USDA United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with the Arizona Agricultural Experiment Station

Soil Survey of Navajo County Area, Arizona, Central Part

How to Use This Soil Survey

General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

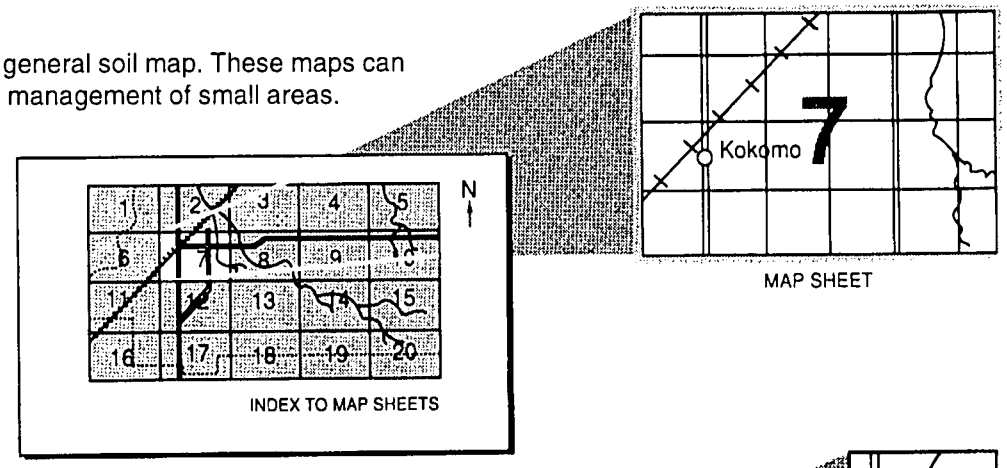
Detailed Soil Maps

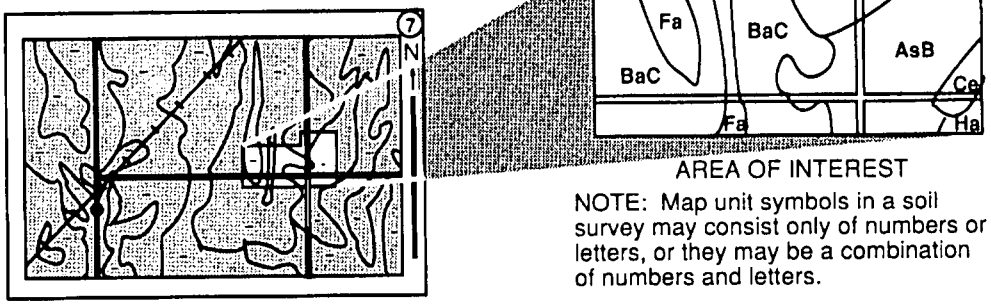
The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

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

Locate your area of interest on the map sheet. Note the map units 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 **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.





NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

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 1987. Soil names and descriptions were approved in 1994. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1987. This survey was made cooperatively by the Natural Resources Conservation Service and the Arizona Agricultural Experiment Station. It is part of the technical assistance furnished to the Navajo County Natural Resource Conservation District.

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

Cover: An area of Badland-Torriorthents association, 1 to 30 percent slopes, in the Painted Desert.

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Issued 2003

Summary of Tables

Foreword

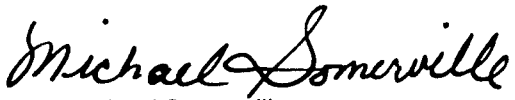
This soil survey contains information that affects land use planning in this survey area. It contains predictions of soil behavior for selected land uses. The survey also highlights soil limitations, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

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



Michael Somerville
State Conservationist
Natural Resources Conservation Service

Soil Survey of Navajo County Area, Arizona, Central Part

By Alfred A. DeWall, Natural Resources Conservation Service

Fieldwork by Alfred A. DeWall, Robert J. Ahrens, Gregg W. Schellentrager, Dal L. Ames, and Tim Wheeler, Natural Resources Conservation Service

United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with the
Arizona Agricultural Experiment Station

The survey area is in the central part of Navajo County in northeastern Arizona (fig. 1). It is bounded on the north by the Navajo Nation, on the east by Apache County, on the west by Coconino County, and on the south by U.S. Forest Service administered land.

General Nature of the Survey Area

This section gives general information about the survey area. It describes history and development and climate.

History and Development

Garnette Franklin, president, Navajo County Historical Society, prepared this section.

Millions of years ago, dinosaurs lived and died in this area, as shown by the many well preserved fossilized bones that have been found embedded in the mudstone and sandstone of the Chinle Formation. About 15,000 years ago, humans came to this continent and settled, evolving into the Hohokam and the Anasazi Indians (Weaver 1982).

Some of the earliest recorded evidence of human influence in this area is found in the prehistoric Indian sites along the Little Colorado River. These sites existed from A.D. 600 to 1400. Evidence of dams, canals, and terraces indicates that farming was probably practiced. The reason that the Indians began to leave the area in the late 1300's remains a mystery.

The Spanish were the first modern humans to reach this area. They were in search of the Seven Cities of Cibolo. They looked in vain for these cities of gold and were eventually repulsed by the Pueblo Indians.

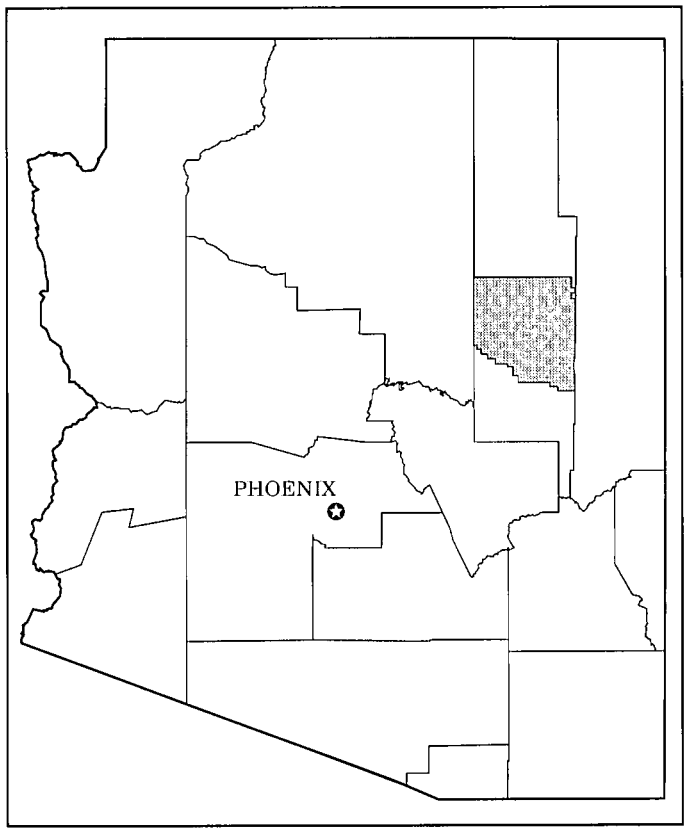


Figure 1.—Location of the survey area in Arizona.

Trappers and explorers traveled along the 35th parallel directly through the area that is now Holbrook on their way

across the continent. In 1852, the U.S. Government sent Captain Lorenzo Sitgreaves and a party on a reconnaissance along this route. A year later, Lieutenant A.W. Whipple of the Corps of Topographical Engineers was selected to head an expedition to explore and report on all land lying adjacent to the 35th parallel. In 1857, Lieutenant Edward F. Beale accepted a commission to lay out a wagon road along this reasonably accessible trail. This expedition was unique in that Beale used camels. All of these parties reported that the valley of the Little Colorado River was fertile with abundant grama grasses and plenty of water (Wayte).

Up to this time, the environment was little affected by human occupation and migration. This fact changed with the arrival of the railroad in 1881. The Atlantic and Pacific Railroad reached Holbrook and quickly became important for shipping to the south and east. Holbrook became the supply center for the outlying towns settled by Mormon pioneers and the Navajo, Hopi, and Apache Reservations to the north and south.

In order to defray expenses, the railroad sold every other section of land along the right-of-way. These sections were eagerly bought and used for ranching. With plenty of water and grass in the Little Colorado River valley, cattle inevitably were brought in to feed and grow fat for shipping to market. Sixty thousand head of cattle were shipped from Holbrook during those years. By 1900, the lush grass supply was depleted. The land is now sparsely covered with many undesirable plants. Although cattle are still raised in this area, it is no longer considered an agricultural paradise. Overgrazing has taken its toll.

In the 1970's, the water table dropped drastically because of the accelerated, increased use of ground water for the manufacture of electricity. Many of the old cottonwood trees died. They could not reseed themselves because of the lack of accessible water.

Interstate 40 bypasses Holbrook, Joseph City, and Winslow. Old Route 66 used to pass through these communities. Once known as the "Hub City," Holbrook is still the center of scenic attractions. It has the Old Navajo County Court House, which is now a museum (Doyle). The Petrified Forest National Park is just east of Holbrook. Many people from around the world tour the park and visit the museum. The new Navajo County Government Complex is 2 miles south of Holbrook.

Climate

In the central part of Navajo County, summers are hot, especially at the lower elevations, and winters are cold. Precipitation normally is light at the lower elevations during all months of the year, and land is used mainly for livestock grazing. At the higher elevations, precipitation is much heavier and snow can accumulate.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Winslow and Snowflake, Arizona, in the period 1901 to 1993 and at Holbrook, Arizona, in the period 1903 to 1993. 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 is 35.1 degrees at Winslow, 35.4 degrees at Holbrook, and 34.3 degrees at Snowflake. The average daily minimum temperature is 21.6 degrees at Winslow, 20.3 degrees at Holbrook, and 18.3 degrees at Snowflake. The lowest temperature on record, which occurred at Snowflake on January 7, 1971, is -29 degrees. In summer, the average temperature is 75 degrees at Winslow, 74.2 degrees at Holbrook, and 70 degrees at Snowflake. The average daily maximum temperature is 91.3 degrees at Winslow, 92.1 degrees at Holbrook, and 88.2 degrees at Snowflake. The highest recorded temperature, which occurred at Winslow on July 13, 1971, is 109 degrees.

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

The total annual precipitation is 12.5 inches at Snowflake, 8.6 inches at Holbrook, and 8.1 inches at Winslow. Of this, 60 percent usually falls in April through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall during the period of record was 2.74 inches at Snowflake on August 28, 1951. Thunderstorms occur on about 51 days each year.

The average seasonal snowfall is 12 inches at Winslow, 5 inches at Holbrook, and 18 inches at Snowflake. The greatest snow depth at any one time during the period of record was 9 inches at Holbrook, 30 inches at Snowflake, and 29 inches at Winslow. On the average, 2 days at Holbrook, 5 days at Snowflake, and 7 days at Winslow have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 40 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The sun shines 80 percent of the time possible in summer and 70 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 9 miles per hour, in spring.

Every few years a blizzard strikes the area with high winds and drifting snow. Even at the lower elevations, snow remains on the ground for many weeks and livestock suffer.

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 or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, 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.

Individual soils on the landscape commonly merge into one another as their characteristics gradually change. To construct an accurate 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 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 interpreted 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 better knowledge of soils, modifications in series concepts or variations in the intensity of mapping or in the extent of the soils in the survey areas.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a

characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

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

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

General Soil Map Units

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

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

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

The general soil map units in this survey have been grouped for broad interpretive purposes. Each of the broad groups and the map units in each group are described on the following pages.

Soil Descriptions

Arid Soils on Flood Plains, Alluvial Fans, and Stream Terraces

This group consists of two map units. It makes up 15.3 percent of the survey area. The soils in this group are nearly level to gently sloping. The vegetation in uncultivated areas is mainly streamside trees, shrubs, and grasses. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is about 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

The soils in this group are very deep. They are well drained to poorly drained. They formed in mixed alluvium and eolian material derived dominantly from sandstone and mudstone.

This group is used for irrigated cropland, homesite development, livestock grazing, recreation, and wildlife habitat.

1. Tours-Jocity-Navajo

Very deep, well drained to poorly drained, nearly level to gently sloping, silty, loamy, and clayey soils; on flood plains, playas, and alluvial fans

This map unit is along the Little Colorado and Puerco Rivers and the major intermittent streams that feed these rivers. Slopes range from 0 to 3 percent. The vegetation in uncultivated areas is dominantly riparian. Cottonwood, willow, and saltcedar trees with an understory of western wheatgrass, Indian ricegrass, bottlebrush squirreltail, and sand dropseed are typical plants along perennial streams. Alkali sacaton, inland saltgrass, bermuda grass, and cattail dominate wet areas. Alluvial fans and dry areas of the flood plains support alkali sacaton, galleta, blue grama, and Indian ricegrass. The vegetation has a brushy appearance because of fourwing saltbush, black greasewood, and mound saltbush. Vegetation is limited by excess salt. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is about 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit makes up 7.3 percent of the survey area. It is about 19 percent Tours soils, 16 percent Jocity soils, and 15 percent Navajo and similar soils. The remaining 50 percent is components of minor extent.

Tours soils are on flood plains and alluvial fans. They are very deep and well drained. They formed in mixed alluvium. These soils are silty throughout and extend to a depth of 60 inches or more. These soils have a medium to high salinity and a moderate sodium hazard.

Jocity soils are on flood plains and alluvial fans. These soils are very deep and well drained. They formed in mixed alluvium derived from sandstone and mudstone. These soils are loamy throughout and extend to a depth of 60 inches or more. They have a medium to high salinity and a moderate sodium hazard.

Navajo and similar soils are on flood plains, playas, and alluvial fans. These soils are very deep. They are well drained to poorly drained. In a few areas a seasonal high water table fluctuates between above ground during July

through September and a depth of 60 inches or more, but it is generally at a depth of 24 to 36 inches most of the year. These soils formed in mixed alluvium derived from sandstone and mudstone. They are clayey throughout and extend to a depth of 60 inches or more. They have a medium to high salinity and a moderate sodium hazard.

Of minor extent in this unit are Trail and Ives soils, Riverwash, Dune land, Torrifluvents, and Medisaprists.

This unit is used for homesite development, irrigated cropland, livestock grazing, recreation, and wildlife habitat.

