 inches thick; the lower part is reddish brown very cobbly clay loam extending to 62 inches or more.

The permeability of the Needleton soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Graysill loam on structural benches; 5 percent Snowdon extremely stony loam on mountain slopes; small areas of Scotch loam on structural benches; and small areas that are wet from poor drainage in swales. Graysill soils are moderately deep. Snowdon and Scotch soils are shallow. Inclusions make up about 15 percent of the map unit.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit is mainly Englemann's spruce, subalpine fir, quaking aspen, and whortleberry. Other important plants that characterize this unit are mountain brome, Thurber's fescue, bluegrass, Richardson's geranium, heartleaf arnica, smallflowered woodrush, spike trisetum, sedge, and snowberry. The average annual understory production of air-dry vegetation is about 900 pounds per acre on the Haviland soil, and about 800 pounds per acre on the Needleton soil.

Soil Management Implications

This unit is used mainly for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 90 on the Haviland soil. It can produce about 91 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 90 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitation to reforestation on this unit is the content of stones in the Needleton soil. Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Many areas of this unit are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, squirrels, coyotes, bear, hawks, eagles, and blue grouse utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this map unit is used for recreational development, the main limitation is the slope, which limits development of the unit mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Haviland soil is in capability subclass 6e, nonirrigated. The Needleton soil is in capability subclass 7s, nonirrigated.

386—Needleton stony loam, 60 to 90 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 8,800 to 11,500 feet. The surface of this unit is covered with 1 to 3 percent stones. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Needleton stony loam

The Needleton soil formed in slope alluvium and colluvium derived dominantly from sandstone and rhyolite. Typically, the surface is covered with a mat of needles, twigs, and partly decomposed material about 2 inches thick. The surface layer is light reddish brown stony loam about 14 inches thick. The subsurface layer is reddish brown very cobbly sandy clay loam and light reddish brown very cobbly loam about 10 inches thick. The upper part of the subsoil is reddish brown very stony sandy clay loam about 22 inches thick; the lower part is reddish brown very cobbly clay loam extending to 62 inches or more.

The permeability of the Needleton soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Snowdon extremely stony loam, 10 percent Nordicol very stony sandy loam, and 5 percent Horsethief soils, all on mountain slopes; and 5 percent Rubble land. Snowdon soils are shallow. Nordicol soils have dark colored surface layers. Horsethief soils have the top of the subsoil below 24 inches. Included soils make up about 30 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Juniperus communis*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, Rocky Mountain Douglas-fir, and common juniper. Other important plants that characterize this unit are mountain brome, bluegrass, Richardson's geranium, heartleaf arnica, sedge, whortleberry, spike trisetum, and kinnikinnick. The

average annual understory production of air-dry vegetation is about 800 pounds per acre.

Soil Management Implications

This unit is used for woodland, wildlife habitat, and limited livestock grazing on the lower slopes.

A representative site index for this map unit for Englemann's spruce is 84 on the Needleton soil. It can produce about 82 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated high for this unit because of the very steep slopes.

This map unit is generally too steep for commercial timber production although some windfall areas have been logged. The main concerns in producing and harvesting timber are reforestation, road construction, and preventing water erosion along roads and other areas where vegetation has been removed. The steepness of slope limits the kinds of equipment that can be used in forest management. Careful consideration of road systems and harvesting methods should be made to minimize erosion. Minimizing the risk of erosion is essential in all timber management practices.

The main limitation to the building of unsurfaced roads on this unit is the very steep slopes.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. The slope limits access by livestock and results in overgrazing of the less sloping areas. Mechanical treatment practices are not practical, because the surface is stony and the slopes are steep.

Wildlife such as elk, mule deer, bear, coyote, blue grouse, squirrels, and rabbits utilize this unit. Management for wildlife should include prevention of fire and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

This map unit is poorly suited to recreational development. The main limitations are the very steep slopes and the content of stones.

This map unit is in capability subclass 7e, nonirrigated.

387—Frisco-Quazar complex, 30 to 60 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 9,000 to 11,000 feet. The average annual precipitation is 30 to 40 inches, the average annual air temperature is 32 to 38 degrees F., and the average frost-free period is 40 to 65 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 50 percent Frisco stony loam, 40 percent Quazar very cobbly loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Frisco stony loam

The Frisco soil formed in slope alluvium and colluvium derived dominantly from rhyolite and tuff. Typically, the surface is covered with a mat of needles, twigs, and partly decomposed organic material about 2 inches thick. The surface layer is brown stony loam about 3 inches thick. The subsurface layer is light brown stony loam about

6 inches thick. The next layer is brown cobbly loam about 8 inches thick. The upper part of the subsoil is brown extremely stony sandy clay loam about 29 inches thick; the lower part is brown extremely stony loam extending to 62 inches or more.

The permeability of the Frisco soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Quazar very cobbly loam

The Quazar soil formed in slope alluvium and colluvium derived dominantly from rhyolite and tuff. Typically, the surface layer is dark grayish brown very cobbly loam about 12 inches thick. The subsoil is light brown extremely gravelly clay loam about 14 inches thick. The substratum is brown extremely gravelly clay loam to a depth of 60 inches or more.

The permeability of the Quazar soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 4 percent Horsethief stony loam and 5 percent Snowdon very stony fine sandy loam, both on mountain slopes; and small areas of Rock outcrop on breaks. The upper boundary of the subsoil in the Horsethief soil is deeper than two feet. Snowdon soils are shallow over bedrock. Included soils make up about 10 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa*-*Picea engelmannii*/*Vaccinium myrtillus*. Areas that are not wooded have *Festuca thurberi*/*Vicia americana*-*Lathyrus leucanthus*. Some *Populus tremuloides*/*Symphoricarpos oreophilus*/*Carex geyeri* may also occur on south slopes. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, quaking aspen, and Rocky Mountain Douglas-fir. Other important plants that characterize this unit are whortleberry, Thurber's fescue, mountain brome, bluegrass, needlegrass, snowberry, American vetch, elk sedge, Nevada pea, and meadow-rue. The average annual understory production of air-dry vegetation is about 700 pounds per acre on the Frisco soil. The average annual production of air-dry vegetation is about 2,400 pounds per acre on the Quazar soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 80 on the Frisco soil. It can produce about 76 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated moderate for this unit.

The main concerns in producing and harvesting timber are reforestation, slope and road construction in the stony soils. Conventional harvesting methods generally are limited to slopes of less than 40 percent. The steepness of the slope limits the kinds of equipment that can be used in forest management. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitations to reforestation on this unit are the steep slopes and the rock content of the soils. Large stones limit rooting space and soil moisture, and interfere with planting operations. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock will hasten reforestation. Hand planting is usually necessary. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and

lodgepole pine. Other trees suited to this unit are Rocky Mountain Douglas-fir and quaking aspen.

The main limitations to the building of unsurfaced roads on this unit are the steep slopes and the content of stones. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and the growth of understory grasses. The slope limits access by livestock and results in overgrazing of the less sloping areas.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the content of stones and the steep slopes. The slopes limit use of the unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

388—Frisco-Quazar complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 10,000 to 11,000 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is 32 to 38 degrees F., and the average frost-free period is 40 to 65 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 50 percent Frisco cobbly loam, 45 percent Quazar very cobbly loam, and 5 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Frisco cobbly loam

The Frisco soil formed in slope alluvium derived dominantly from rhyolite and tuff. Typically, the surface is covered with a mat of needles, twigs, and partly decomposed organic material about 2 inches thick. The surface layer is brown cobbly loam about 3 inches thick. The subsurface layer is light brown cobbly loam about 6 inches thick. The next layer is brown cobbly loam about 8 inches thick. The upper part of the subsoil is brown extremely stony sandy clay loam about 29 inches thick; the lower part is brown extremely stony loam extending to 62 inches or more.

The permeability of the Frisco soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Quazar very cobbly loam

The Quazar soil formed in slope alluvium derived dominantly from rhyolite and tuff. Typically, the surface layer is dark grayish brown very cobbly loam about 12 inches thick. The subsoil is light brown extremely gravelly clay loam about 14 inches thick.

The substratum is brown extremely gravelly clay loam to a depth of 60 inches or more.

The permeability of the Quazar soil is high. The available water capacity is slight. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 3 percent Hourglass loam on toeslope, and 2 percent Scout very cobbly loam on mountain slopes. Hourglass soils have less than 35 percent rock fragments in the subsoil. Scout soils lack argillic horizons.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. Areas that are not wooded have *Festuca thurberi/Vicia americana-Lathyrus leucanthus*. Some *Populus tremuloides/Symphoricarpos oreophilus/Carex geyeri* may also occur on south slopes. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, and quaking aspen. Other important plants that characterize this unit are whortleberry, snowberry, Thurber's fescue, mountain brome, bluegrass, needlegrass, American vetch, gooseberry currant, heartleaf arnica, meadow-rue, and sedge. The average annual understory production of air-dry vegetation is about 700 pounds per acre on the Frisco soil. The average annual production of air-dry vegetation is about 2,400 pounds per acre on the Quazar soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 80 for the Frisco soil. It can produce about 76 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope and the high content of rock fragments.

The main concerns in producing and harvesting timber are reforestation and road construction in the stony soils. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitation to reforestation on this unit is the high rock content of the soils. Large stones limit rooting space and soil moisture, and interfere with planting operations. Planting nursery stock will hasten reforestation. Hand planting is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine. Other trees suited to this unit are Rocky Mountain Douglas-fir and quaking aspen. Grazing in harvested areas should be deferred for at least 2 years to allow development of sufficient plant cover to protect the soil from erosion.

The main limitations for building unsurfaced roads on this unit are the stones and cobbles in the soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of vegetation for grazing.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the slopes and the content of stones. It is moderately suited to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7s, nonirrigated.

389—Seitz gravelly loam, 10 to 60 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 10,000 to 11,000 feet. The average annual precipitation is 25 to 30 inches, the average annual air temperature is 35 to 40 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include Frisco cobbly loam. These similar soils make up about 15 percent of the total acreage; the percentage varies from one area to another.

Brief Soil Description

Seitz gravelly loam

The Seitz soil formed in slope alluvium derived dominantly from volcanic rocks. Typically, the surface is covered with a mat of needles, twigs, and partly decomposed organic material about 2 inches thick. The surface layer is brown gravelly loam about 2 inches thick. The subsurface layer is pale brown very stony loam about 7 inches thick. The next layer is brown very stony clay loam and pale brown very stony loam about 7 inches thick. The subsoil is brown extremely stony clay about 24 inches thick. The substratum is brown extremely stony clay loam to a depth of 62 inches or more. The included Frisco soils have less than 35 percent clay in the subsoil.

The permeability of the Seitz soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce and subalpine fir. Other important plants that characterize this unit are whortleberry, mountain brome, slender wheatgrass, heartleaf arnica, gooseberry currant, common juniper, smallflowered woodrush, Richardson's geranium, and sedge. The average annual understory production of air-dry vegetation is about 350 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 66 for the Seitz soil. It can produce about 57 cubic feet of merchantable timber per acre from a fully stocked stand of even-aged trees 120 years old.

The mass movement potential is rated low for this unit because of the slope and the high content of rock fragments.

The main concerns in producing and harvesting timber are reforestation and stones in the soil. Conventional methods of harvesting timber can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The high content of rock fragments can make the planting of seedlings difficult. After harvest, reforestation must be carefully managed to reduce competition from

undesirable understory plants. Planting nursery stock will hasten reforestation. Hand planting is usually necessary. Among the trees that are suitable for planting are Englemann's spruce and subalpine fir.

The main limitation to building unsurfaced roads on this unit is the content of stones in the soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quantity and quality of native vegetation. Stock water development and fencing will help to improve livestock distribution and the growth of understory grasses.

If this map unit is used for recreational development, the main limitations are the slope and the gravelly surface layers. The slope limits development of most areas of this unit to paths and trails that should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded and mulched.

This map unit is in capability subclass 7e, nonirrigated.

390—Clayburn-Heisspitz complex, 30 to 60 percent slopes

Map Unit Description

This map unit is a complex of very deep and shallow, well drained soils on mountain slopes. The elevation is 9,500 to 11,000 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 40 percent Clayburn loam, 30 percent Heisspitz loam, and 30 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Clayburn loam

The Clayburn soil is very deep. It formed in slope alluvium derived dominantly from sandstone and shale. Typically, the surface layer is grayish brown and dark grayish brown loam about 13 inches thick. The upper 5 inches of the subsoil are brown clay loam. The middle part is brown clay loam about 18 inches thick. The lower 12 inches are light brown sandy clay loam. The substratum is light brown sandy clay loam to a depth of 60 inches or more.

The permeability of the Clayburn soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Heisspitz loam

The Heisspitz soil is shallow. It formed in colluvium derived dominantly from limestone and sandstone. Typically, the surface layer is brown loam about 9 inches thick, and the next layer is brown loam about 5 inches thick. Fractured limestone bedrock is at a depth of 14 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Heisspitz soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 15 percent Runlett loam on structural benches; 10 percent Rock outcrop on breaks; and 5 percent Needleton loam on mountain slopes. Runlett soils are moderately deep over limestone or sandstone. Needleton soils have more than 35 percent rock fragments in the profile.

Vegetation

The dominant plant association on this unit is *Festuca thurberi/Vicia americana-Lathyrus leucanthus*. Some *Populus tremuloides/Symphoricarpos oreophilus* also occurs in quaking aspen groves. The native vegetation on this unit consists mainly of Thurber's fescue, Letterman's needlegrass, mountain brome, bluegrass, and nodding brome. Other important plants that characterize this unit are American vetch, Parry's danthonia, and slender wheatgrass. Snowberry and quaking aspen occurs in groves. The average annual production of air-dry vegetation is about 2,800 pounds per acre on the Clayburn soil and about 2,500 pounds on the Heisspitz soil.

Soil Management Implications

This unit is used for livestock grazing, wildlife habitat, and recreation.

The mass movement potential is rated moderate for this unit.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of rangeland vegetation. The slope limits access by livestock and results in overgrazing of the less sloping areas.

Wildlife such as elk, mule deer, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes in the unit and the depth to bedrock in the Heisspitz soil. The slopes limit use of the unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

391—Runlett-Sessions complex, 5 to 30 percent slopes**Map Unit Description**

This map unit is a complex of moderately deep, and very deep, well drained soils on mesas, mountain slopes and structural benches. The elevation is 9,500 to 11,000 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 50 percent Runlett loam, 30 percent Sessions loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description**Runlett loam**

The Runlett soil is moderately deep. It formed in slope alluvium and residuum derived dominantly from limestone, sandstone, and shale. Typically, the surface layer is grayish brown loam about 14 inches thick. The next layer is brown loam about 5 inches thick. The subsoil is brown heavy clay loam and clay about 8 inches thick.

Weathered bedrock is at a depth of 27 inches; however, the depth to weathered bedrock ranges from 20 to 40 inches.

The permeability of the Runlett soil is slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 20 to 40 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Sessions loam

The Sessions soil is very deep. It formed in slope alluvium derived dominantly from sandstone and limestone. Typically, the surface layer is dark grayish brown and grayish brown loam about 11 inches thick. The upper part of the subsoil is brown clay loam about 8 inches thick. The next part is brown clay about 15 inches thick. The lower part of the subsoil is light reddish brown clay about 14 inches thick. The substratum is light reddish brown gravelly clay loam extending to 60 inches or more.

The permeability of the Sessions soil is slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 or more inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included is about 10 percent Heisspitz loam on edges of breaks, 5 percent Snowdon very cobbly loam on mountain slopes, and 5 percent Rock outcrop. Heisspitz soils are shallow. Snowdon soils are shallow and have more than 35 percent rock fragments in the profile.

Vegetation

The dominant plant association on this unit is *Festuca thurberi/Vicia americana-Lathyrus leucanthus*. The native vegetation on this unit consists mainly of Thurber's fescue, Letterman's needlegrass, Kentucky bluegrass, mountain brome, and nodding brome. Other important plants that characterize this unit are American vetch, Parry's danthonia, slender wheatgrass, elk sedge, slender cinquefoil, Richardson's geranium, and whitestem gooseberry. The average annual production of air-dry vegetation is about 2,500 pounds per acre on the Runlett soil, and about 2,800 pounds per acre on the Sessions soil.