2. Burnswick-Marcou

Very deep, somewhat excessively drained to well drained, nearly level to rolling, loamy soils; on fan terraces and stabilized dunes

This map unit is mainly in the northern half of the survey area. It is mainly on terraces and stabilized transverse and coppice dunes. Slopes range from 1 to 8 percent. The vegetation is mainly alkali sacaton, Indian ricegrass, galleta, and sandhill muhly and has a brushy appearance because of Mormon tea, fourwing saltbush, and sand sagebrush. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is about 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit makes up about 8 percent of the survey area. It is about 50 percent Burnswick soils and 24 percent Marcou soils. The remaining 26 percent is components of minor extent.

Burnswick soils are on fan terraces. They are very deep and well drained. They formed in mixed alluvium derived from sandstone and mudstone. These soils are loamy and strongly alkaline throughout and extend to a depth of 60 inches or more. They have a moderate sodium hazard.

Marcou soils are on stabilized transverse and coppice dunes. They are very deep and somewhat excessively drained. They formed in eolian material over mixed alluvium. The upper 47 inches is coarse-loamy and the lower part to a depth of 60 inches or more is loamy and strongly alkaline throughout. These soils have a moderate sodium hazard.

Of minor extent in this unit are Jocity, Tours, and Claysprings soils and Badland.

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

Arid Soils on Undulating Plateaus, Mesas, and Buttes

This group consists of four map units. It makes up 38.3 percent of the survey area. The soils in this group are nearly level to very steep. Vegetation is mainly grasses and shrubs. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is about 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

The soils in this group are very deep to very shallow and well drained to excessively drained. They formed in mixed alluvium and eolian material derived dominantly from sandstone and mudstone.

This group is used for irrigated cropland, homesite development, livestock grazing, and wildlife habitat.

3. Purgatory-Claysprings

Moderately deep and shallow, well drained, gently sloping to moderately steep, loamy-gypsic and clayey soils; on hills and fan terraces

This map unit is mainly in the northern half and the eastern third of the survey area. It is mainly on hills and fan terraces. Slopes range from 1 to 20 percent. The vegetation is mainly alkali sacaton, blue grama, galleta, Indian ricegrass, and gyp dropseed. It has a brushy appearance because of Mormon tea, fourwing saltbush, Bigelow sagebrush, and shadscale. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit makes up about 7 percent of the survey area. It is about 47 percent Purgatory soils and 30 percent Claysprings soils. The remaining 23 percent is components of minor extent.

Purgatory soils are on hills adjacent to Badland. They are moderately deep and well drained. They formed in a mixture of eolian material and alluvium derived from sandstone and mudstone. The upper 47 inches is loamy-gypsic soils over mudstone to a depth of 60 inches.

Claysprings soils are on fan terraces adjacent to Badland. They are shallow and well drained. They formed in alluvium derived from siltstone and mudstone. These soils are clayey over mudstone at a depth of 15 inches to more than 60 inches.

Of minor extent in this unit are Jocity, Tours, Burnswick, and Marcou soils and Badland.

This unit is used for livestock grazing, wildlife habitat, recreation, and, to a minor extent, homesite development.

4. Badland-Torriorthents-Calciorthids

Deep to very shallow, well drained, gently sloping to very steep, loamy to clayey soils; in areas where geologic erosion occurs

This map unit is mainly in the northern third of the survey area. It is mainly in active geologic eroding areas

composed of buttes and steeply dissected hills. Slopes range from 2 to 60 percent. Much of this unit is void of vegetation. In areas where vegetation does occur, it is mainly alkali sacaton, galleta, shadscale, mound saltbush, and fourwing saltbush. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit makes up 6.3 percent of the survey area. It is about 50 percent Badland, 20 percent Torriorthents, 11 percent Calciorthids, and 8 percent Rock outcrop. The remaining 11 percent is components of minor extent.

Badland is in active geologic eroding areas composed of buttes and steeply dissected hills. Badland is an area of exposed multicolored mudstone and siltstone deposits of the Chinle Formation.

Torriorthents are on toe slopes adjacent to the Badland. They are shallow and well drained. They formed in alluvium derived from sandstone and mudstone. They are loamy to clayey over mudstone at a depth of less than 10 inches.

Calciorthids are on summits and shoulders of mesa escarpments. They are deep and well drained. They formed in alluvium derived from mixed sources. They are loamy to sandy, calcareous soils.

Rock outcrop consists of areas of sandstone and basalt capping buttes and mesas.

Of minor extent in this unit are Gypisorthids, Haplargids, and Torrifluvents.

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

5. Grieta-Sheppard-Kinan

Very deep, well drained to somewhat excessively drained, gently sloping to steep, loamy to sandy soils; on fan terraces and dunes on undulating plateaus

This map unit is mainly in the northern half of the survey area. It is on fan terraces and dunes on undulating plateaus. Slopes range from 1 to 30 percent. The vegetation is mainly blue grama, black grama, galleta, Indian ricegrass, and sand dropseed. It has a brushy appearance because of fourwing saltbush, Mormon tea, and winterfat. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit makes up about 10 percent of the survey area. It is about 44 percent Grieta soils, 19 percent Sheppard soils and 8 percent Kinan soils. The remaining 29 percent is components of minor extent.

Grieta soils are on fan terraces on undulating plateaus. They are very deep and well drained. They formed in eolian material and alluvium. They are loamy throughout to a depth of 60 inches or more.

Sheppard soils are on stabilized dunes on undulating plateaus. They are very deep and somewhat excessively drained. They formed in eolian deposits derived from mixed alluvium. They are sandy throughout to a depth of 60 inches or more.

Kinan soils are on stabilized coppice dunes and terraces on undulating plateaus. These soils are very deep and somewhat excessively drained. They formed in eolian material and mixed alluvium. They are coarse-loamy throughout to a depth of 60 inches or more.

Of minor extent in this unit are Penzance, Epikom, Burnswick, and Marcou soils.

This unit is used for irrigated crops, homesite development, livestock grazing, recreation, and wildlife habitat.

6. Epikom-Rock Outcrop

Shallow and very shallow, well drained, gently sloping to very steep, loamy soils over sandstone and limestone; on undulating plateaus, mesas, and buttes

This unit is mainly in the northern half of the survey area. It is on undulating plateaus, mesas, and buttes. Slopes range from 1 to 60 percent. This unit has numerous vertical rock-walled canyons. The vegetation is mainly blue grama, black grama, galleta, and bush muhly. It has a brushy appearance because of fourwing saltbush, Mormon tea, and Bigelow sagebrush. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit makes up 15 percent of the survey area. It is about 50 percent Epikom soils and 15 percent Rock outcrop. The remaining 35 percent is components of minor extent.

Epikom soils are on undulating plateaus, mesas, and buttes. They are shallow and well drained. They formed in eolian material and alluvium derived dominantly from sandstone and mudstone. These soils are loamy over sandstone at a depth of about 14 inches.

Rock outcrop consists of areas of exposed sandstone, limestone, and mudstone. Of minor extent in this unit are Needle, Purgatory, Claysprings, Tours, Jocity, Burnswick, and Marcou soils and Badland.

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

Semi-arid Soils on Undulating Plateaus, Mesas, and Buttes

This group consists of four map units. It makes up about

42 percent of the survey area. The soils in this group are nearly level to very steep. Vegetation is mainly grasses, shrubs, and juniper trees. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is about 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

The soils in this group are very deep to very shallow and well drained to excessively drained. They formed in mixed alluvium derived dominantly from sandstone and mudstone.

This group is used for irrigated cropland, homesite development, livestock grazing, recreation, and wildlife habitat.

7. Arntz-Leanto

Moderately deep and shallow, well drained, gently sloping to moderately steep loamy-gypsic and clayey soils; on hills, undulating plateaus, mesas, and buttes

This map unit is in the southeastern quarter of the survey area. It is mainly on hills, undulating plateaus, mesas, and buttes. Slopes range from 1 to 20 percent. The vegetation is mainly alkali sacaton, blue grama, galleta, and gyp dropseed. It has a brushy appearance because of Mormon tea, fourwing saltbush, Bigelow sagebrush, and a few scattered juniper trees. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit makes up 2.5 percent of the survey area. It is about 68 percent Arntz soils and 10 percent Leanto soils. The remaining 22 percent is components of minor extent.

Arntz soils are on fan terraces adjacent to buttes. They are moderately deep and well drained. They formed in alluvium derived from sandstone and mudstone. The upper 25 inches is loamy-gypsic soils over mudstone to a depth of 60 inches.

Leanto soils are on undulating plateaus, buttes, and mesas. They are shallow and well drained. They formed in eolian material and alluvium derived from sandstone, limestone, and mudstone. The upper 14 inches is a channery loamy soil over bedrock.

Of minor extent in this unit are Springerville soils, Torrifluvents, Badland, and Rock outcrop.

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

8. Cerrillos-Barx-Ubank

Very deep, well drained, gently sloping to rolling, loamy and clayey soils; on fan terraces on undulating plateaus

This map unit is mainly in the southern half of the survey area. It is on fan terraces on undulating plateaus. Slopes range from 1 to 10 percent. The vegetation is mainly pinyon pine and juniper with an understory of black grama, blue grama, sideoats grama, Indian ricegrass, bottlebrush squirreltail, and galleta. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is about 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit makes up 9 percent of the survey area. It is about 26 percent Cerrillos soils, 18 percent Barx soils, and 10 percent Ubank soils. The remaining 46 percent is components of minor extent.

Cerrillos soils are on fan terraces on undulating plateaus. They are very deep and well drained. They formed in mixed alluvium and eolian material derived dominantly from sandstone, mudstone, limestone, and basalt. These soils are loamy throughout to a depth of 60 inches or more and are calcareous below a depth of 15 inches.

Barx soils are on fan terraces on undulating plateaus. They are very deep and well drained. They formed in mixed alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. These soils are loamy throughout to a depth of 60 inches or more.

Ubank soils are on fan terraces on undulating plateaus. They are very deep and well drained. They formed in mixed alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. These soils are loamy throughout to a depth of 60 inches or more and are weakly lime cemented below a depth of 11 inches.

Of minor extent in this unit are Nuffel, Poley, Manzano, and Sheza soils.

This unit is used for fuelwood production, livestock grazing, homesite development, recreation, and wildlife habitat.

9. Rock Outcrop-Kech-Bisoodi

Shallow and very shallow, well drained, gently sloping to very steep, loamy soils over sandstone and limestone; on undulating plateaus, mesas, and buttes

This unit is mainly in the southern half of the survey area. Slopes range from 1 to 60 percent. This unit has numerous vertical rock-walled canyons. The vegetation is mainly blue grama, black grama, galleta, fourwing saltbush, Bigelow sagebrush, and a few scattered juniper trees. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit makes up 29 percent of the survey area. It is about 18 percent Rock outcrop, 15 percent Kech soils, and 13 percent Bisoodi soils. The remaining 54 percent is components of minor extent.

Rock outcrop consists of areas of exposed sandstone, limestone, and mudstone. It forms the steep to vertical sides of buttes, mesas, canyons, and sinks.

Kech soils are shallow and well drained. They formed in eolian material and alluvium derived dominantly from sandstone and mudstone. These soils are loamy over sandstone at a depth of about 12 inches.

Bisoodi soils are shallow and well drained. They formed in eolian material and alluvium derived dominantly from sandstone and mudstone. These soils are loamy over sandstone at a depth of about 14 inches.

Of minor extent in this unit are moderately deep loamy Torrifluvents, shallow and moderately deep loamy Torriorthents, and Arntz soils.

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

10. Nuffel-Manzano-Radnik

Very deep, well drained, nearly level to gently sloping, loamy and clayey soils; on flood plains and alluvial fans

This map unit is mainly in the southern third of the survey area. It is mainly on flood plains and alluvial fans. Slopes range from 0 to 3 percent. The vegetation in uncultivated areas is dominantly cottonwood and juniper trees with an understory of western wheatgrass, alkali sacaton, vine-mesquite, Indian ricegrass, and bottlebrush squirreltail along perennial and major intermittent streams and blue grama, black grama, western wheatgrass, alkali sacaton, and bottlebrush squirreltail on alluvial fans. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is about 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit makes up 1.5 percent of the survey area. It is about 66 percent Nuffel soils, 6 percent Manzano soils, and 4 percent Radnik soils. The remaining 24 percent is components of minor extent.

Nuffel soils are on flood plains and alluvial fans. They are very deep and well drained. These soils are formed in mixed alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. These soils are silty throughout and extend to a depth of 60 inches or more.

Manzano soils are on flood plains and low stream terraces. They are very deep and well drained. They formed in mixed alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. These soils are loamy throughout and extend to a depth of 60 inches or more.

Radnik soils are on flood plains and low stream terraces. They are very deep and well drained. They formed in mixed alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. These soils are coarse-loamy throughout and extend to a depth of 60 inches or more.

Of minor extent in this unit are Bagley soils, Escavada family soils, and Riverwash.

This unit is used for irrigated cropland, homesite development, livestock grazing, recreation, and wildlife habitat.

Dry Subhumid Soils on Undulating Plateaus, Mesas, and Buttes

This group consists of two map units. It makes up about 4.4 percent of the survey area. The soils in this group are nearly level to steep. The vegetation is mainly juniper and pinyon pine with an understory of black grama, blue grama, New Mexico feathergrass, Indian ricegrass, and fourwing saltbush. Elevation is 6,000 to 7,000 feet. The mean annual precipitation is about 14 to 16 inches, the mean annual air temperature is 50 to 53 degrees F, and the frost-free period is 120 to 150 days.

The soils in this group are very deep to very shallow and well drained. They formed in mixed alluvium and eolian material derived from sandstone, mudstone, limestone, cinders, and basalt.

This group is used for homesite development, livestock grazing, fuelwood production, recreation, and wildlife habitat.

11. Deama-Rock Outcrop-Atarque

Shallow, well drained, gently sloping to very steep, loamy soils over sandstone and limestone; on undulating plateaus, mesas, and buttes

This map unit is mainly in the southwest corner of the survey area. It is mainly on undulating plateaus, buttes, and mesas. Slopes range from 1 to 60 percent. This unit has numerous vertical rock-walled canyons. The vegetation is mainly juniper and pinyon pine with an understory of black grama, New Mexico feathergrass, blue grama, Indian ricegrass, and fourwing saltbush. Elevation is 6,000 to 7,000 feet. The mean annual precipitation is about 14 to 16 inches, the mean annual air temperature is 50 to 53 degrees F, and the frost-free period is 120 to 150 days.