Soil Management Implications

This unit is used for livestock grazing, wildlife habitat, and recreation.

The mass movement potential is rated low for this unit because of the slope.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of rangeland vegetation. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Wildlife such as elk, mule deer, bear, hawks, and eagles utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are slopes that are over 8 percent and the slow permeability. The slopes limit development of most areas to paths and trails. Drainage should be provided for paths and trails.

This map unit is in capability subclass 6e, nonirrigated.

392—Runlett-Needleton-Sessions complex, 15 to 45 percent slopes

Map Unit Description

This map unit is a complex of moderately deep, and very deep, well drained soils on mountain slopes and mesas. The elevation is 10,000 to 11,000 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 30 percent Runlett loam, 30 percent Needleton loam, 20 percent Sessions loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Runlett loam

The Runlett soil is moderately deep. It formed in slope alluvium and residuum derived dominantly from limestone, sandstone, and shale. Typically, the surface layer is grayish brown loam about 14 inches thick. The next layer is brown loam about 5 inches thick. The subsoil is brown heavy clay loam and clay about 8 inches thick. Weathered bedrock is at a depth of 27 inches; however, the depth to weathered bedrock generally ranges from 20 to 40 inches.

The permeability of the Runlett soil is slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 20 to 40 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is high.

Needleton loam

The Needleton soil is very deep. It formed in colluvium and slope alluvium derived dominantly from limestone and sandstone. Typically, the surface is covered with a mat of organic material about 2 inches thick. The surface layer consists of light reddish brown loam about 14 inches thick. The subsurface layer is reddish brown very cobbly sandy clay loam and light reddish brown very cobbly loam about 10 inches thick. The upper part of the subsoil is reddish brown very stony sandy clay loam about 22 inches thick; the lower part is reddish brown very cobbly clay loam extending to 62 inches or more.

The permeability of the Needleton soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Sessions loam

The Sessions soil is very deep. It formed in slope alluvium derived dominantly from sandstone and limestone. Typically, the surface layer is dark grayish brown and grayish brown loam about 11 inches thick. The upper part of the subsoil is brown clay loam about 8 inches thick. The next part is brown clay about 15 inches thick. The lower part of the subsoil is light reddish brown clay about 14 inches thick. The substratum is light reddish brown gravelly clay loam extending to 60 inches or more.

The permeability of the Sessions soil is slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 or more inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this map unit are about 10 percent Heisspitz loam on edges of slope breaks and 10 percent Tamarron loam on mountain slopes. Heisspitz soils are

shallow. Tamarron soils are moderately deep and have more than 35 percent rock fragments in the profile.

Vegetation

The dominant plant association is *Festuca thurberi/Vicia americana-Lathyrus leucanthus*. *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus* occurs in wooded areas. The native vegetation on this unit consists mainly of Thurber's fescue, Letterman's needlegrass, Kentucky bluegrass, mountain brome, and nodding brome. Other important plants that characterize this unit are Parry's danthonia, American vetch, heartleaf arnica, and slender wheatgrass. Subalpine fir, Englemann's spruce, quaking aspen, snowberry, and whortleberry occur in patches and are mainly on the Needleton soil. The average annual production of air-dry vegetation is about 2,500 pounds per acre on the Runlet soil, and about 2,800 pounds per acre on the Sessions soil. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Needleton soil.

Soil Management Implications

This unit is used for livestock grazing, wildlife habitat, and recreation.

The mass movement potential is rated low for this unit.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of rangeland and understory vegetation. More uniform use of rangeland is aided by properly locating salt and by herding.

Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Wildlife such as elk, mule deer, bear, coyotes, hawks, eagles, and blue grouse utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the slope and the slow permeability. The slope limits the areas mainly to paths and trails that should extend across the slope. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

393—Heisspitz-Sessions-Rock outcrop complex, 5 to 15 percent slopes

Map Unit Description

This map unit is a complex of shallow and very deep, well drained soils and Rock outcrop on mountain slopes and structural benches. The elevation is 9,000 to 11,000 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 50 percent Heisspitz loam, 25 percent Sessions loam, 20 percent Rock outcrop, and 5 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Heisspitz loam

The Heisspitz soil is shallow. It formed in colluvium derived dominantly from limestone and sandstone. Typically, the surface layer is brown loam about 9 inches thick. The next layer is brown loam about 5 inches thick. Fractured limestone bedrock

is at a depth of about 14 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Heisspitz soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Sessions loam

The Sessions soil is very deep. It formed in slope alluvium derived dominantly from sandstone and limestone. Typically, the surface layer is dark grayish brown and grayish brown loam about 11 inches thick. The upper part of the subsoil is brown clay loam about 8 inches thick. The next part is brown clay about 15 inches thick. The lower part of the subsoil is light reddish brown clay about 14 inches thick. The substratum is light reddish brown gravelly clay loam extending to 60 inches or more.

The permeability of the Sessions soil is slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Rock outcrop

Rock outcrop consists of exposures of limestone and sandstone bedrock, usually as ledges and as bare rock on structural benches and mountain slopes.

Contrasting Inclusions

Included in this map unit is about 5 percent Runlett loam on structural benches. Runlett soils are moderately deep over limestone or sandstone.

Vegetation

The dominant plant association on this unit is *Festuca thurberi/Vicia americana-Lathyrus leucanthus*. The native vegetation on this unit consists mainly of Thurber's fescue, Letterman's needlegrass, Kentucky bluegrass, mountain brome, and nodding brome. Other important plants that characterize this unit are Parry's danthonia, American vetch, slender wheatgrass, elk sedge, slender cinquefoil, Richardson's geranium, and scattered quaking aspen. The average annual production of air-dry vegetation is about 2,500 pounds per acre on the Heisspitz soil and about 2,800 pounds per acre on the Sessions soil.

This unit is used for livestock grazing, wildlife habitat, and recreation.

The mass movement potential is rated low for this unit because of the slope.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of rangeland vegetation. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Wildlife such as elk, mule deer, coyotes, hawks, and eagles utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the depth to bedrock of the Heisspitz soil, the rock outcrops, and slopes that are over 8 percent. Paths and trails can be developed.

The Heisspitz soil is in capability subclass 6s, nonirrigated. The Sessions soil is in capability subclass 6c, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

394—Clayburn-Heisspitz complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep and shallow, well drained soils on mountain slopes. The elevation is 9,000 to 10,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F., and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 55 percent Clayburn loam, 30 percent Heisspitz loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Clayburn loam

The Clayburn soil is very deep. It formed in slope alluvium derived dominantly from sandstone and shale. Typically, the surface layer is grayish brown and dark grayish brown loam about 13 inches thick. The upper 5 inches of the subsoil are brown light clay loam. The middle part is brown clay loam about 18 inches thick. The lower 12 inches are light brown sandy clay loam. The substratum is light brown sandy clay loam to a depth of 60 inches or more.

The permeability of the Clayburn soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Heisspitz loam

The Heisspitz soil is shallow. It formed in colluvium derived dominantly from limestone and sandstone. The surface layer is brown loam about 9 inches thick. The underlying material is brown loam to a depth of 14 inches. Fractured limestone bedrock is at a depth of 14 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Heisspitz soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Hourglass loam on mountain slopes; 4 percent Runlett loam on structural benches; and small areas of Needleton loam on mountain slopes. Hourglass soils have dark surface layers less than 16 inches thick. Runlett soils are moderately deep over limestone or sandstone. Needleton soils have more than 35 percent rock fragments in the profile. Included soils make up about 15 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Festuca thurberi/Vicia americana-Lathyrus leucanthus*. Some *Populus tremuloides/Symphoricarpos oreophilus* also occurs in quaking aspen groves. The native vegetation on this unit consists mainly of Thurber's fescue, Letterman needlegrass, mountain brome, and nodding brome. Other important plants that characterize this unit are bluegrass, Parry's danthonia, slender wheatgrass, slender cinquefoil, and American vetch. Snowberry and quaking aspen occur in groves. The average annual production of air-dry vegetation is about 2,800 pounds per acre on the Clayburn soil and about 2,500 pounds per acre on the Heisspitz soil.

Soil Management Implications

This unit is used for livestock grazing, wildlife habitat, and recreation.

The mass movement potential is rated low for this unit.

The main limitations to the building of unsurfaced roads on this unit are the depth to bedrock and the low strength. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing.

This unit is well suited to range production. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of rangeland vegetation.

Wildlife such as elk, mule deer, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the depth to bedrock of the Heisspitz soil and the slopes on the unit. It is limited mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

395—Scout silt loam, 10 to 30 percent slopes**Map Unit Description**

This very deep, well drained soil is on mountain slopes and mesas. The elevation is 9,600 to 11,600 feet. The average annual precipitation is 35 to 45 inches. The average annual air temperature is 32 to 38 degrees F., and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description**Scout silt loam**

The Scout soil formed in slope alluvium and colluvium derived from rhyolite. Typically the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is brown silt loam about 1 inch thick. The subsurface layer is light brown very cobbly silt loam about 7 inches thick. The subsoil is brown very cobbly loam about 8 inches thick. The substratum is brownish yellow very cobbly loam to a depth of 61 inches or more.

The permeability of the Scout soil is moderately rapid. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is low, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Frisco loam, small areas of Cryorthents with a cobbly loam surface, and small areas of Rock outcrop, all on mountain slopes. Frisco soils have more clay in the subsoil than the Scout soils. Cryorthents do not have subsoil horizons. Included soils make up about 15 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists of Englemann's spruce,

subalpine fir, whortleberry, mountain brome, sedge, heartleaf arnica, Richardson's geranium, and wheatgrass. The average annual understory production of air-dry vegetation is about 900 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 72 on the Scout soil. It can produce about 65 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 110 years old.

The mass movement potential is rated low for this unit because of the slope and the high content of rock fragments.

The main concerns in producing and harvesting timber are reforestation and road construction in the stony soils. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

This unit is well suited to Englemann's spruce. The main limitation to reforestation is the content of stones. Large stones limit rooting space and soil moisture, and interfere with the planting operations. The high content of rock fragments can make planting of seedlings difficult. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and Lodgepole pine.

The main limitations for building unsurfaced roads on this unit are the stones and cobbles in the soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of vegetation for grazing.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitation is the slope, which limits use of the unit mainly to paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7s, nonirrigated.

396—Scout silt loam, 30 to 60 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 9,600 to 11,600 feet. The average annual precipitation is 35 to 45 inches. The average annual air temperature is 32 to 38 degrees F., and the average frost free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Scout silt loam

The Scout soil formed in slope alluvium and colluvium derived from rhyolite. Typically the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is brown silt loam about 1 inch thick. The subsurface layer is light

brown very cobbly silt loam about 7 inches thick. The subsoil is brown very cobbly loam about 8 inches thick. The substratum is brownish yellow very cobbly loam to a depth of 61 inches or more.

The permeability of the Scout soil is moderately rapid. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Frisco loam on mountain slopes; 5 percent Cryorthents on the steeper slopes; 4 percent Rubble land on the very steep slopes; and small areas of Rock outcrop. Frisco soils have more clay in the subsoil than the Scout soils. Cryorthents consist of mostly rock fragments and lack soil development. Included soils make up about 15 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists of Englemann's spruce, subalpine fir, whortleberry, mountain brome, sedge, heartleaf arnica, Richardson's geranium, and wheatgrass. The average annual understory production of air-dry vegetation is about 900 pounds per acre.

Soil Management Implications

This unit is used for timber production and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 72 on the Scout soil. It can produce about 65 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 110 years old.

The mass movement potential is rated moderate for this unit.

The main concerns in producing and harvesting timber are reforestation, steep slopes and road construction in the stony soils. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitation to reforestation is the content of stones. Large stones limit rooting space and soil moisture, and interfere with the planting operations. The high content of rock fragments can make planting of seedlings difficult. Planting nursery stock will hasten reforestation. Among the trees suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations for building roads on this unit are the slope and the stones and cobbles in the soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitation is the steep slopes, which limit the unit to a few paths and trails that should extend across the slope. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

399—Kite-Rock outcrop complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of shallow or very shallow, well drained soils and Rock outcrop on and mountain slopes. The elevation is 11,000 to 12,000 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 30 to 35 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 40 percent Kite loam, 35 percent Rock outcrop, and 25 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Kite loam

The Kite soil formed in residuum weathered mostly from limestone and sandstone. Typically, the surface layer is dark grayish brown loam about 1 inch thick. The next layer is brown sandy loam about 3 inches thick. The upper part of the subsoil is brown sandy clay loam about 5 inches thick. The next part is dark yellowish brown gravelly sandy loam about 6 inches thick. The lower part of the subsoil is yellowish brown sandy loam extending to 18 inches. Limestone bedrock is at a depth of 18 inches; however, the depth to bedrock generally ranges from 8 to 20 inches.

The permeability of the Kite soil is moderate. The available water capacity is very low. The hydrologic group is C. The effective rooting depth is 8 to 20 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of limestone and sandstone as cliffs, breaks, and escarpments, and as bare rock on structural benches and mountain slopes.

Contrasting Inclusions

Included in this unit are about 15 percent moderately deep Dystrocryepts and about 5 percent Cryorthents, both on mountain slopes; and 5 percent very deep Dystrocryepts on toeslopes. All are deeper than 20 inches to bedrock. Cryorthents lack soil development.

Vegetation

The dominant plant association is *Deschampsia cespitosa*/*Carex spp.*; and *Acomastylis rossii*/*Trifolium sp.*-*Deschampsia cespitosa* occurs in depressional areas. The native vegetation on this unit consists mainly of tufted hairgrass, Ross' avens, alpine fescue, sedge, spreading wheatgrass, American bistort, kobresia, and alpine bluegrass. The average annual production of air-dry vegetation is about 900 pounds per acre.

Soil Management Implications

This unit is used for recreation, wildlife habitat, and limited livestock grazing.

The mass movement potential is rated low for this unit because of the slope and the depth to bedrock.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. More uniform use of rangeland is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, marmots, and pica utilize this unit. Management for wildlife should include protection from overgrazing by livestock, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are rock outcrops, the depth to bedrock, and the slope. The slope limits use of the unit mainly to paths and trails.

The Kite soil is in capability subclass 6e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

450—Lostlake-Rock outcrop complex, 30 to 80 percent slopes

Map Unit Description

This map unit is a complex of shallow or very shallow, well drained soils and Rock outcrop on mountain slopes. The elevation is 9,000 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 45 percent Lostlake loam, 35 percent Rock outcrop, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Lostlake loam

The Lostlake soil formed in residuum and slope alluvium weathered from granite. Typically, the surface is covered with a mat of organic material about 2 inches thick. The surface layer is reddish gray loam about 4 inches thick. The subsoil is light reddish brown gravelly sandy clay loam about 9 inches thick. Granite bedrock is at a depth of 15 inches; however, the depth to bedrock generally ranges from 8 to 20 inches from the mineral soil surface.

The permeability of the Lostlake soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 8 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of granite as cliffs, breaks, escarpments, and as bare rock on structural benches and mountain slopes.

Contrasting Inclusions

Included in this unit are about 15 percent Snowdon very stony loam on mountain slopes and structural benches and 5 percent Needleton stony loam on mountain slopes. Snowdon soils have argillic horizons. Needleton soils are very deep.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium scoparium*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, Rocky Mountain Douglas-fir, and quaking aspen. Other important plants that characterize this unit are whortleberry, nodding brome, Thurber's fescue, bluegrass, elk sedge, currant, Woods' rose, smallflowered woodrush, and snowberry. The average annual understory production of air-dry vegetation is about 650 pounds per acre.

Soil Management Implications

This unit is used for recreation, wildlife habitat, woodland, and limited livestock grazing.

A representative site index for this map unit for Englemann's spruce is 60 on the Lostlake soil. It can produce about 50 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 120 years old.

The mass movement potential is rated low for this unit because of the shallow depth to bedrock.