This unit makes up about 1.3 percent of the survey area. It is about 43.9 percent Deama soils, 31.9 percent Rock outcrop, and 9.8 percent Atarque soils. The remaining 14.4 percent is components of minor extent.

Deama soils are on undulating plateaus. They are shallow and well drained. They formed in alluvium derived mainly from limestone. These soils are loamy, channery and flaggy soils over limestone at a depth of 14 inches.

Rock outcrop consists of areas of exposed sandstone,

mudstone, and limestone. Many vertical exposures of rock occur throughout the unit as canyon walls and buttes.

Atarque soils are on undulating plateaus, mesas, and buttes. They are shallow and well drained. They formed in eolian material and alluvium derived from sandstone and mudstone. These soils are loamy over sandstone at a depth of 12 inches.

Of minor extent in this unit are shallow and moderately deep, sandy soils over sandstone and moderately deep, loamy Ustifluvents.

This unit is used for livestock grazing, fuelwood production, homesite development, recreation, and wildlife habitat.

12. Thunderbird-Deama Family-Springerville

Very deep to shallow, well drained, gently sloping to very steep, clayey and loamy soils; on basalt flows and cinder cones

This map unit is in the southeast corner of the survey area. It is mainly on old basalt flows and a few cinder cones. Slopes range from 1 to 60 percent. The vegetation is mainly juniper and pinyon pine with an understory of western wheatgrass, blue grama, galleta, and New Mexico feathergrass. Elevation is 6,000 to 7,000 feet. The mean annual precipitation is about 14 to 16 inches, the mean annual air temperature is 50 to 53 degrees F, and the frost-free period is 120 to 150 days.

This unit makes up about 3.1 percent of the survey area. It is 70.8 percent Thunderbird soils, 6.4 percent Deama family soils, and 2.2 percent Springerville soils. The remaining 20.6 percent is components of minor extent.

Thunderbird soils are on old basalt flows. They are moderately deep and well drained. They formed in alluvium derived dominantly from basalt. These soils are clayey over basalt at a depth of about 28 inches.

Deama family soils are on old basalt flows. They are shallow and well drained. They formed in alluvium derived dominantly from basalt. These soils are loamy calcareous soils over basalt at a depth of about 20 inches.

Springerville soils are on old basalt flows. They are very deep and well drained. They formed in mixed alluvium derived dominantly from basalt. These soils are clayey over basalt at a depth of about 54 inches or more.

Of minor extent in this unit is a clayey shallow soil over basalt and rock outcrop.

This unit is used for fuelwood production, livestock grazing, homesite development, recreation, and wildlife habitat.

Detailed Soil Map Units

The map units delineated on the detailed maps at the back of 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. More information about each map unit is given under the heading "Use and Management of the Soils."

A map unit delineation on a 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 or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas 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 "included" areas that belong to other taxonomic classes.

Most included 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, inclusions. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. 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 included areas of contrasting soils or miscellaneous areas are mentioned in the map unit descriptions. A few included areas 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 included areas 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 segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, 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 or of the underlying layers, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

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

Some map units are made up of two or more major soils or miscellaneous areas. These map units are called 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. Pensom-Chedeski complex, 1 to 5 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas

Figure 2.—An area of Rock outcrop. Small areas such as this one are identified with a special symbol on the map. Many of the larger areas of Rock outcrop are mapped as Calciorthids-Torriorthents-Rock outcrop complex.

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. Gypsiorthids-Torriorthents association, 5 to 60 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 (fig. 2).

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

Soil Descriptions

1—Arntz fine sandy loam, 1 to 8 percent slopes

This moderately deep and deep, well drained soil is on plateaus. It formed in alluvium derived dominantly from gypsiferous mudstone and sandstone. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer and the upper part of the subsoil are reddish brown fine sandy loam 6 inches thick. The next 6 inches of the subsoil is reddish brown clay loam. The middle 20 inches is light reddish brown and reddish brown gypsiferous loam. The lower 10 inches is

reddish brown gypsiferous clay loam. The underlying material to a depth of 60 inches is interbedded gypsiferous mudstone and crystalline gypsum. In some areas the surface layer is loam, sandy loam, gravelly loam, and gravelly sandy loam. This soil contains moderate to large amounts of crystalline gypsum throughout. Some pedons have 1- to 6-inch thick layers of clear or white gypsum crystals (fig. 3). Depth to the underlying mudstone ranges from 30 to 60 inches.

Included in this unit are small areas of gypsum mounds, a clayey soil that is similar to the Arntz soil, shallow-loamy Torriorthents, and outcrops of mudstone and sandstone. Depth to bedrock in some areas is less than 30 inches. Included areas make up about 30 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in the Arntz soil. Available water capacity is moderate. The effective rooting depth is 30 to 59 inches. Roots can extend to a depth of 60 inches or more in areas where the mudstone and gypsum layers are fractured. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is moderately high.

This unit is used for recreation and livestock grazing.

The potential plant community is mainly galleta, gyp dropseed, alkali sacaton, and Indian ricegrass. Fourwing saltbush, Mormon tea, Bigelow sagebrush, shadscale, and juniper are in some places. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a

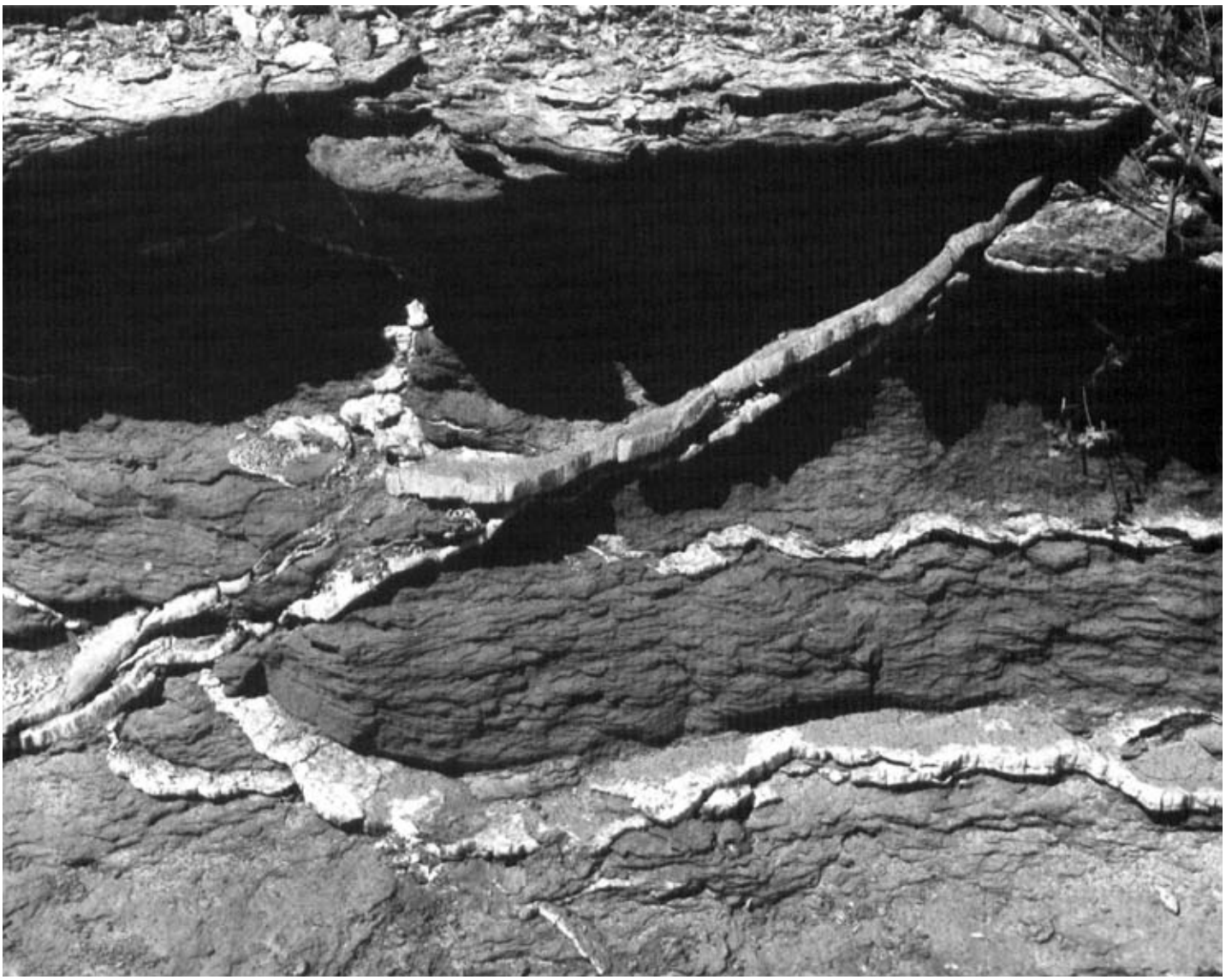


Figure 3.—Multiple seams of crystalline gypsum in the subhorizons of Arntz fine sandy loam, 1 to 8 percent slopes.

proper balance of desirable species is maintained and sufficient ground cover is maintained to control erosion. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is moderately suited to the production of herbaceous plants and shrubs. It has good plant diversity for wildlife use. Competition between wildlife and cattle can be severe during all seasons.

If this unit is used for homesite development, the main limitations are subsidence and sulfate damage to concrete. Construction of homes and other buildings on this soil tends to alter the runoff pattern of the precipitation. Large amounts of water concentrate in areas around buildings below the roof line, and the water leaches gypsum from the soil. The weight of the building then causes this leached soil to subside, and structural damage results. The high concentration of sulfates in this soil causes disintegration of concrete.

The limited ability of the soil to support a load can be overcome by diverting runoff away from buildings, sloping the surface of the soil away from buildings, installing rain gutters and downspouts on the eaves, excavating and packing the subsoil or replacing it with material that has a high load-bearing capacity, and putting extra reinforcement in the wide foundations needed to support buildings on this unit. Sulfate damage to concrete may be partially overcome by using Type 5 concrete.

The capability subclass is 6E. The range site is Gypsum Upland, 9-13" p.z. The wildlife habitat suitability group is 3.

2—Atarque fine sandy loam, 1 to 12 percent slopes

This very shallow and shallow, well drained soil is on plateaus, mesas, and buttes. It formed in alluvium derived dominantly from sandstone and mudstone. Elevation is 6,500 to 7,000 feet. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 50 to 53 degrees F, and the frost-free period is 120 to 150 days.

Typically, the surface layer is brown fine sandy loam 1 inch thick. The upper 5 inches of the subsoil is brown loam. The lower 8 inches is yellowish red loam over sandstone. Depth to bedrock ranges from 6 to 20 inches. In some areas the surface layer is channery sandy loam.

Included in this unit are small areas of shallow, loamy soils that are similar to Deama fine sandy loam; rock outcrop; and small sand dunes. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderate in the Atarque soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Roots can extend to a depth of 30 inches or more in areas where the bedrock is fractured. Runoff is medium to rapid, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is moderately high.

This unit is used for livestock grazing, recreation, and homesite development.

The potential plant community is juniper and pinyon pine with an understory of black grama, alkali sacaton, blue grama, and galleta. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Proper grazing use, range seeding, and a planned grazing system are needed to maintain or improve the production of forage and control erosion. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community.

This unit is poorly suited to the production of herbaceous plants and shrubs for wildlife habitat. It is moderately suited to the production of coniferous trees. The wooded areas provide habitat for many species. Fuelwood gatherers should not disturb nest trees.

If this unit is used for homesite development, the main limitations are depth to bedrock and slope. The cuts needed to provide level building sites can expose bedrock.

If this soil is used as a site for septic tank absorption fields, the main limitation is the shallow depth to bedrock. An engineer should be consulted for design recommendations. Alternatives are to install holding tanks or transport the waste and effluent by pipeline to a more suitable site.

The capability subclass is 6E. The woodland site is Sandstone Upland, 13-17" p.z. The wildlife habitat suitability group is 3.

3—Badland-Torriorthents association, 1 to 30 percent slopes

This map unit is on hills and escarpments. Slopes are 1 to 30 percent. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit is 75 percent Badland and 15 percent Torriorthents.

Included in this unit are small areas of shallow and moderately deep, sandy to clayey Torrifluvents and Torripsamments and sandstone rock outcrop. Included areas make up about 10 percent of the total acreage. The percentage varies from one area to another.

Badland consists of areas of multicolored siltstone, claystone, and mudstone deposits of the Chinle Formation that have been exposed by active geologic erosion. Slopes

are dominantly 5 to 30 percent but range to vertical. The beautiful Painted Desert and the Petrified Forest National Park are two areas of Badland. Both water and wind erosion constantly alter this sculptured landscape from a ridge to a series of rounded pinnacles or pedestal formations that are frequently capped by sandstone or petrified wood. A typical pedon has a reddish brown clay surface layer about 1 inch thick over mudstone.

Permeability is very slow in the Badland. Available water capacity is very low. The effective rooting depth is less than 10 inches, except in areas where the mudstone, claystone, or siltstone is highly weathered or fractured. Runoff is medium to very rapid, and the hazard of water erosion is moderate to severe. The hazard of wind erosion is moderate.

Torriorthents are shallow and very shallow, excessively drained to well drained soils on foot slopes below the Badland. Parent materials include eolian material, alluvium, and colluvium. Slopes are 1 to 10 percent. The texture, color, and thickness of the layers of these soils vary from one area to another. Textures vary from stratified sands to clay with varying amounts of gravel over mudstone or siltstone. Depth to mudstone or siltstone ranges from 5 to 20 inches. Generally, these soils are sodic, saline, and strongly alkaline. A typical profile has a surface layer of reddish brown loamy sand that is 4 inches thick. The subsurface layer is light reddish brown sandy clay 6 inches thick over mudstone at a depth of 10 inches.

Permeability is very slow to rapid in the Torriorthents. Available water capacity is very low. The effective rooting depth is 5 to 20 inches, except in areas where the mudstone is highly weathered or fractured. Runoff is medium to rapid, and the hazard of water erosion is slight. The hazard of wind erosion is high.

This unit is used for recreation, rangeland, and homesite development.

The scenic beauty of the multicolored layers of the Painted Desert and the abundance of petrified wood in the Petrified Forest National Park provide recreational value in this unit.

Use of this unit as rangeland is restricted to areas outside the national park. Rangeland is limited by accessibility and a low amount of forage. Badland generally is barren, and Torriorthents support only sparse vegetation, generally consisting of alkali sacaton, galleta, shadscale, and mound saltbush. The production of vegetation suitable for livestock grazing is limited by the hazard of active geologic erosion, excess salts, excess sodium, and droughtiness.

This unit is poorly suited to the production of herbaceous plants, shrubs, and vines for wildlife habitat. Any wildlife found in this unit is transient from adjacent sites.

If this unit is used for homesite development, the main limitations are slope, sulfate damage to concrete, and the shrink-swell potential. Access roads should be designed to provide adequate cut-slope grade, and drains are needed to control surface runoff and keep soil losses to a minimum. Use of Type 5 cement minimizes sulfate damage. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has a low shrink-swell potential.

If this unit is used as a site for septic tank absorption fields, the main limitations are slope and very slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for the permeability.

The capability class is 8 for Badland. The capability subclass is 7E for Torriorthents. The range site is Shale Upland, 5-9" p.z., for the Torriorthents; and the wildlife habitat suitability group is 2. The Badland is not assigned a range site or a wildlife habitat suitability group.

4—Bagley clay loam, 0 to 3 percent slopes

This very deep, well drained soil is on flood plains and stream terraces. It formed in recent mixed alluvium derived dominantly from sandstone, limestone, mudstone, and basalt. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer is brown clay loam 9 inches thick. The upper 30 inches of the subsurface layer is brown clay loam. The lower part to a depth of 60 inches is brown loam. In some areas the surface layer is sandy clay loam.

Included in this unit are small areas of very deep loamy soils that are similar to Lynx clay loam and Nuffel silty clay loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in the Bagley soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate. This soil is subject to occasional, brief periods of flooding from July to September.

This unit is used for irrigated cropland and pasture, livestock grazing, and recreation.

This unit is well suited to hay and pasture. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Leveling helps to ensure the uniform application of water. Annual applications of nitrogen and phosphorous fertilizer are needed to maintain production of high quality irrigated pasture. Under good management about 20 to 24 animal unit months (AUM's) and 6 to 7 tons of alfalfa hay per acre can be produced annually on this unit.

This unit is well suited to adapted, irrigated crops. Because of the slow permeability, the length of irrigation runs should be adjusted to permit adequate infiltration of water. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Under good management 65 to 70 bushels of barley, 50 to 55 bushels of wheat, and 25 to 30 tons of corn silage per acre can be produced annually on this unit.

The potential native plant community is mainly alkali sacaton, blue grama, western wheatgrass, and galleta. Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. This results in overgrazing and the subsequent deterioration of the vegetation.

This unit is well suited to the production of herbaceous plants, shrubs, and riparian plants for wildlife habitat. Riparian plants such as cottonwood, willow, ash, and walnut grow near water courses where soil moisture is adequate. These types of vegetation provide habitat for a large number of wildlife species. Riparian vegetation should be replanted in drainageways where the soil is moist. Protection from grazing is essential. Competition between cattle and wildlife is high throughout the year.

If this unit is used for homesite development, the main limitations are flooding and the shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling.

If this unit is used as a site for septic tank absorption fields, the main limitation is permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for the permeability.

The capability subclass is 2W, irrigated, and 6W, nonirrigated. The range site is Clayey Bottom, 9-13" p.z. The wildlife habitat suitability group is 4.

5—Barx fine sandy loam, 0 to 3 percent slopes

This very deep, well drained soil is on fan terraces. It formed in mixed alluvium derived dominantly from sandstone, limestone, mudstone, and basalt. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer is reddish brown fine sandy loam 10 inches thick. The upper part of subsoil is red and reddish brown clay loam 8 inches thick. The lower part is sandy clay loam 10 inches thick. The substratum to a depth of 60 inches or more is reddish brown sandy loam, loam, and sandy clay loam. Moderate amounts of calcium carbonate accumulation occur below a depth of 18 inches. The profile is moderately alkaline throughout. In some areas surface textures include sandy loam, gravelly fine sandy loam, and gravelly sandy loam.

Included in this unit are small areas of very deep clayey and loamy soils that are similar to Poley sandy loam, Nuffel silt loam, Bagley clay loam, and Lynx sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderate in the Barx soil. Available water capacity is high or very high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderately high.

This unit is used mainly for irrigated crops and pasture and livestock grazing. It is also used for homesite development and fuelwood production.

This unit is well suited to hay and pasture. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Leveling helps to ensure the uniform application of water. Annual applications of nitrogen and phosphorous fertilizer are needed to maintain production of high quality irrigated hay or pasture. Under good management about 20 to 24 AUM's (animal unit months) and 6 to 7 tons of alfalfa hay per acre can be produced on this unit.

This unit is well suited to irrigated crops. For the efficient application and removal of irrigation water, leveling is recommended in sloping areas. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop. Under good management about 60 to 65 bushels of barley, 50 to 55 bushels of wheat, or 25 to 30 tons of corn silage per acre can be produced annually on this unit.

The potential native plant community is pinyon pine and juniper with an understory of black grama, blue grama, sideoats grama, Indian ricegrass, bottlebrush squirreltail, and galleta. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Range seeding is recommended if the range is in poor condition. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Fencing and deferred grazing are important in a planned grazing system.

This unit is moderately suited to the production of herbaceous plants and shrubs. Open rangeland wildlife prefer this site.

This unit is moderately suited to pinyon pine and

oneseed juniper. It can produce 2 to 4 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Minimizing the risk of erosion is essential in harvesting fuelwood.

This unit is moderately suited to the production of coniferous trees. These woody areas provide habitat for many species. Fuelwood gatherers should not disturb nest trees.

If this unit is used for homesite development, the main limitation is the hazard of wind erosion. Preserving the existing plant cover during construction helps to control erosion. Revegetating the disturbed areas around construction sites as soon as possible helps to control wind erosion.

The capability subclass is 2E, irrigated, and 6E, nonirrigated. The range site is Loamy Upland, 9-13" p.z. The wildlife habitat suitability group is 3.

6—Barx fine sandy loam, 3 to 10 percent slopes

This very deep, well drained soil is on fan terraces. It formed in mixed alluvium derived dominantly from sandstone, limestone, mudstone, and basalt. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer is reddish brown fine sandy loam 3 inches thick. The upper part of the subsoil is red clay loam 15 inches thick. The middle part is reddish brown sandy clay loam 24 inches thick. The lower part to a depth of 60 inches or more is reddish brown sandy loam and sandy clay loam. Moderate amounts of calcium carbonate accumulation occur below a depth of 18 inches. In some areas surface textures include sandy loam, gravelly fine sandy loam, and gravelly sandy loam.

Included in this unit are small areas of very deep loamy to clayey soils that are similar to Poley sandy loam, Nuffel silt loam, Cerrillos gravelly sandy loam, Padilla sandy clay loam, and Ubank sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderate in the Barx soil. Available water capacity is high or very high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is severe. The hazard of wind erosion is moderately high.

This unit is used mainly for livestock grazing, fuelwood production, and recreation. It is also used for homesite development.

The potential plant community is pinyon pine and juniper with an understory of black grama, blue grama, sideoats grama, Indian ricegrass, bottlebrush squirreltail, and galleta. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Range seeding is suitable if the range is in poor condition. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Fencing and deferred grazing are important in planned grazing systems.

This unit is moderately suited to the production of herbaceous plants and shrubs. Open rangeland wildlife prefer this site.

This unit is moderately suited to pinyon pine and oneseed juniper. It can produce 2 to 4 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Minimizing the risk of erosion is essential in harvesting fuelwood.

This unit is moderately suited to the production of coniferous trees. These woody areas provide habitat for many species. Fuelwood gatherers should not disturb nest trees.

If this unit is used for homesite development, the main limitation is the hazard of wind erosion. Preserving the existing plant cover during construction helps to control erosion. Revegetating disturbed areas around construction sites as soon as possible helps to control wind erosion.

The capability subclass is 6E. The range site is Loamy Upland, 9-13" p.z. The wildlife habitat suitability group is 3.

7—Bisoodi fine sandy loam, 1 to 8 percent slopes

This shallow, well drained soil is on plateaus. It formed in alluvium derived dominantly from calcareous sandstone and limestone. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer is light brown fine sandy loam 1 inch thick. The subsurface layer is reddish yellow loam 3 inches thick. The subsoil is pink, calcareous, gravelly loam and loam 10 inches thick. The substratum is very pale brown highly weathered sandstone 4 inches thick over unweathered calcareous sandstone. Depth to bedrock ranges from 10 to 20 inches. In some areas the surface layer is channery fine sandy loam.

Included in this unit are small areas of a shallow loamy soil that is similar to Leanto sandy loam, rock outcrop, and a moderately deep loamy soil along drainageways. Included areas make up about 30 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderate in the Bisoodi soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water

erosion is slight. The hazard of wind erosion is moderately high.

This unit is used for recreation and livestock grazing.

The potential plant community is mainly black grama, New Mexico feathergrass, grama, and needleandthread with scattered juniper, pinyon pine, and fourwing saltbush. The present vegetation in most areas is mainly juniper, broom snakeweed, blue grama, fourwing saltbush, and threeawn. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Fencing and deferred grazing are important in planned grazing systems.

This unit is poorly suited to the production of herbaceous plants and shrubs for wildlife habitat. Wildlife use of this site is limited to transients from adjacent sites.

If this unit is used for homesite development, the main limitations are depth to rock and slope. The cuts needed to provide level building sites can expose bedrock.

If this unit is used as a site for septic tank absorption fields, the main limitation is depth to rock. This limitation can be partially overcome by increasing the size of the absorption field and by using fill material over the leach lines. Alternatives are to install holding tanks or transport the waste and effluent by pipeline to a more suitable site.

The capability subclass is 7E. The range site is Shallow Loamy, 9-13" p.z. The wildlife habitat suitability group is 2.

8—Burnswick-Marcou complex, 1 to 5 percent slopes

This map unit is on fan terraces and stabilized transverse and coppice dunes. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit is 40 percent Burnswick sandy clay loam and 30 percent Marcou loamy sand. The Burnswick soil is on fan terraces in deflated areas below the Marcou soil, which is on stabilized transverse and coppice dunes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of shallow clayey soils that are similar to Claysprings sandy clay, very deep loamy soils that are similar to Jocity sandy clay loam, and badland. Included areas make up about 30 percent of the total acreage. The percentage varies from one area to another.

The Burnswick soil is very deep and well drained. It formed in mixed alluvium derived dominantly from mudstone, siltstone, and sandstone. Typically, the surface layer is light reddish brown, moderately alkaline sandy clay loam about 3 inches thick. The upper 13 inches of the of the subsoil is reddish brown moderately alkaline sandy clay loam. The middle 25 inches is reddish brown sodic, strongly alkaline sandy clay loam. The lower 12 inches of the subsoil is reddish brown, sodic, strongly alkaline sandy loam over buried light reddish brown, sodic, strongly alkaline sandy clay loam to a depth of 60 inches or more. In some areas the surface layer is sandy loam, gravelly sandy loam, or gravelly sandy clay loam. This soil has a moderate to strong sodium hazard and a sodium absorption ratio of 13 or more.

Permeability is moderately slow in the Burnswick soil. The sodium hazard restricts water movement in the soil and nutrient and water uptake by plants. Available water capacity is very low or low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

The Marcou soil is very deep and somewhat excessively drained. It formed in eolian deposits over mixed alluvium derived dominantly from mudstone, siltstone, and sandstone. Typically, the surface layer is light reddish brown, moderately alkaline loamy sand about 6 inches thick. The upper 41 inches of the substratum is reddish brown sodic, strongly alkaline coarse sandy loam and sandy loam. The upper part of the buried subsoil is light reddish brown, sodic, strongly alkaline sandy clay loam. The lower part to a depth of 60 inches is sodic, strongly alkaline loamy coarse sand. This soil has a moderate to strong sodium hazard and a sodium absorption ratio of 13 or more. Thickness of the coarser textured eolian deposit and depth to the fine textured alluvial deposit range from 40 to 60 inches. Textures in the upper 40 to 60 inches range from loamy sand to sandy loam.

Permeability is moderate in the Marcou soil. Available water capacity is low or moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is high.

This unit is used for recreation and livestock grazing.

The potential plant community on the Burnswick soil is mainly alkali sacaton, galleta, black grama, and blue grama. It has a shrubby appearance because of fourwing saltbush, mound saltbush, and Bigelow sagebrush. The potential plant community on the Marcou soil is mainly Indian ricegrass, alkali sacaton, and galleta with scattered fourwing saltbush. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a

proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. The production of vegetation suitable for livestock grazing is limited by the content of toxic salts in the soil.

This unit is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat. Burrowing animals find the Marcou soil to be a suitable site for digging.

If this unit is used for homesite development, the main limitations on the Burnswick soil are the shrink-swell potential and sulfate damage to concrete. The main limitations on the Marcou soil are the hazard of wind erosion and sulfate damage to concrete. The effects of shrinking and swelling can be minimized by using proper engineering designs. The use of Type 5 cement will limit the damage to concrete caused by high concentrations of sulfate in the soil. Revegetating the disturbed areas around construction sites as soon as possible helps to control wind erosion.

If this unit is used as a site for septic tank absorption fields, it is limited mainly by the moderately slow permeability in the Burnswick soil and the seepage potential in the Marcou soil. Use of sandy backfill for the trench and long absorption lines helps to compensate for the moderately slow permeability. Effluent from septic tank absorption fields can surface in downslope areas and thus create a health hazard in the Marcou soil. If the density of housing is moderate to high, community sewage systems are needed to prevent a health hazard as a result of seepage from onsite sewage disposal systems.

The capability subclass is 7S for the Burnswick soil and 7E for the Marcou soil. The range site is Clay Loam Terrace (sodic), 5-9" p.z., for the Burnswick soil and Sandy Upland (sodic), 5-9" p.z., for the Marcou soil. The wildlife habitat suitability group is 3 for both soils.