The main concerns in producing and harvesting timber are steep slopes, shallow soils and Rock outcrops and their effect on road construction and reforestation. Only the less sloping areas should be considered for timber harvesting. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The shallow depth to bedrock can make the planting of seedlings difficult. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations for building unsurfaced roads on this unit are the depth to bedrock, the slope, and rock outcrops. Road construction may be severely limited due to these conditions. Careful planning of road systems will help avoid cuts in the shallow soils and Rock outcrop.

Livestock grazing is severely limited by the steep slopes, rock outcrops, and rock ledges. The slopes limit access by livestock and results in overgrazing of the less sloping areas. Livestock grazing should be managed to protect the unit from excessive erosion.

Wildlife such as elk, mule deer, squirrels, coyotes, bear, blue grouse, and marmots utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this map unit is used for recreational development, the main limitations are rock outcrops, the depth to bedrock, and the steep slopes. The slopes limit use of the unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Lostlake soil is in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

452—Dystrocryepts-Rock outcrop complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of very shallow to very deep, well drained soils and Rock outcrop on high mesas and mountain slopes. The elevation is 11,000 to 13,000 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 28 to 35 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 55 percent Dystrocryepts, 35 percent Rock outcrop, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Dystrocryepts

The Dystrocryepts soil formed in residuum weathered from granite. In a representative profile, the surface layer is brown gravelly sandy clay loam about 1

inch thick. The subsurface layer is light brown gravelly sandy clay loam about 8 inches thick. The subsoil is light brown gravelly sandy clay loam about 8 inches thick. Granite bedrock is at a depth of 17 inches; however, the depth to bedrock generally ranges from 8 to 60 inches or more.

The permeability of the Dystrocryepts soil is moderate. The available water capacity is very low to high. The hydrologic group is C. The effective rooting depth is 8 to 60 inches or more. Runoff is medium to very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of granite bedrock as small knobs and ridges and along drainageways.

Contrasting Inclusions

Included are about 5 percent very shallow soils on ridges and 5 percent wet soils in depressions. Included soils make up about 10 percent of the map unit. The percentage varies from one area to another.

Vegetation

The dominant plant associations are *Deschampsia cespitosa/Carex spp.* and *Acomastylis rossii/Trifolium sp.-Deschampsia cespitosa*. The native vegetation on this unit consists mainly of tufted hairgrass, kobresia, Ross' avens, sedge, and Baker's wheatgrass. Other important plants that characterize this unit are alpine fescue, alpine bluegrass, spreading wheatgrass, and American bistort. The average annual production of air-dry vegetation is about 1,000 pounds per acre.

Soil Management Implications

This unit is used for sheep grazing, recreation, scenic attraction, and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

Livestock grazing is limited by the short growing season. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. More uniform use of rangeland is aided by properly locating salt and by herding. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Loss of the surface layer results in a severe decrease in productivity and in the potential of the soil to produce plants suitable for grazing.

Wildlife such as elk, mule deer, coyotes, marmots, pika, and ptarmigan utilize this unit. Management for wildlife should include protection from overgrazing by livestock, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are rock outcrops, the slope, and the depth to bedrock. Development of this unit is limited mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

The Dystrocryepts soil is in capability subclass 7s, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

453—Sig-Rock outcrop-Snowdon complex, 15 to 45 percent slopes

Map Unit Description

This map unit is a complex of shallow or very shallow, well drained soils and Rock outcrop on mountain slopes and structural benches. The surface of this map unit is

covered with about 1 to 3 percent stones. The elevation is 8,500 to 10,000 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F., and the average frost-free period is 60 to 75 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 40 percent Sig gravelly loam, 30 percent Rock outcrop, 20 percent Snowdon very stony loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Sig gravelly loam

The Sig soil is shallow or very shallow and formed in slope alluvium and colluvium weathered dominantly from granite. Typically, the surface is covered with a litter layer about 2 inches thick. The surface layer is light reddish brown gravelly loam about 7 inches thick. The subsoil is reddish brown very gravelly loam to a depth of 16 inches. Granite bedrock is at a depth of 16 inches; however, the depth to bedrock generally ranges from 8 to 20 inches from the mineral soil surface.

The permeability of the Sig soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 8 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of outcrops of granitic rocks as cliffs, breaks, and knobs.

Snowdon extremely stony loam

The Snowdon soil is shallow and formed in slope alluvium and colluvium weathered dominantly from granite. Typically, the surface is covered with a litter layer about 2 inches thick. The surface layer is light reddish brown extremely stony loam about 4 inches thick. The subsurface layer is pinkish gray very stony sandy loam about 7 inches thick. The subsoil is reddish brown extremely stony sandy clay loam about 7 inches thick. Bedrock is at a depth of 20 inches; however, the depth to bedrock generally ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Snowdon soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Frisco loam on mountain slopes; small areas of Lostlake loam on mountain slopes; small areas of Heisspitz loam on structural benches; and small areas of Quazar extremely cobbly loam on alluvial fans. Frisco and Quazar soils are very deep. Lostlake soils have less than 35 percent rock fragments throughout. Heisspitz soils have dark surface layers. Included areas make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Populus tremuloides/Poa agassizensis*. Some *Pseudotsuga menziesii-Pinus ponderosa/Artemisia tridentata-Juniperus communis* occurs on north slopes. The native vegetation on this unit consists mainly of quaking aspen, Thurber's fescue, Letterman's needlegrass, bluegrass, snowberry, mountain brome, and nodding brome. Other important plants that characterize this unit are spike trisetum, smallflowered woodrush, Oregongrape, kinnikinnick, whortleberry, Fendler's meadow-rue, elk sedge, Richardson's geranium, and slender cinquefoil. Rocky Mountain Douglas-fir, white fir, ponderosa pine, Englemann's spruce, and subalpine fir occur as isolated trees or in small patches. The average annual

understory production of air-dry vegetation is about 800 pounds per acre on the Sig soil, and about 500 pounds per acre on the Snowdon soil.

Soil Management Implications

This unit is used for woodland, wildlife habitat, livestock grazing, and recreation.

A representative site index for this map unit for quaking aspen is 46 on the Sig soil. It can produce about 21 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 70 years old.

The mass movement potential is rated low for this unit because of the shallow depth to bedrock.

This map unit is generally not suited for commercial timber production although some quaking aspen areas could be used. The main concerns in producing and harvesting timber are reforestation and road construction due to the shallow depth to bedrock and Rock outcrop.

The main limitations to reforestation on this unit are the shallow depth to bedrock and the stones. The high content of rock fragments can make the planting of seedlings difficult. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, lodgepole pine and Rocky Mountain Douglas-fir. Quaking aspen will usually regenerate from roots after harvest.

The main limitations to the building of unsurfaced roads on this unit are rock outcrops and the shallow depth to bedrock.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of vegetation suitable for grazing. Any reseeding is limited to broadcasting because of the content of stones, the shallow soil, and steep slopes. Mechanical treatment practices are not practical, because the surface is stony and the slopes are steep.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the depth to bedrock, rock outcrops, stones, and the steep slopes. Development of the unit is limited mainly to paths and trails.

The Sig and Snowdon soils are in capability subclass 7s, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

454—Snowdon-Sig-Rock outcrop complex, 15 to 45 percent slopes

Map Unit Description

This map unit is a complex of shallow or very shallow, well drained soils and Rock outcrop on mountain slopes. The surface of this unit is covered with 1 to 3 percent stones. The elevation is 9,000 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F., and the average frost-free period is 60 to 75 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 35 percent Snowdon very cobbly loam, 30 percent Sig gravelly loam, 25 percent Rock outcrop, and 10 percent included soils. The

components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Snowdon very cobbly loam

The Snowdon soil is shallow and formed in slope alluvium and colluvium weathered dominantly from granite. Typically, the surface is covered with a litter layer about 2 inches thick. The surface layer is light reddish brown very cobbly loam about 4 inches thick. The subsurface layer is pinkish gray extremely stony sandy loam about 7 inches thick. The subsoil is reddish brown extremely stony sandy clay loam about 7 inches thick. Bedrock is at a depth of 20 inches; however, the depth to bedrock generally ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Snowdon soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Sig gravelly loam

The Sig soil is shallow or very shallow and formed in slope alluvium and colluvium weathered dominantly from granite. Typically, the surface is covered with a litter layer about 2 inches thick. The surface layer is light reddish brown gravelly loam about 7 inches thick. The subsoil is reddish brown very gravelly loam to a depth of 16 inches. Granite bedrock is at a depth of 16 inches; however, the depth to bedrock generally ranges from 8 to 20 inches from the mineral soil surface.