9—Burnswick sandy clay loam, 1 to 5 percent slopes

This very deep, well drained sodic soil is on fan terraces. It formed in mixed alluvium derived from mudstone and sandstone. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is light reddish brown sandy clay loam about 3 inches thick. The upper 13 inches of the subsoil is reddish brown sandy clay loam. The middle 25 inches is reddish brown, sodic, strongly alkaline, sandy clay loam. The lower 12 inches is light reddish brown, sodic, strongly alkaline, sandy loam over buried, light reddish brown, sodic, strongly alkaline, sandy clay loam to a depth of 60 inches or more. In some areas the surface layer is sandy loam, gravelly sandy loam, or gravelly sandy clay loam. This soil has a moderate to strong sodium hazard and a sodium absorption ratio of 13 or more.

Included in this unit are small areas of shallow clayey soils that are similar to Claysprings sandy clay, very deep loamy soils that are similar to Jocity sandy clay loam, very deep sandy soils that are similar to Marcou sandy loam, and areas of badland. Included areas make up about 25 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in the Burnswick soil. The medium to high sodium hazard restricts water movement in the soil and nutrient and water uptake by plants. Available water capacity is very low or low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

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

If this unit is used for hay and pasture, the main limitations are the content of toxic salts in the soil and the slope. the content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Fertilizer is needed to ensure optimum growth of grasses and legumes. Leveling helps to ensure the uniform application of water. Good irrigation water management is essential to maintain productivity. Under intensive management about 3 to 4 tons of alfalfa hay or 12 to 15 AUM's (animal unit months) per acre can be produced annually on this unit.

If this unit is used for irrigated crops, the main limitations are the content of toxic salts in the soil and the slope. Intensive management is required to reduce the salinity and sodicity and maintain soil productivity. The content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Leveling helps to ensure the efficient application and removal of irrigation water in sloping areas. Under intensive management about 15 to 20 tons of corn silage, 30 to 40 bushels of wheat, or 40 to 50 bushels of barley per acre can be produced annually on this unit.

The potential native plant community is mainly alkali sacaton, galleta, black grama, and blue grama. It has a shrubby appearance because of fourwing saltbush, mound saltbush, and shadscale. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

The production of vegetation suitable for livestock

grazing is limited by the content of toxic salts.

This unit is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat.

If this unit is used for homesite development, the main limitations are the shrink-swell potential and the sulfate damage to concrete. The effects of shrinking and swelling can be minimized by using proper engineering designs. The use of Type 5 cement will limit the damage to concrete caused by high concentrations of sulfate in the soil.

If this unit is used as a site for septic tank absorption fields, the main limitation is the moderately slow permeability. Use of sandy backfill for the trench and long absorption lines helps to compensate for the permeability.

The capability subclass is 4S, irrigated, and 7S, nonirrigated. The range site is Clay Loam Terrace (sodic), 5-9" p.z. The wildlife habitat suitability group is 3.

10—Calciorthids-Torriorthents-Rock outcrop complex, 15 to 80 percent slopes

This map unit is on buttes that are remnants of volcanic plugs and dikes stemming through the underlying mudstone and sandstone. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit is 30 percent Calciorthids, 20 percent Torriorthents, and 20 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of moderately deep, loamy, gypsic soils that are similar to Gypsiorthids; moderately deep or deep loamy soils that are similar to Typic Haplargids; and talus slopes. Included areas make up about 30 percent of the total acreage. The percentage varies from one area to another.

Calciorthids are shallow to deep and are well drained. They formed in alluvium and colluvium derived dominantly from basalt, sandstone, and mudstone. Slopes range from 15 to 50 percent. About 20 to 75 percent of the surface is covered with basalt cobbles and gravel. Typically, the surface layer is brown very cobbly loam about 5 inches thick. The upper part of the subsoil is reddish brown clay loam 7 inches thick. The lower 15 inches is pink, calcareous, gravelly loam over interbedded sandstone and mudstone at a depth of 27 inches. The content of rock fragments, which are cobbles and gravel, ranges from 5 to 75 percent throughout the profile. Basalt, sandstone, or mudstone is at a depth of 10 to 50 inches or more.

Permeability is moderate or moderately slow in the Calciorthids. Available water capacity is low. The effective rooting depth is 10 to 50 inches or more. Runoff is rapid, and the hazard of water erosion is moderate to severe. The hazard of wind erosion is very slight.

Torriorthents are shallow to deep and well drained. They formed in alluvium and colluvium derived dominantly from basalt, sandstone, and mudstone. Slopes range from 15 to 80 percent. About 20 to 75 percent of the surface is covered with basalt cobbles and gravel. Typically, the surface layer is dark brown very cobbly silty clay loam about 2 inches thick. The subsurface layer is dark brown very gravelly clay loam about 6 inches thick. The substratum is reddish brown clay loam about 24 inches thick over mudstone at a depth of 32 inches. Depth to mudstone ranges from 10 to 55 inches. The mudstone is interbedded with layers of sandstone. Soil textures range from clay to loam throughout the profile. The content of rock fragments ranges from 5 to 55 percent throughout the profile.

Permeability is moderately slow or very slow in the Torriorthents. Available water capacity is low. The effective rooting depth is 10 to 55 inches. Runoff is very rapid, and the hazard of water erosion is severe. The hazard of wind erosion is very slight.

Rock outcrop consists of exposed areas of basalt, sandstone, or mudstone. Basalt is exposed on summits and shoulders of buttes and, in some areas, is on side slopes. Sandstone and mudstone are exposed on the steep side slopes. Slopes are 1 percent to nearly vertical.

This unit is used for recreation and livestock grazing.

The potential plant community is mainly galleta, Indian ricegrass, and Bigelow sagebrush. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed to encourage livestock to graze in areas where access is limited.

Calciorthids are moderately suited to the production of herbaceous plants and shrubs. Torriorthents are poorly suited to the production of herbaceous plants, shrubs, and vines for wildlife habitat. Any wildlife found on these sites generally is transient from adjacent sites.

The capability subclass is 7E for Calciorthids and Torriorthents. The capability class is 8 for Rock outcrop. The range site is Breaks, 5-9" p.z., for Calciorthids and Torriorthents; and the wildlife habitat suitability group is 3. Rock outcrop is not assigned a range site or wildlife habitat suitability group.

11—Cerrillos sandy loam, 1 to 10 percent slopes

This very deep, well drained soil is on fan terraces. It formed in mixed alluvium and eolian material derived

dominantly from sandstone and mudstone. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer is reddish brown sandy loam 2 inches thick. The upper 13 inches of the subsoil is reddish brown sandy clay loam. The lower 19 inches is reddish yellow and light reddish brown clay loam that contains a moderate amount of calcium carbonate. The underlying material to a depth of 60 inches is light reddish brown sandy clay loam. A low sodium hazard can exist below a depth of 15 inches. In some areas the surface layer is gravelly sandy loam, loamy sand, or gravelly loam. In other areas this soil has moderate amounts of gravel throughout the profile.

Included in this unit are small areas of shallow loamy soils that are similar to Leanto sandy loam; very deep, loamy, very gravelly soils that are similar to Sheza gravelly sandy loam; very deep clayey soils that are similar to Padilla sandy clay loam; very deep, loamy, limy soils that are similar to Ubank sandy loam; and very deep loamy soils that are similar to Nuffel fine sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in the Cerrillos soil. Available water capacity is high or very high. The effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

This unit is used for livestock grazing, recreation, and homesite development. It can be used for adapted, irrigated crops if suitable water is available.

The potential plant community is mainly black grama, blue grama, galleta, and fourwing saltbush with scattered juniper. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Brush management improves deteriorated areas of range that are producing too many woody shrubs. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Fencing and deferred grazing are important in planned grazing systems.

This unit is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat.

This unit is well suited to homesite development. It has few limitations.

This unit is well suited to irrigated crops if good quality water is available. The main limitations are the slope and the hazard of wind erosion. Because of the slope, sprinkler or drip irrigation is most suitable for most crops. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the needs of the crop. Under good management about 60 to 65 bushels of barley, 45 to 50 bushels of wheat, or 20 to 25 tons of corn silage per acre can be produced annually on this soil.

This unit is well suited to hay and pasture. The main limitations are the slope and the hazard of wind erosion. All adapted pasture plants can be grown, but bunch type species planted alone generally are not suitable because of the erosion hazard. Rotation grazing helps to maintain the quality of forage. Irrigation water can best be applied by sprinkler because of the slope. Under good management about 5 to 6 tons of alfalfa hay or 16 to 20 AUM's (animal unit months) per acre can be produced annually on this soil.

The capability subclass is 3E, irrigated, and 6E, nonirrigated. The range site is Sandy Loam Upland, 9-13" p.z. The wildlife habitat suitability group is 3.

12—Cerrillos-Ubank complex, 1 to 8 percent slopes

This map unit is on fan terraces on plateaus. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit is 50 percent Cerrillos sandy loam and 35 percent Ubank fine sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of very deep loamy soils that are similar to Nuffel silt loam, very deep clayey soils that are similar to Padilla sandy clay loam, and areas of coppice dunes. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Cerrillos soil is very deep and well drained. It formed in mixed alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. Typically, the surface layer is reddish brown sandy loam about 2 inches thick. The upper 13 inches of the subsoil is reddish brown sandy clay loam. The lower 19 inches is reddish yellow calcareous clay loam. The underlying material is light reddish brown calcareous sandy clay loam to a depth of 60 inches or more. A low sodium hazard can exist below a depth of 15 inches. Surface textures include loamy fine sand, loamy sand, sandy loam, and gravelly sandy loam. Depth to the calcareous layer ranges from 10 to 20 inches.

Permeability is moderately slow in the Cerrillos soil. Available water capacity is high or very high. The effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

The Ubank soil is very deep and well drained. It formed in mixed alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. Typically, the surface layer is reddish brown fine sandy loam about 2 inches thick. The upper 8 inches of the subsoil is reddish brown sandy loam. The lower 4 inches is pinkish white and pink very calcareous loam. The upper 30 inches of the underlying material is pink, weakly calcium carbonate cemented loam. The lower part to a depth of 60 inches is reddish yellow very calcareous sandy clay loam. The Ubank soil is moderately alkaline throughout. Surface textures include very fine sandy loam, fine sandy loam, gravelly sandy loam, loam, and gravelly loam. Depth to the weakly calcium carbonate cemented layer ranges from 10 to 20 inches.

Permeability is moderate in the Ubank soil. Available water capacity is medium to high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The hazard of wind erosion is moderately high.

This unit is used for livestock grazing, homesite development, and recreation.

The potential plant community is mainly black grama, blue grama, sideoats grama, galleta, and fourwing saltbush with scattered juniper. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Brush management improves deteriorated areas of range that are producing too many woody shrubs. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Proper grazing use, range seeding, and a planned grazing system are needed to maintain or improve the production of forage.

This unit is moderately suited to the production of herbaceous plants and shrubs. Open rangeland wildlife prefer this site.

This unit is well suited to homesite development. Wind erosion is a hazard. Preserving the existing plant cover during construction helps to control erosion. Revegetating the disturbed areas around construction sites as soon as possible helps to control wind erosion.

The capability subclass is 6E for the Cerrillos and Ubank soils. The range site is Sandy Loam Upland, 9-13" p.z., for the Cerrillos soil and Loamy Upland, 9-13" p.z., for the Ubank soil. The wildlife habitat suitability group is 3 for both soils.

13—Claysprings clay, 1 to 10 percent slopes

This shallow and well drained soil is on plateaus adjacent to badland. It formed in alluvium derived dominantly from shale, siltstone, and mudstone. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is pinkish gray clay 3 inches thick. The substratum is reddish brown clay 15 inches thick over mudstone. Depth to mudstone ranges from 10 to 20 inches. This soil is moderately to strongly alkaline. Surface textures include sandy loam, fine sandy loam, clay loam, sandy clay loam, gravelly clay loam, and gravelly sandy clay loam.

Included in this unit are small areas of very deep loamy soils that are similar to Jocity sandy clay loam, very deep loamy sandy soils that are similar to Ives sandy loam, shallow loamy soils that are similar to Epikom channery sandy loam, very deep clayey soils that are similar to Penzance sandy clay loam, very deep sandy soils that are similar to Sheppard loamy sand, badland, and sandstone rock outcrop. Included areas make up about 25 percent of the total acreage. The percentage varies from one area to another.

Permeability is very slow in the Claysprings soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Roots can extend to a depth of 60 inches in areas where the mudstone is fractured and weathered. Runoff is medium to rapid, and the hazard of water erosion is moderate. The hazard of wind erosion is moderate.

This unit is used for recreation and livestock grazing.

The potential plant community is mainly alkali sacaton, galleta, and mound saltbush. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Planned grazing systems are essential to maintain plant vigor and forage production. Fencing and deferred grazing are important in planned grazing systems.

This unit is poorly suited to the production of herbaceous plants, shrubs, and vines for wildlife habitat. Any wildlife found on this site is transient from adjacent sites.

If this unit is used for homesite development, the main limitations are the shrink-swell potential and the slope. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling. The slope and the very slow permeability are management concerns on sites used for septic tank absorption fields. An engineer should be consulted for design recommendations.

The capability subclass is 7S. The range site is Shale Upland, 5-9" p.z. The wildlife habitat suitability group is 2.

14—Deama family very gravelly loam, 1 to 8 percent slopes

This shallow, well drained soil is on basalt mesas. It formed in alluvium derived dominantly from basalt. Elevation is 6,500 to 7,000 feet. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 50 to 53 degrees F, and the frost-free period is 120 to 150 days.

Typically, the surface layer is dark brown very gravelly loam 6 inches thick. The subsoil to a depth of 17 inches is pinkish gray and brown very gravelly loam over lime coated basalt. Depth to bedrock ranges from 15 to 20 inches. In some areas 10 to 50 percent of the surface is covered with basalt cobbles and stones.

Included in this unit are small areas of moderately deep clayey soils that are similar to Thunderbird gravelly clay loam, rock outcrop, and soils that are similar to this Deama family soil but have a clay subsoil or are more than 20 inches deep over bedrock. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderate in the Deama family soil. Available water capacity is very low. The effective rooting depth is 15 to 20 inches. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is very slight.

This unit is used for livestock grazing, fuelwood production, recreation, and homesite development.

The potential plant community is mainly sideoats grama and muttongrass with an overstory of juniper and pinyon. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

If this unit is used for fuelwood production, the main limitations are limited access because of the large rock fragments on the surface and depth to rock. This unit can produce 4 to 6 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Minimizing the risk of erosion is essential in harvesting.

This unit is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat. It is moderately suited to the production of coniferous trees. These pinyon-juniper woodlands provide habitat for many species. Fuelwood gatherers should not disturb nest trees.

If this unit is used for homesite development, the main limitation is depth to bedrock. The cuts needed to provide level building sites can expose bedrock. If onsite sewage disposal is to be used, an engineer should be consulted for design recommendations and installation of facilities.

The capability subclass is 6S. The woodland site is Basalt Upland (P.J.), 13-17" p.z. The wildlife habitat suitability group is 3.

15—Deama-Rock outcrop complex, 1 to 20 percent slopes

This map unit is on plateaus, mesas, and buttes. Elevation is 6,500 to 7,000 feet. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 50 to 53 degrees F, and the frost-free period is 120 to 150 days.

This unit is 50 percent Deama very channery loam and 35 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of loamy, moderately deep Ustifluvents and a moderately deep soil that is similar to the Deama soil. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Deama soil is shallow and well drained. It formed in alluvium derived dominantly from limestone. Typically, the surface layer is grayish brown very channery loam about 1 inch thick. The upper part of the subsoil is grayish brown channery loam about 3 inches thick. The next 9 inches of the subsoil is pale brown very channery loam. The lower 7 inches is very pale brown extremely channery loam. Limestone is at a depth of 20 inches. Depth to bedrock ranges from 10 to 20 inches. In areas the surface layer is flaggy or very flaggy loam. This soil is highly calcareous and moderately alkaline throughout.

Permeability is moderate in the Deama soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is medium to very rapid, and the hazard of water erosion is slight. The hazard of wind erosion is very slight.

Rock outcrop consists of exposed areas of limestone and sandstone. In some areas it is vertical exposures of 3 to 10 or more feet.

This unit is used for livestock grazing, recreation, and fuelwood production.

The potential plant community on the Deama soil is pinyon pine and oneseed juniper with an understory of sideoats grama, blue grama, black grama, needleandthread, and bottlebrush squirreltail. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Brush management improves deteriorated areas of range that are producing too many woody shrubs. Range seeding is suitable if the range is in poor condition.

This unit is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat. Scattered pinyon-juniper trees add structural diversity to this open grassland. The pinyon-juniper woodlands provide habitat for many species. Fuelwood gatherers should not disturb nest trees.

This unit is well suited to fuelwood production. It can produce 5.5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Thinning of dense stands of trees may be desirable where livestock grazing is the main use. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.

If this unit is used for homesite development, the main limitations are slope and depth to bedrock. The cuts needed to provide level building sites can expose bedrock. If this unit is used as a site for septic tank absorption fields, extreme care should be taken in selecting a site. The shallow soil can become saturated with effluent and create a health hazard. Transporting sewage effluent to a more suitable site is highly recommended.

The capability subclass is 6E for the Deama soil. The capability class is 8 for Rock outcrop. The woodland site is Shallow Loamy, 13-17" p.z., for the Deama soil; and the wildlife habitat suitability group is 3. Rock outcrop is not assigned a woodland site or a wildlife habitat suitability group.

16—Dune land

This unit consists of both active barchan and longitudinal sand dunes that generally are on the east side of major intermittent drainageways. Some dunes are 50 feet high or more. The dunes generally move in a northeasterly direction at the rate of 1 to 5 feet per year. Slopes are 5 to 80 percent. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 190 days.

A representative pedon of soils in this unit is light brown and light reddish brown sand and fine sand to a depth of 60 inches or more.

Included in this unit are small areas of very deep sandy soils that are similar to Sheppard and Kinan loamy sands and very deep loamy soils that are similar to Jocity sandy clay loam and Grieta sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is very rapid in the Dune land. Available water capacity is very low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight to severe. The hazard of wind erosion is very high.

This unit is used for recreation and as a source of sand for construction.

The capability class is 8. Dune land is not assigned a range site or a wildlife habitat suitability group.

17—Epikom channery sandy loam, 1 to 12 percent slopes

This shallow, well drained soil is on plateaus. It formed in alluvium derived dominantly from sandstone and mudstone. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is light reddish brown channery sandy loam 1 inch thick. The upper 9 inches of the subsoil is light reddish brown loam. The lower part to a depth of 14 inches is light reddish brown very flaggy loam over sandstone. Depth to bedrock ranges from 10 to 20 inches. Reaction is moderately alkaline throughout. A moderate amount of calcium carbonate accumulation occurs just above the bedrock. In areas the surface layer is sandy loam and loamy sand, and the substratum is channery sandy loam or channery loam.

Included in this unit are small areas of moderately deep, loamy, gypsic soils that are similar to Purgatory sandy loam; shallow clayey soils that are similar to Claysprings clay and Shalet silty clay loam; very deep loamy soils that are similar to Grieta sandy loam; moderately deep loamy soils that are similar to Tours sandy clay loam; and mudstone and sandstone outcrop. Included areas make up about 35 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderate in the Epikom soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

This unit is used for livestock grazing, recreation, and homesite development. It can be used for hay and pasture if an adequate water supply is available for sprinkler irrigation, if depth to bedrock is more than 15 inches, if the area is large enough to be economically feasible, and if use of equipment is not limited by the slope.

The potential plant community is mainly blue grama, black grama, and galleta. Bigelow sagebrush, Mormon tea, and fourwing saltbush are in some places. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Brush management improves deteriorated areas of range that are producing too many woody shrubs.

Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This soil is poorly suited to the production of herbaceous plants and shrubs for wildlife habitat. Any wildlife found on this site is transient from adjacent sites.

If this unit is used for homesite development, the main limitations are depth to bedrock and slope. The cuts needed to provide level building sites can expose bedrock. Erosion is a hazard in the steeper areas. Only the part of the site that is used for construction should be disturbed.

If this unit is used as a site for septic tank absorption fields, the main limitation is depth to bedrock. An engineer should be consulted for design recommendations of an onsite sewage disposal system. The system designed for this unit may include pressure dosing, mound or evaporation bed systems, or a combination of these types of systems. Another alternative may be to install a holding tank and transporting the sewage effluent off site to a more suitable soil.

The capability subclass is 7E. The range site is Sandstone Upland, 5-9" p.z. The wildlife habitat suitability group is 2.

18—Epikom-Rock outcrop complex, 1 to 20 percent slopes

This map unit is on plateaus and small mesas and buttes. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit is 50 percent Epikom channery sandy loam and 30 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of moderately deep, loamy, gypsic soils that are similar to Purgatory gravelly sandy loam; shallow clayey soils that are similar to Claysprings clay; very deep loamy soils that are similar to Grieta sandy loam; and moderately deep loamy soils that are similar to Tours sandy clay loam, which overlies sandstone. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Epikom soil is shallow and well drained. It formed in alluvium derived dominantly from sandstone and mudstone. Slopes are 1 to 20 percent. Typically, the surface layer is reddish brown channery sandy loam 3 inches thick. The substratum is reddish brown channery heavy sandy loam 11 inches thick over sandstone. Depth to bedrock ranges from 10 to 20 inches. Reaction is moderately alkaline throughout. A moderate amount of lime accumulation occurs just above the bedrock. In areas the surface layer is sandy loam, flaggy sandy loam, or channery loam and the substratum is flaggy sandy loam or channery loam.

Permeability is moderate in the Epikom soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

Rock outcrop consists of exposed areas of sandstone and mudstone. The mesas and buttes have sandstone caps. Slopes are 1 percent to nearly vertical. The steep and very steep side slopes expose the horizontal interbedding of sandstone and mudstone. These layers range from 1 foot to 20 feet thick. In areas 4- to 14-inch thick strata of rocklike gypsum are in the mudstone. Fissures are common in areas along the Holbrook Anticline, commonly referred to as the Pink Cliffs (fig. 4).

This unit is used for livestock grazing, recreation, and homesite development.

The potential plant community is mainly galleta, blue grama, and black grama. Bigelow sagebrush, Mormon tea, and fourwing saltbush are in some places. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Brush management improves deteriorated areas of range that are producing too many woody shrubs. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is poorly suited to the production of herbaceous plants and shrubs for wildlife habitat. Any wildlife found on this site is transient from adjacent sites.

Homesite development is limited to the tops of the buttes and mesas and to the foot slopes and toe slopes. The shrink-swell potential severely limits construction of buildings in or around the mudstone deposits. When building on the tops of buttes and mesas, excavation for foundations, water lines, and waste disposal systems is limited by the depth to rock. Onsite investigation is needed before building on this unit.

The capability class is 8 for Rock outcrop. The capability subclass is 7E for the Epikom soil. The range site is Sandstone Upland, 5-9" p.z., for the Epikom soil; and the wildlife habitat suitability group is 2.

19—Escavada family sandy loam, 0 to 3 percent slopes

This very deep, somewhat excessively drained soil is on flood plains. It formed in mixed alluvium derived dominantly from sandstone and mudstone. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the

Figure 4.—A fissure in an area of Epikom-Rock outcrop complex, 1 to 20 percent slopes.

mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer is brown sandy loam 10 inches thick. The substratum to a depth of 60 inches or more is light brown and light reddish brown stratified sandy loam to loamy sand. The substratum is loamy sand when mixed. In some areas the surface layer is loamy fine sand or loam. This soil is moderately alkaline and nonsaline throughout.

Included in this unit are small areas of very deep fine silty soils that are similar to Nuffel silt loam, very deep fine loamy soils that are similar to Lynx and Bagley sandy clay loams, and very deep loamy soils that are similar to Barx sandy loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability generally is moderately rapid in the Escavada family soil, but it ranges from moderately slow to rapid depending on the nature, number, and thickness of the thin, fine textured strata. Available water capacity is

moderate to high. The effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high. This soil is subject to rare, very brief periods of flooding from July to September. In areas where local sand and gravel companies have mined the sand and gravel from the adjacent stream bed and have lowered the channel substantially, there is no hazard of flooding.

This unit is used for irrigated cropland, livestock grazing, and recreation.

If this unit is used for hay and pasture, the main limitation is the low available water capacity. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Leveling helps to ensure the uniform application of water. Annual applications of nitrogen, phosphorus, and potassium fertilizer are needed to maintain the production of high quality irrigated pasture. Under good management about 14 to 18 AUM's (animal unit months) or 5 to 6 tons of alfalfa hay per acre can be produced annually on this soil.

If this unit is used for irrigated crops, the main limitations are the low available water capacity and the hazard of wind erosion. Applications of irrigation water should be light and frequent because the soil in this unit is droughty. Water should be applied in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. For the efficient application and removal of irrigation water, leveling is helpful in sloping areas. Wind erosion can be reduced by returning crop residue to the soil and minimizing tillage. Under good management about 60 to 65 bushels of barley, 45 to 50 bushels of wheat, or 20 to 25 tons of corn silage per acre can be produced annually on this soil.

The potential plant community is mainly western wheatgrass, Indian ricegrass, bottlebrush squirreltail, and alkali sacaton with scattered fourwing saltbush and cottonwood trees. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Good accessibility, a large variety of palatable plants, and the availability of water encourage a constant grazing pressure. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is well suited to the production of herbaceous plants, shrubs, and riparian plants for wildlife habitat. Riparian plants such as cottonwood, willow, ash, and walnut grow near water courses in areas where soil moisture is adequate. These types of vegetation provide habitat for a large number of wildlife species.

Riparian vegetation should be replanted in drainageways where the soil is moist. Protection from grazing is essential. Competition between livestock and wildlife is high throughout the year.

If this unit is used for homesite development, the main limitations are flooding and seepage. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Seepage from sewage disposal systems can cause a health hazard down slope. Roads and streets should be located above the expected flood level.

The capability subclass is 3E, irrigated, and 6E, nonirrigated. The range site is Loamy Bottom, 9-13" p.z. The wildlife habitat suitability group is 4.

20—Grieta sandy loam, 1 to 3 percent slopes

This very deep, well drained soil is on fan terraces on plateaus. It formed in alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is reddish brown sandy loam 3 inches thick. The upper 17 inches of the subsoil is reddish brown sandy clay loam. The lower 24 inches is light reddish brown, calcareous, sandy clay loam. The substratum to a depth of 60 inches or more is light reddish brown sandy loam. In some areas the surface layer is loamy sand, fine sandy loam, or gravelly sandy loam, and the subsoil is sandy clay loam and/or clay loam to a depth of 60 inches or more. Depth to maximum calcium carbonate accumulation is 20 to 24 inches.

Included in this unit are small areas of very deep sandy soils that are similar to Kinan loamy sand and Sheppard loamy sand and very deep clayey soils that are similar to Penzance sandy clay loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderate in the Grieta soil. Available water capacity is moderate or high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

This unit is used for livestock grazing, homesite development, irrigated cropland and pasture, and recreation.

The potential plant community is mainly black grama, blue grama, Indian ricegrass, and bush muhly. It has a brushy appearance because of fourwing saltbush and Mormon tea. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of

desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Planned grazing systems are essential to maintain plant vigor and forage production.

This unit is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat.

This unit is well suited to homesite development. Wind erosion is the main hazard. In some areas excavation for houses and access roads exposes material that is highly susceptible to wind erosion. Revegetating disturbed areas around construction sites as soon as possible helps to control wind erosion.

This unit is well suited to irrigated crops if good quality water is available. It is limited mainly by slope and wind erosion. Because of the slope, sprinkler or drip irrigation is most suitable for crops. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, water intake rate, and the needs of the crop. Under good management about 60 to 65 bushels of barley, 45 to 50 bushels of winter wheat, or 20 to 25 tons of corn silage can be produced per acre annually on this soil.