The permeability of the Sig soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 8 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of rock on cliffs, breaks, and knobs.

Contrasting Inclusions

Included in this unit are about 5 percent moderately deep soils on mountain slopes; small areas of Hourglass loam on toeslopes; and small areas of Lostlake loam on structural benches. Hourglass soils are very deep. Lostlake soils have less than 35 percent rock fragments in all layers. Included areas make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. Some *Populus tremuloides/Symphoricarpos oreophilus* may also occur on south slopes and in drainageways. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, quaking aspen, whortleberry, and mountain brome. Other important plants that characterize this unit are Letterman's needlegrass, Thurber's fescue, Kentucky bluegrass, snowberry, smallflowered woodrush, Oregongrape, kinnikinnick, heartleaf arnica, elk sedge, Richardson's geranium, spike trisetum, and twinflower. The average annual understory production of air-dry vegetation is about 500 pounds per acre on the Snowdon soil, and about 400 pounds per acre on the Sig soil.

Soil Management Implications

This unit is used for timber production, wildlife habitat, limited livestock grazing, and recreation.

A representative site index for this map unit for Englemann's spruce is 70 on the Snowdon soil. It can produce about 63 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 110 years old.

The mass movement potential is rated low for this unit because of the shallow depth to bedrock.

The main concerns in producing and harvesting timber are reforestation and road construction on the shallow soils and Rock outcrop. Conventional methods of harvesting timber can be used. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt and high rainfall.

The main limitations to reforestation on this unit are the shallow depth to bedrock and the content of stones. The high content of rock fragments can make the planting of seedlings difficult. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations to the building of unsurfaced roads on this unit are the shallow depth to bedrock and the Rock outcrop.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of vegetation suitable for grazing. Any reseeding is limited to broadcasting because of the content of stones, the shallow soils, and steep slopes. Mechanical treatment practices are not practical, because the surface is stony and the slopes are steep.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the rock outcrops, the depth to bedrock, the content of stones, and steep slopes. The slopes limit use of the unit mainly to a few paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Snowdon and Sig soils are in capability subclass 7s, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

493—Badland

Badland is moderately steep to very steep barren lands dissected by many intermittent drainage channels on eroded uplands. These areas are formed by active geologic erosion of soft, multicolored, sedimentary beds consisting of shale and sandstone. The elevation is 6,500 to 8,000 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 43 to 45 degrees F., and the average frost-free period is 80 to 120 days. The slopes are 10 to 120 percent.

This map unit consists of 90 percent barren knolls, ridges, and side slopes. Another 10 percent of this unit includes soils that range from very shallow to very deep. The very deep soil occurs in narrow drainageways and support sparse vegetation such as greasewood and shadscale.

Runoff is very rapid, and the hazard of water erosion is severe.

This map unit is used for wildlife habitat; however, the suitability for all wildlife is very poor on this unit. This unit provides very limited habitat for mule deer, rabbits, rodents, and raptors.

This map unit is severely limited for all other uses.

This map unit is in capability subclass 8e, nonirrigated. No range site has been assigned.

494—Pits, Gravel

This map unit consists of very deep, somewhat excessively drained areas that have been excavated for gravel. They are on mountain slopes and mesas. The remaining material consists of sand, gravel, cobbles, and stones primarily alluvium from volcanic and igneous rocks. The elevation ranges from 7,500 to 10,000 feet. Average annual precipitation ranges from 15 to 35 inches, the average annual air temperature is 35 to 50 degrees F., and the frost-free period is 50 to 100 days. The slope ranges from 3 to 50 percent.

Included in this unit is about 5 percent loamy soils.

Vegetation

There is little or no vegetation except what has been planted in reclamation and in small areas of inclusions. The small amount of native vegetation that occurs consists of mountain brome, Arizona fescue, and bluegrass.

Soil Management Implications

This map unit is used for gravel excavation and limited wildlife habitat.

Most reclaimed areas have been reseeded to native grasses.

This map unit is in capability subclass 8s, nonirrigated.

495—Riverwash

This map unit consists of poorly drained undifferentiated sand, gravel, and cobbles on flood plains and alluvial valley floors of major drainageways. It consists primarily of water-worn rock material derived from volcanic and igneous rocks. It has a high water table throughout the year and is subject to frequent flooding, mainly in the spring. The slope ranges from 0 to 3 percent. The elevation ranges from 8,300 to 10,500 feet. Average annual precipitation ranges from 18 to 30 inches. Average annual air temperature ranges from 34 to 38 degrees F., and the frost-free season ranges from 40 to 70 days.

Included in this map unit are small areas of Fluvaquents and small areas of Cryaquolls.

Vegetation

There is little or no vegetation on this unit. The small amount of vegetation that occurs consists of willows and cottonwood trees and water-tolerant grasses and sedges on inclusions in the map unit.

Soil Management Implications

This map unit is used for wildlife habitat and as a source of construction materials. It is a good source of sand and gravel.

The hazard of flooding is a severe limitation for road building and most engineering uses of this unit.

Wildlife such as raptors, hawks, and waterfowl utilize this unit. It provides concealment and nesting areas for some species.

This map unit has severe limitations for recreational uses due to the content of rock fragments and the hazard of flooding.

This map unit is in capability subclass 8w, nonirrigated.

496—Rock outcrop

This map unit consists of exposures of Rock outcrop on cliffs, breaks, escarpments, hills, ridges, steep mountain peaks, and mountain slopes. The rock is predominately rhyolite, tuff and similar volcanic rocks, sandstone, limestone, granite, and schist. The elevation ranges from 8,300 to 14,246 feet. Average annual precipitation ranges from 25 to 60 inches. Average annual air temperature ranges from 26 to 38 degrees F., and the frost-free season ranges from 20 to 75 days.

Included in this unit are about 20 percent Rubble land and 10 percent small areas of shallow and very shallow soils over bedrock. Inclusions make up about 30 percent of the map unit; the percentage varies from one area to another.

Vegetation

Native vegetation is sparse and occurs on the small areas of inclusions and in cracks and fissures in bedrock. It varies largely with elevation and consists mostly of alpine grasses and forbs above timberline; and Englemann's spruce, subalpine fir, quaking aspen, Rocky Mountain Douglas fir, shrubs, and grasses at lower elevations.

Soil Management Implications

This map unit is used for wildlife habitat, recreation, scenic attraction, watershed, and construction materials.

Outcrops of rock, cliffs, and steep slopes are severe limitations for road construction and other engineering uses of this unit. Some of the more accessible areas of this unit are used as a source of construction materials for road building.

Wildlife such as marmots, eagles, hawks, pika, squirrels, mountain goats, and bears use this unit. It provides concealment and nesting areas for many species. They obtain food from inclusions and nearby soils.

This map unit has severe limitations for most recreational uses but offers many opportunities for mountain climbing and hiking at high elevations. It is important for its scenic attraction.

This map unit is in capability subclass 8s, nonirrigated.

497—Rubble land

This map unit consists of exposures of slide rock and other rock material formed on moderately steep to very steep mountain slopes, at the base of cliffs and ridges, in alpine valleys, and in cirque basins. It consists primarily of rock material ranging in size from gravel to boulders. It is predominately rhyolite, tuff, and similar volcanic rocks although a few areas contain granite, schist or sandstone. The slope ranges from 15 to 100 percent or more. The elevation ranges from 8,300 to 14,000 feet. Average annual precipitation ranges from 25 to 60 inches. Average annual air temperature ranges from 26 to 38 degrees F., and the frost-free season ranges from 20 to 70 days.

Included in this unit are about 10 percent Rock outcrop and small areas of Henson very gravelly loam and Varden stony loam.

Vegetation

Native vegetation is sparse and occurs mostly on small areas of inclusions. It varies largely with elevation and consists mostly of alpine grasses and forbs above timberline; and quaking aspen, Englemann's spruce, subalpine fir, Rocky Mountain Douglas fir, shrubs, and grasses at lower elevations.

Soil Management Implications

This map unit is used for wildlife habitat, recreation, scenic areas, water catchment areas, and construction materials.

Poor stability, the content of stones, and the slopes are severe limitations for road construction and other engineering uses of this unit. Some of the more accessible areas of this unit are used as a source of construction materials for road building.

Wildlife such as marmots, eagles, hawks, pika, and squirrels use this unit. It provides concealment and nesting areas for many species. They obtain food from inclusions and nearby soils.

This map unit has severe limitations for most recreational uses.

This map unit is in capability subclass 8s, nonirrigated.

498—Slickens

This map unit consists of mill tailings on toeslopes of mountains. The material consists of finely ground rock and debris primarily from volcanic and igneous rocks. The texture ranges from fine sand to clay. The elevation ranges from 9,300 to 9,800 feet. Average annual precipitation ranges from 25 to 30 inches, the average annual air temperature is 35 to 38 degrees F., and the frost-free period is 40 to 50 days. The slope ranges from 3 to 50 percent.

Included in this unit is about 20 percent Rubble land. Some areas have been covered with other soil material in reclamation.

Vegetation

There is little or no vegetation except what has been planted in reclamation. The small amount of native vegetation that occurs consists of willows along the bottom edge of the mill tailings, and a few trees and grasses along the top edge of the tailings.

Soil Management Implications

This map unit is used for limited wildlife habitat.

Most reclaimed areas have been reseeded to native grasses and shrubs.

This map unit is in capability subclass 8s, nonirrigated.

499—Water

This map unit consists of bodies of water, such as lakes and reservoirs.

500—Dolores-Fivepine complex, 0 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep and shallow, well drained soils on mesas and hills. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 41 to 45 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 50 percent Dolores loam, 35 percent Fivepine flaggy loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Dolores loam

The Dolores soil is very deep. It formed in slope alluvium derived dominantly from sandstone. Typically, the surface has a layer of organic material about 1 inch thick. The surface layer is reddish brown loam about 7 inches thick with 1 to 3 percent stones on the surface. The upper part of the subsoil is reddish brown to yellowish red

extremely bouldery clay loam about 16 inches thick. The next part is yellowish red extremely stony clay about 25 inches thick. The lower part of the subsoil is brown extremely stony clay to a depth of 61 inches or more.

The permeability of the Dolores soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Fivepine flaggy loam

The Fivepine soil is shallow. It formed in residuum and slope alluvium derived dominantly from sandstone. Typically, the surface layer is reddish brown flaggy loam about 3 inches thick with 1 to 3 percent flags on the surface. The upper 9 inches of the subsoil are reddish brown flaggy clay loam, and the lower 3 inches are yellowish red flaggy clay. Hard fractured sandstone is at a depth of 15 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Fivepine soil is slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 5 percent Fughes loam in drainageways and on hillslopes; 5 percent Granath loam on mesas and hillslopes; and 5 percent Nortez soils on mesas and hillslopes. Fughes and Granath soils are very deep and have less than 35 percent rock fragments in the control section. Nortez soils are moderately deep.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation consists mainly of ponderosa pine, Gambel oak, Arizona fescue, prairie Junegrass, western wheatgrass, and mountain muhly. Other common plants that characterize this unit are bluegrass, elk sedge, mountain brome, nodding brome, pine dropseed, bottlebrush squirreltail, common snowberry, Utah serviceberry, and Woods' rose. The average annual understory production of air-dry vegetation is about 1,200 pounds per acre on the Dolores soil, and about 800 pounds per acre on the Fivepine soil.

Soil Management Implications

This unit is used mainly for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 60 on the Dolores soil. It can produce about 46 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope.

Timber productivity is estimated to be moderate. Conventional methods of harvesting timber generally can be used. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. Thinning the overstory generally enhances reproduction and promotes the growth of grass and younger trees. Harvesting some of the mature trees for lumber and thinning dense stands of younger trees for use as poles increases the growth rate of the rest of the stand and increases the understory vegetation.

The main limitations to reforestation on this unit are the large stones and the depth to bedrock. Large stones limit rooting space and soil moisture, and interfere with planting operations. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees.

Hand planting of nursery stock is usually necessary to establish or improve a stand. Trees suitable for planting are ponderosa pine.

The main limitations to the building of unsurfaced roads on this unit are the large stones and the depth to bedrock. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills. Grazing in harvested areas should be deferred for at least 2 years to assure development of sufficient plant cover to protect the soil from erosion.

Most areas of this unit are used for livestock grazing. More uniform distribution of grazing is aided by properly locating stock water development and salt, and by fencing and herding. If the range and understory vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the large stones and the depth to bedrock. Seeding late in fall helps to ensure that soil moisture will be adequate to establish seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the stones on the surface, the slow permeability, and the depth to bedrock of the Fivepine soil. Paths and trails can be developed.

This map unit is in capability subclass 7s, nonirrigated.

501—Fivepine-Nortez complex, 0 to 15 percent slopes

Map Unit Description

This map unit is a complex of shallow to moderately deep, well drained soils on mesas and hills. The elevation is 7,100 to 8,500. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 41 to 45 degrees F, and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This unit consists of 60 percent Fivepine flaggy loam, 25 percent Nortez loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Fivepine flaggy loam

The Fivepine soil is shallow. It formed in residuum and slope alluvium derived dominantly from sandstone. It has about 1 to 3 percent flagstones on the surface. Typically, the surface layer is reddish brown flaggy loam about 3 inches thick. The upper 9 inches of the subsoil are reddish brown flaggy clay loam, and the lower 3 inches are yellowish red flaggy clay. Hard fractured sandstone is at a depth of 15 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Fivepine soil is slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Nortez loam

The Nortez soil is moderately deep. It formed in eolian material derived dominantly from sandstone. Typically, the surface layer is reddish brown loam about 3 inches thick. The next layer is reddish brown clay loam about 7 inches thick. The subsoil is

yellowish red clay loam about 22 inches thick over bedrock. Hard sandstone is at a depth of 32 inches. The depth to bedrock ranges from 20 to 40 inches.

The permeability of the Nortez soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 5 percent Rock outcrop on eroded areas and the edges of mesas; 5 percent Fivepine loam on hills and mesas with less rock fragments on the surface; and 5 percent Granath loam on hills. Granath soils are very deep.

Vegetation

The dominant plant associations are *Pinus ponderosa/Quercus gambelii* in the wooded areas and *Quercus gambelii/Symphoricarpos oreophilus* in open areas. The native vegetation consists mainly of ponderosa pine, Gambel oak, Arizona fescue, western wheatgrass, prairie Junegrass and common snowberry. Other plants that characterize this unit are Parry's danthonia, mountain brome, nodding brome, pine dropseed, mountain muhly, bluegrass, needleandthread, bottlebrush squirreltail, Utah serviceberry, antelope bitterbrush, Rocky Mountain juniper, and mountain big sagebrush. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Fivepine soil, and about 1,200 pounds per acre on the Nortez soil.

Soil Management Implications

This unit is used for limited timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 67 on the Fivepine soil. It can produce about 52 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concerns in producing and harvesting timber are reforestation and road construction due to the shallow depth to bedrock in the Fivepine soil. Conventional harvesting methods can be used. Timber productivity is estimated to be low.

Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult. After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Trees that are suitable for planting are ponderosa pine.

The main limitations to building unsurfaced roads on this unit are the depth to bedrock and the large stones. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to insure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the depth to bedrock of the Fivepine soil, the content of stones, and slopes that are over 8 percent. Paths and trails can be developed.

The Fivepine soil is in capability subclass 7s, nonirrigated. The Nortez soil is in capability subclass 4e, nonirrigated.