This unit is well suited to hay and pasture. The main limitations are slope and wind erosion. All adapted pasture plants can be grown, but bunch-type species planted alone generally are not suitable because of the hazard of erosion. Rotation grazing helps to maintain the quality of forage. Irrigation water can be applied by sprinkler, border, or corrugation method. Sprinkler irrigation is best suited to this soil because of the slope. Leveling would be necessary for any other method of irrigation. Fertilizer is needed to ensure optimum growth of grasses and legumes. Under good management about 5 to 6 tons of alfalfa hay and about 16 to 20 AUM's (animal unit months) can be produced per acre annually on this soil.

The capability subclass is 3E, irrigated, and 7E, nonirrigated. The range site is Sandy Loam Upland, 5-9" p.z. The wildlife habitat suitability group is 3.

21—Grieta sandy loam, 3 to 10 percent slopes

This very deep, well drained soil is on fan terraces on plateaus. It formed in alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is reddish brown sandy loam 3 inches thick. The upper 17 inches of the subsoil is reddish brown sandy clay loam. The lower 24 inches is light reddish brown, calcareous, sandy clay loam. The substratum to a depth of 60 inches or more is light reddish brown sandy loam. In some areas the surface layer is loamy sand, fine sandy loam, or gravelly sandy loam, and the subsoil is sandy clay loam and/or clay loam to a depth of 60 inches or more. Depth to moderate lime accumulation is 20 to 24 inches.

Included in this unit are small areas of very deep sandy soils that are similar to Kinan loamy sand and Sheppard loamy sand; moderately deep, loamy, gypsic soils that are similar to Purgatory sandy loam; and very deep clayey soils that are similar to Penzance sandy clay loam. Included areas make up about 30 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderate in the Grieta soil. Available water capacity is moderate or high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

This unit is used for livestock grazing, homesite development, irrigated cropland and pasture, and recreation.

The potential plant community is mainly black grama, blue grama, Indian ricegrass, sand dropseed, bush muhly, and spike dropseed. It has a brushy appearance because of fourwing saltbush and Mormon tea. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Planned grazing systems are essential for maintaining plant vigor and forage production.

This unit is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat.

This unit is well suited to homesite development. The main limitation is wind erosion. In some places excavation for houses and access roads exposes material that is highly susceptible to wind erosion. Revegetating disturbed areas around construction sites as soon as possible helps to control wind erosion.

This unit is well suited to irrigated crops if good quality water is available. It is limited mainly by slope and wind erosion. Because of the slope, sprinkler or drip irrigation is most suitable for crops. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the needs of the crop. Under good management about 60 to 65 bushels of barley, 45 to 50 bushels of winter wheat, and 20 to 25 tons of corn silage can be produced per acre annually on this soil.

This unit is well suited to hay and pasture. The main limitations are slope and wind erosion. All adapted pasture

plants can be grown, but bunch-type species planted alone generally are not suitable because of the hazard of erosion. Rotation grazing helps to maintain the quality of forage. Irrigation water can be applied by sprinkler, border, or corrugation method. Sprinkler irrigation is best suited to this soil because of the slope. Leveling would be necessary for any other method of irrigation. Fertilizer is needed to ensure optimum growth of grasses and legumes. Under good management about 5 to 6 tons of alfalfa hay and about 16 to 20 AUM's (animal unit months) can be produced per acre annually on this soil.

The capability subclass is 4E, irrigated, and 7E, nonirrigated. The range site is Sandy Loam Upland, 5-9" p.z. The wildlife habitat suitability group is 3.

22—Gypsiorthids-Torriorthents association, 5 to 60 percent slopes

This map unit is on hills along the Little Colorado River. Slopes are 5 to 60 percent. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit is about 30 percent Gypsiorthids and 30 percent Torriorthents. These soils have varying amounts of gypsum in the profile and are underlain by stratified sand and gravel. Depth to sand and gravel averages 29 inches, and the thickness of the deposit ranges from about 3 to 30 feet. This sand and gravel deposit is a major source of construction aggregate. Sandstone and mudstone is exposed on the steep side slopes of some of the hills.

Included in this unit are small areas of deep, very gravelly loamy soils that contain moderate to high amounts of calcium carbonate; moderately deep and shallow, very gravelly loamy soils over bedrock; and exposed bedrock on sides of hills. Included areas make up 40 percent of the unit.

Gypsiorthids are deep and very deep and somewhat excessively drained. They formed in alluvium and colluvium derived from mixed sources. The texture, color, and thickness of the layers of these soils vary from one area to another. A typical pedon has a surface layer of reddish brown very gravelly loam about 3 inches thick. The subsoil is reddish brown gravelly clay loam about 5 inches thick. The lower subsoil to a depth of 60 inches or more is stratified with multicolored bands that vary from white to black and yellow to red. The texture varies from sand and gravel to very gravelly sandy clay. The substratum contains gypsum crystals throughout and has several 2- to 4-inch thick horizontal layers of pure white and clear crystalline gypsum.

Permeability is moderate or moderately slow in the Gypsiorthids. Available water capacity is very low or low. The effective rooting depth is 40 to 60 inches or more. Runoff is medium to rapid, and the hazard of water erosion is slight to severe. The hazard of wind erosion is very slight.

Torriorthents are very deep. They are well drained to excessively drained. They formed in alluvium derived from mixed sources. The texture, color, and thickness of the layers of these soils vary from one area to another. A typical pedon has a surface layer covered with 5 to 65 percent pebbles and a few cobbles. The surface layer is reddish brown very gravelly sandy loam about 3 inches thick. The subsurface layer is reddish brown very gravelly loam about 6 inches thick. The substratum to a depth of 60 inches or more is light reddish brown, highly stratified, sand and gravel.

Permeability is moderate to rapid in the Torriorthents. Available water capacity is very low or low. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is moderate or severe. The hazard of wind erosion is very slight.

This unit is used for source material for construction aggregate, rangeland, and recreation. The gravel and sand deposits of this unit are used extensively and contribute most of the sand and gravel used in the area.

The potential plant community is mainly Indian ricegrass, black grama, blue grama, bush muhly, alkali sacaton, and galleta with a few scattered shrubs consisting of fourwing saltbush, Mormon tea, and winterfat. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is moderately suited to the production of herbaceous plants and shrubs. Open rangeland wildlife prefer this site.

If this unit is used for homesite development, the main limitations are slope, sulfate damage to concrete, and subsidence. Erosion is a hazard in the steeper areas. Only the part of the site that is used for construction should be disturbed. Structures to divert runoff are needed if buildings and roads are constructed. Type 5 cement is recommended to minimize sulfate damage. Great care should be taken when selecting a homesite. Onsite soils investigations are recommended to determine soil limitations before construction begins. After soil limitations are determined, specific design recommendations can be made to help overcome these limitations.

The capability subclass is 7E. The range site is Breaks, 5-9" p.z. The wildlife habitat suitability group is 3.

23—Ives fine sandy loam, wet, 0 to 1 percent slopes

This very deep, somewhat poorly drained, strongly saline soil is on flood plains. It formed in mixed alluvium derived dominantly from sandstone and mudstone. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface is covered with a soft layer of salt. The surface layer is light reddish brown fine sandy loam 4 inches thick. The substratum to a depth of 60 inches or more is highly stratified light reddish brown to reddish brown sandy loam to fine sandy loam. This soil is moderately alkaline and strongly saline throughout. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of very deep clayey soils that are similar to Navajo silty clay and Navajo silty clay (wet), very deep loamy soils that are similar to Tours silty clay loam, and very deep sandy soils that are similar to Trail loamy sand. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderate in the Ives soil. Available water capacity is very low. The effective rooting depth is limited by the depth to the fluctuating water table. Salinity is strong, and the sodium hazard is slight. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high. This soil is subject to occasional, brief periods of flooding from July to September. A high water table fluctuates between depths of 6 to 60 inches, but is generally at a depth of 24 to 36 inches most of the year.

This unit is used for recreation and livestock grazing.

The present plant community is mainly smotherweed, camelthorn, big rabbitbrush, and alkali sacaton. The potential plant community is mainly vine mesquite, alkali sacaton, and western wheatgrass. Woody species included in the plant community are cottonwood, fourwing saltbush, and greasewood. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock.

This unit is well suited to the production of herbaceous plants, shrubs, and riparian plants for wildlife habitat. Riparian plants such as cottonwood, willow, ash, and walnut grow near water courses in areas where soil moisture is adequate. These types of vegetation provide habitat for a large number of wildlife species. Competition between cattle and wildlife is high throughout the year.

If this unit is used for irrigated crops, the main limitations are the high content of salt, the fluctuating high water table, and flooding. Tile drainage can be used to lower the water table if a suitable outlet is available. Filter sleeves help to control the movement of silt and very fine sand into the tile line. Levees and dikes can be used to help control flooding.

If this unit is used for homesite development, the main limitations are the fluctuating high water table, sulfate damage to concrete, and flooding. Wetness can be reduced by installing tile drains around footings. Type 5 cement is recommended to minimize sulfate damage. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding.

The capability subclass is 7W. The range site is Saline Subirrigated, 5-9" p.z. The wildlife habitat suitability group is 4.

24—Ives sandy loam, saline-sodic, 1 to 3 percent slopes

This very deep, somewhat excessively drained saline-sodic soil is on flood plains and alluvial fans. It formed in mixed alluvium derived dominantly from sandstone and mudstone. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is light reddish brown sandy loam 4 inches thick. The upper 45 inches of the substratum is highly stratified light reddish brown and pink sandy loam. The lower substratum to a depth of 62 inches or more is pink stratified loamy sand. This soil is moderately alkaline and strongly saline throughout. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of poorly drained, very deep, coarse loamy soils that are similar to Ives fine sandy loam (wet); very deep loamy soils that are similar to Jocity sandy clay loam and Tours clay loam; very deep clayey soils that are similar to Navajo silty clay; and very deep sandy soils that are similar to Trail fine sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability generally is moderate in the Ives soil. Percolation rates range from slow to rapid, depending on the nature and number of the thin strata and on the depth to the strata. Available water capacity is very low. Salinity is strong, and the sodium hazard is slight. The effective rooting depth is 60 inches or more. Runoff is slow, and the

hazard of water erosion is slight. The hazard of wind erosion is moderately high. This soil is subject to occasional, brief periods of flooding from July to September.

This unit is used for recreation and livestock grazing. It can be used for irrigated pasture and crops if good quality water is available.

The potential plant community is mainly alkali sacaton, fourwing saltbush, inland saltgrass, and galleta. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Range seeding is suitable if the range is in poor condition. Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. This results in overgrazing and the subsequent deterioration of the vegetation. Seepage limits the use of this unit as a site for livestock watering ponds and other water impoundments.

This unit is moderately suited to the production of wild herbaceous plants and shrubs for wildlife habitat. Water can stand in the flat areas after rain storms. Competition between cattle and wildlife can be high during the growing season.

If this unit is used for hay and pasture, the main limitations are flooding and the content of toxic salts. The toxic salts can be leached from the root zone with applications of soil amendments and with good quality water. Suitable soil amendments include sulfuric acid, gypsum, and sulfur. Annual applications of nitrogen and phosphorous fertilizer are needed to maintain production of high quality irrigated pasture. Under intensive management about 12 to 15 AUM's (animal unit months) or 3 to 4 tons of alfalfa hay per acre can be produced annually on this soil.

If this unit is used for irrigated crops, the main limitations are flooding and the content of toxic salts. Levees, dikes, and channels can be used to limit flood damage. The content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. If the water available for leaching has a high salt content, it will limit reclamation. Irrigation water should be applied at a rate that ensures optimum production by increasing deep percolation and reducing runoff and erosion. For the efficient application and removal of irrigation water, the land should be leveled in sloping areas. Wind erosion can be reduced by returning crop residue to the soil and minimizing tillage. Under intensive management about 15 to 20 tons of corn silage, 30 to 40 bushels of wheat, or 40 to 50 bushels of barley per acre can be produced annually on this soil.

If this unit is used for homesite development, the main limitations are the hazard of brief flooding, the high content of salt, and sulfate damage to concrete. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. The high content of salt in the soil can limit the choices of plants for landscaping and home beautification. The sulfate damage to concrete can be minimized by using Type 5 cement or a similar cement that is resistant to sulfate damage.

The capability subclass is 4W, irrigated, and 7W, nonirrigated. The range site is Saline Bottom, 5-9" p.z. The wildlife habitat suitability group is 3.

25—Ives very fine sandy loam, saline-sodic, 0 to 1 percent slopes

This very deep, somewhat excessively drained saline-sodic soil is on flood plains. It formed in mixed alluvium derived dominantly from sandstone and mudstone. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is light reddish brown stratified very fine sandy loam 13 inches thick. The upper 42 inches of the substratum is highly stratified light reddish brown and pink sandy loam. The lower substratum to a depth of 62 inches or more is stratified pink loamy sand. This soil is moderately alkaline throughout. In some areas the surface layer is fine sandy loam.

Included in this unit are small areas of very deep, poorly drained, coarse loamy soils that are similar to Ives fine sandy loam (wet); very deep loamy soils that are similar to Jocity sandy clay loam and Tours silty clay loam; very deep clayey soils that are similar to Navajo silty clay; and very deep sandy soils that are similar to Trail loamy sand. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderate in the Ives soil. Available water capacity is very low. Salinity is strong, and the sodium hazard is slight. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is moderately high. This soil is subject to occasional, brief periods of flooding from July to September.

This unit is used for irrigated crops and pasture, livestock grazing, and recreation.

If this unit is used for hay and pasture, the main limitations are the content of toxic salts and flooding. Toxic salts can be leached from the root zone with good quality water. Levees, dikes, and channels can be used to limit flood damage. Annual applications of nitrogen, phosphorus, and potassium fertilizer are needed to maintain production of high quality irrigated pasture. Under

intensive management about 3 to 4 tons of alfalfa hay or 12 to 15 AUM's (animal unit months) per acre can be produced annually on this soil.

If this unit is used for irrigated crops, the main limitations are the content of toxic salts and the hazards of flooding and wind erosion. Intensive management is required to reduce the salinity and maintain soil productivity. The content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Irrigation water needs to be applied at a rate that ensures optimum production without increasing deep percolation, runoff, and erosion. Levees, dikes, and channels can be used to limit flood damage. Wind erosion can be reduced by returning crop residue to the soil and minimizing tillage. Under intensive management about 15 to 20 tons of corn silage, 40 to 50 bushels of barley, or 30 to 40 bushels of wheat per acre can be produced annually on this soil.