503—Ormiston-Fivepine complex, 0 to 15 percent slopes

Map Unit Description

This map unit is a complex of deep and shallow, well drained soils on mesas and hills. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 41 to 45 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 50 percent Ormiston loam, 35 percent Fivepine flaggy loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Ormiston loam

The Ormiston soil is deep. It formed in slope alluvium and eolian material derived dominantly from sandstone. Typically, the surface layer is brown loam about 7 inches thick with 1 to 3 percent stones on the surface. The upper part of the subsoil is reddish brown very stony heavy clay loam about 17 inches thick; the lower part is reddish brown stony clay loam about 8 inches thick. The substratum is pinkish white stony clay loam about 12 inches thick. Sandstone bedrock is at a depth of 44 inches; however, the depth to bedrock generally ranges from 40 to 60 inches.

The permeability of the Ormiston soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 40 to 60 inches. Runoff is very high and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Fivepine flaggy loam

The Fivepine soil is shallow. It formed in residuum and slope alluvium derived from sandstone. Typically, the surface layer is reddish brown flaggy loam about 3 inches thick with 1 to 3 percent flags on the surface. The upper 9 inches of the subsoil are reddish brown flaggy clay loam, and the lower 3 inches are yellowish red flaggy clay. Hard fractured sandstone is at a depth of 15 inches. The depth to bedrock ranges from 10 to 20 inches.

The permeability of the Fivepine soil is slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 5 percent Fughes loam in drainageways and on hillslopes; 5 percent Granath loam on mesas and hillslopes; and 5 percent Nortez soils on mesas and hillslopes. Fughes and Granath soils are very deep and have less than 35 percent rock fragments in the control section. Nortez soils are moderately deep.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation consists mainly of ponderosa pine, Gambel oak, prairie Junegrass, western wheatgrass, and mountain brome. Other common plants that characterize this unit are nodding brome, pine dropseed, mountain muhly, bottlebrush squirreltail,

bluegrass, Woods' rose, Utah serviceberry, common snowberry, and Rocky Mountain juniper. The average annual understory production of air-dry vegetation is about 1,200 pounds per acre on the Ormiston soil, and about 800 pounds per acre on the Fivepine soil.

Soil Management Implications

This unit is used mainly for timber production, livestock grazing, and wildlife habitat

A representative site index for this map unit for ponderosa pine is 60 on the Ormiston soil. It can produce about 46 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old. The average canopy cover ranges from 30 to 55 percent of the overstory and 40 to 60 percent for the understory.

The mass movement potential is rated low for this unit because of the slope.

Timber productivity is estimated to be moderate. Conventional methods of harvesting timber generally can be used. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. Thinning the overstory generally enhances reproduction and promotes the growth of grass and younger trees. Harvesting some of the mature trees for lumber and thinning dense stands of younger trees for use as poles increases the growth rate of the rest of the stand and increases the understory vegetation.

The main limitations to reforestation on this unit are the large stones and the depth to bedrock. Large stones limit rooting space and soil moisture, and interfere with planting operations. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Hand planting of nursery stock is usually necessary to establish or improve a stand. Trees suitable for planting are ponderosa pine.

The main limitations to the building of unsurfaced roads on this unit are the large stones and the depth to bedrock. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills. Grazing in harvested areas should be deferred for at least 2 years to assure development of sufficient plant cover to protect the soil from erosion.

Most areas of this unit are used for livestock grazing. More uniform distribution of grazing is aided by properly locating stock water development and salt, and by fencing and herding. If the range and understory vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the large stones and the depth to bedrock. Seeding late in fall helps to ensure that soil moisture will be adequate to establish seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the stones on the surface, the slow permeability, and the depth to bedrock of the Fivepine soil. Paths and trails can be developed.

This map unit is in capability subclass 7s, nonirrigated.

504—Jemco-Detra-Beje complex, 1 to 15 percent slopes

Map Unit Description

This map unit is a complex of shallow to deep, well drained soils on mesas, hills, and ridges. The elevation is 7,800 to 8,500 feet. The average annual precipitation is 18 to 22 inches and the mean annual air temperature is 41 to 45 degrees F. The frost-

free period is 80 to 100 days. The soil moisture and temperature regimes are ustic and frigid, respectively.

The unit consists of 40 percent Jemco silt loam, 30 percent Detra loam, 20 percent Beje loam, and 10 percent included soils. The components of this map unit are so intricately intermingled that it was not practical to separate them at the scale used.

Brief Soil Description

Jemco silt loam

The Jemco soil is moderately deep. It formed in eolian material over residuum derived dominantly from sandstone. Typically the surface is brown silt loam about 7 inches thick. The subsurface layer is light reddish brown loam 7 inches thick. The upper 8 inches of subsoil are brown loam. The next part of the subsoil is reddish brown clay loam 13 inches thick. The lower part of the subsoil is yellowish red clay loam about 4 inches thick. Hard fractured sandstone bedrock is at a depth of 39 inches; however, the depth to bedrock generally ranges from 20 to 40 inches. Rock fragments range from 0 to 5 percent.

The permeability of the Jemco soil is moderately slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

This soil is found throughout the mapping unit and is associated most frequently with undulating micro relief of hummocks.

Detra loam

The Detra soil is deep. It formed in eolian materials and slope alluvium over residuum derived from sandstone and shale. It has eolian deposition resulting in a hummocky surface, usually in areas where shrubs are thickest. Typically, the surface layer is dark brown loam about 16 inches thick. The upper 14 inches of the subsoil are brown loam. The middle part of the subsoil is light reddish brown clay loam about 13 inches thick. The lower 8 inches are reddish brown clay loam. The substratum is yellowish red sandy clay loam about 6 inches thick over bedrock. The depth to bedrock ranges from 40 to 60 inches.

The permeability of the Detra soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 40 to 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low. In many places the topsoil has accumulated in clumps of brush making the topsoil thicker and giving the landform a hummocky surface. The potential of shrink-swell is low.

Beje loam

The Beje soil is shallow. It formed in slope alluvium and residuum derived dominantly from sandstone. The surface is slightly eroded in places. Typically the surface is brown loam about 6 inches thick. The subsoil is brown clay loam about 8 inches thick. Hard fractured sandstone bedrock is at about 14 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Beje soil is moderately slow. The available water-holding capacity is very low. The effective rooting depth is 10 to 20 inches. The hydrologic group is D. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

There are 5 percent inclusions of soils with less development than the major components along the edges of swales; and about 5 percent inclusions of soils with thicker dark surface horizons, usually in the larger hummocks. These inclusions are throughout the map unit.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation consists mainly of ponderosa pine, Gambel oak, Arizona fescue, common snowberry, and western wheatgrass. Other important plants that characterize this unit are Saskatoon serviceberry, Oregon grape, Kentucky bluegrass, bottlebrush squirreltail, prairie Junegrass, needleandthread, mountain muhly, bluegrass, mountain brome, black sagebrush, and Rocky Mountain juniper. Some small pockets of quaking aspen occur, usually in low areas. The average annual understory production of air-dry vegetation is about 900 pounds per acre on the Jemco soil, about 1,400 pounds per acre on the Detra soil, and about 1,300 pounds on the Beje soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and recreation.

A representative site index for this map unit for ponderosa pine is 74 on the Jemco soil. It can produce about 60 cubic feet of timber per acre per year from a fully stocked stand of even aged trees 50 years old. Ponderosa pine usually grows in sparse stands on the Beje soil.

The mass movement potential is rated low for this unit because of the slope.

The major limitations to producing and harvesting timber on these soils are the poor stocking and the low to moderate regeneration potential. This is primarily due to low moisture-holding capacity in the Beje soil and to plant competition from shrubs. Disturbance of the thin surface horizons on the Beje soil may cause excessive compaction and erosion. Conventional harvesting methods can be used.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Planting nursery stock will hasten reforestation. Trees that are suitable for planting are Ponderosa pine.

The main limitation to the building of unsurfaced roads on this unit is the shallow depth to bedrock in the Beje soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to insure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of understory vegetation. If the condition of the understory deteriorates, Gambel oak increases. Areas where brush is managed by prescribed burning, chemical or mechanical methods may be subject to a greater hazard of erosion. If the vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the shallow depth to bedrock in the Beje soil and slopes that are over 8 percent. Paths and trails can be developed.

The Jemco and Detra soils are in capability subclass 4e, nonirrigated. The Beje soil is in capability subclass 6s, nonirrigated.

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