The potential plant community is mainly alkali sacaton, fourwing saltbush, inland saltgrass, and galleta. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. This results in overgrazing and the subsequent deterioration of the vegetation. Seepage limits the use of this unit as a site for livestock watering ponds and other water impoundments.

This unit is moderately suited to the production of wild herbaceous plants and shrubs for wildlife habitat. Water can stand in the flat areas after rain storms. Competition between cattle and wildlife can be high during the growing season.

If this unit is used for homesite development, the main limitations are the hazard of brief flooding, the high content of salt, and sulfate damage to concrete. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. The high content of salt in the soil can limit choices of landscaping plants for home beautification. The sulfate damage to concrete can be minimized by using Type 5 cement or a similar cement that is resistant to sulfate damage.

The capability subclass is 4W, irrigated, and 7W, nonirrigated. The range site is Saline Bottom, 5-9" p.z. The wildlife habitat suitability group is 3.

26—Jocity sandy clay loam, 1 to 3 percent slopes

This very deep, well drained soil is on alluvial fans. It formed in mixed alluvium derived dominantly from sandstone, mudstone, and basalt. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 130 to 180 days.

Typically, the surface layer is reddish gray sandy clay loam 9 inches thick. The upper 32 inches of the substratum is stratified, reddish gray sandy clay loam. The lower part to a depth of 60 inches is stratified, gray fine sandy loam. In some areas the surface layer is clay loam or sandy loam. The substratum is stratified with thin layers of silty clay loam and loamy very fine sand.

Included in this unit are small areas of shallow clayey soils that are similar to Claysprings clay, very deep loamy soils that are similar to Grieta sandy clay loam, very deep coarse loamy soils that are similar to Ives sandy loam, shallow loamy soils that are similar to Epikom sandy loam, very deep clayey soils that are similar to Navajo silty clay, very deep sandy soils that are similar to Sheppard loamy sand, and very deep fine silty soils that are similar to Tours silty clay loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in the Jocity soil. Available water capacity is low or moderate. Saline and sodium hazards are low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is slight. This soil is subject to occasional, very brief periods of flooding from July to September.

This soil is used for recreation and livestock grazing. It can be used for irrigated crops and pasture if good quality water is available.

The potential plant community is mainly alkali sacaton, blue grama, galleta, and Indian ricegrass. Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. This results in overgrazing and the subsequent deterioration of the vegetation. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. If water-spreading dikes are installed and grazing is controlled, this unit is highly productive.

This unit is well suited to the production of herbaceous plants, shrubs, and riparian plants for wildlife habitat. Riparian plants such as cottonwood, willow, ash, and walnut grow near water courses in areas where soil moisture is adequate. These types of vegetation provide habitat for a large number of wildlife species. Riparian vegetation should be replanted in drainageways where the soil is moist. Protection from grazing is essential.

Competition between cattle and wildlife is high throughout the year.

This unit is well suited to hay and pasture. The main limitations are the small size of the area suitable for hay and pasture and the poor quality of water available for irrigation. Grasses and legumes grow well if adequate fertilizer is used. Leveling helps to ensure the uniform application of water. Under good management this unit is capable of annually producing about 16 to 20 AUM's (animal unit months) or 5 to 6 tons of alfalfa hay per acre.

This unit is well suited to irrigated crops. It is limited mainly by the small size of the areas suitable for crops. Flooding can be reduced by the use of levees, dikes, and diversions. For the efficient application and removal of irrigation water, land should be leveled in sloping areas. Use of pipe, ditch-lining, or drop structures in irrigation ditches facilitates irrigation and reduces erosion. Tillage should be kept to a minimum. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Under good management, this unit is capable of annually producing 60 to 65 bushels of barley, 20 to 25 tons of corn silage, or 45 to 50 bushels of wheat per acre.

If this unit is used for homesite development, the main limitation is flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding.

If this unit is used as a site for septic tank absorption fields, the main limitations are the moderately slow permeability and flooding. The permeability limitation can be partially overcome by increasing the size of the absorption field.

The capability subclass is 4W, irrigated, and 7W, nonirrigated. The range site is Loamy Bottom, 5-9" p.z. The wildlife habitat suitability group is 4.

27—Jocity sandy clay loam, saline-sodic, 0 to 1 percent slopes

This very deep, well drained saline-sodic soil is on flood plains. It formed in mixed alluvium derived dominantly from sandstone, mudstone, and basalt. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

A thin crust of salt is on the surface in some places. It is strongly to very strongly saline and moderately alkaline throughout. Typically, the surface layer is reddish gray sandy clay loam 9 inches thick. The upper 32 inches of the substratum is reddish gray stratified sandy clay loam. The lower part to a depth of 60 inches is gray stratified fine sandy loam. In some areas the surface layer is silty clay. The substratum is stratified with thin layers of silty clay loam and loamy very fine sand.

Included in this unit are small areas of very deep coarse loamy soils that are similar to Ives sandy loam, very deep clayey soils that are similar to Navajo silty clay, and very deep fine silty soils that are similar to Tours silty clay loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in the Jocity soil. Available water capacity is very low to moderate. The salinity hazard is high, and the sodium hazard is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate. This soil is subject to occasional, very brief periods of flooding from July to September.

This unit is used for irrigated crops and pasture, livestock grazing, and recreation.

If this unit is used for hay and pasture, the main limitations are the content of toxic salts, flooding, and the availability of good quality irrigation water. Toxic salts can be partially removed from the root zone with the addition of soil amendments and by leaching with good quality water. Annual applications of nitrogen and phosphorous fertilizer are needed to maintain production of high quality irrigated pasture. Under intensive management about 12 to 15 AUM's (animal unit months) or 3 to 4 tons of alfalfa hay per acre can be produced annually on this soil.

If this unit is used for irrigated crops, the main limitations are flooding, the content of toxic salts, and the availability of good quality irrigation water. Intensive management is required to reduce the salinity and maintain soil productivity. The content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Levees, dikes, and channels can be used to limit flood damage. Subsoiling improves water infiltration and allows salts to be leached downward. Under intensive management about 15 to 20 tons of corn silage, 30 to 50 bushels of wheat, or 40 to 50 bushels of barley per acre can be produced annually on this soil.

The potential plant community is mainly alkali sacaton, galleta, and fourwing saltbush. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion. Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. This results in overgrazing and the subsequent deterioration of the vegetation.

This unit is moderately suited to the production of wild

herbaceous plants and shrubs for wildlife habitat. Water can stand in the flat areas after rain storms. Competition between cattle and wildlife can be high during the growing season.

If this unit is used for homesite development, the main limitations are flooding, the shrink-swell potential, the high content of salts, and sulfate damage to concrete. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has a low shrink-swell potential. The high salt content of the soil can limit the choices of plants for landscaping and home beautification. Type 5 cement or a similar cement that is designed to resist sulfate damage should be used.

If this unit is used as a site for septic tank absorption fields, the main limitations are flooding and the moderately slow permeability. The permeability limitation can be overcome by increasing the size of the absorption field.

The capability subclass is 4W, irrigated, and 7W, nonirrigated. The range site is Saline Bottom, 5-9" p.z. The wildlife suitability group is 3.

28—Jocity sandy clay loam, saline-sodic, 1 to 3 percent slopes

This very deep, well drained, saline-sodic soil is on flood plains and alluvial fans adjacent to braided, parallel drainageways. It formed in mixed alluvium derived dominantly from sandstone, mudstone, and basalt. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

A thin crust of salt is on the surface in some areas. Typically, the surface layer is reddish gray sandy clay loam 9 inches thick. The upper 32 inches of the substratum is reddish gray, stratified, sandy clay loam. The lower part to a depth of 60 inches is gray stratified fine sandy loam. This soil is strongly to very strongly saline and moderately alkaline throughout. In some areas the surface layer is clay loam. The substratum is stratified with thin layers of silty clay loam and loamy very fine sand.

Included in this unit are small areas of very deep fine silty soils that are similar to Tours silty clay loam, very deep coarse loamy soils that are similar to Ives sandy loam, shallow clayey soils that are similar to Claysprings clay, and very deep sandy soils that are similar to Sheppard sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in the Jocity soil. Available water capacity is very low to moderate. The salinity hazard is high, and the sodium hazard is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate. This soil is subject to occasional, very brief periods of flooding from July to September.

This unit is used for recreation and livestock grazing. It can be used for irrigated pasture and crops if good quality water is available and flooding is controlled.

The potential plant community is mainly alkali sacaton, galleta, and fourwing saltbush. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plant increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion. Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. This results in overgrazing and the subsequent deterioration of the vegetation.

This unit is moderately suited to the production of wild herbaceous plants and shrubs for wildlife habitat. Water can stand in the flat areas after rain storms. Competition between cattle and wildlife can be high during the growing season.

If this unit is used for hay and pasture, the limitations are the content of toxic salts, the availability of good quality water, and flooding. The content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Levees, dikes, and channels can be used to limit flood damage. The poor quality of water available for leaching the salts from this soil can limit reclamation. Annual applications of nitrogen and phosphorous fertilizer are needed to maintain production of high quality irrigated pasture. Under intensive management about 12 to 15 AUM's (animal unit months) or 3 to 4 tons of alfalfa hay per acre can be produced annually on this soil.

If this unit is used for irrigated crops, the main limitations are the content of toxic salts, the availability of good quality water, and flooding. The content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Levees, dikes, and channels can be used to limit flood damage. The poor quality of water available for leaching the salts from this soil can limit reclamation. Under intensive management about 15 to 20 tons of corn silage, 20 to 40 bushels of wheat, or 40 to 50 bushels of barley per acre can be produced annually on this soil.

If this unit is used for homesite development, the main limitations are flooding, the shrink-swell potential, the high content of salt, and sulfate damage to concrete. Dikes and

channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Buildings and roads should be designed to offset the effects of shrinking and swelling. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has a low shrink-swell potential. The high content of salt in the soil can limit choices of plants for landscaping and home beautification. Type 5 cement or a similar cement that is designed to resist sulfate damage should be used.

If this unit is used as a site for septic tank absorption fields, the main limitations are flooding and the moderately slow permeability. The permeability limitation can be partially overcome by increasing the size of the absorption field.

The capability subclass is 4W, irrigated, and 7W, nonirrigated. The range site is Saline Bottom, 5-9" p.z. The wildlife habitat suitability group is 3.

29—Jocity silty clay, saline-sodic, 0 to 1 percent slopes

This very deep, well drained, saline-sodic soil is on flood plains. It formed in mixed alluvium derived dominantly from sandstone, mudstone, and basalt. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

A thin crust of salt is on the surface in some places. Typically, the surface layer is reddish gray silty clay 9 inches thick. The upper 32 inches of the substratum is reddish gray stratified sandy clay loam. The lower part to a depth of 60 inches is gray stratified fine sandy loam. In some areas the surface layer is sandy clay loam. The substratum is stratified with thin layers of silty clay loam and loamy very fine sand. This soil is strongly to very strongly saline and moderately alkaline throughout.

Included in this unit are small areas of very deep coarse loamy soils that are similar to Ives sandy loam, very deep clayey soils that are similar to Navajo silty clay, and very deep fine silty soils that are similar to Tours silty clay loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is slow in the Jocity soil. Available water capacity is very low to moderate. The salinity hazard is high, and the sodium hazard is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate. This soil is subject to occasional, very brief periods of flooding from July to September.

This unit is used for irrigated crops and pasture, livestock grazing, and recreation.

If this unit is used for hay and pasture, the main limitations are the content of toxic salts, flooding, and the availability of good quality irrigation water. The salts can be leached from the root zone with the use of soil amendments and good quality water. Levees, dikes, and channels can be used to limit flood damage. Annual applications of nitrogen and phosphorous fertilizer are needed to maintain production of high quality irrigated pasture. Under intensive management about 12 to 15 AUM's (animal unit months) or 3 to 4 tons of alfalfa hay per acre can be produced annually on this soil.

If this unit is used for irrigated crops, the main limitations are the content of toxic salts, flooding, and the availability of good quality irrigation water. Intensive management is required to reduce the salinity and sodicity while maintaining soil productivity. The content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Subsoiling improves water infiltration and allows salts to be leached downward. Levees, dikes, and channels can be used to limit flood damage. Under intensive management about 15 to 20 tons of corn silage, 30 to 40 bushels of wheat, or 40 to 50 bushels of barley per acre can be produced annually on this soil.

This unit is moderately suited to the production of wild herbaceous plants and shrubs for wildlife habitat. Water can stand in the flat areas after rain storms. Competition between cattle and wildlife can be high during the growing season.

If this unit is used for homesite development, the main limitations are flooding, sulfate damage to concrete, and the shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Type 5 cement is recommended to minimize sulfate damage. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has a low shrink-swell potential.

If this unit is used as a site for septic tank absorption fields, the main limitations are flooding and the slow permeability. The slow permeability can be partially overcome by increasing the size of the absorption field.

The capability subclass is 4W, irrigated, and 7W, nonirrigated. The range site is Saline Bottom, 5-9" p.z. The wildlife habitat suitability group is 3.

30—Kech fine sandy loam, 1 to 12 percent slopes

This shallow, well drained soil is on plateaus. It formed in alluvium derived dominantly from sandstone and mudstone. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer is reddish brown fine sandy

loam 2 inches thick. The upper 3 inches of the subsoil is reddish yellow loam. The lower 6 inches is light reddish brown channery loam. The next layer is calcareous, light reddish brown channery clay loam 4 inches thick over sandstone. Depth to bedrock ranges from 10 to 20 inches. In some areas the surface layer is channery sandy loam.

Included in this unit are small areas of deep sandy soils that are similar to Pensom loamy sand, shallow loamy soils that are similar to Chedeski sandy loam, very shallow soils that are similar to Kech soils, rock outcrop, and small coppice sand dunes. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderate in the Kech soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. In areas where the bedrock is fractured, roots can extend to a depth of 30 inches or more. Runoff is medium to rapid, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is moderately high.

This unit is used for livestock grazing, recreation, and homesite development.

The potential plant community is scattered juniper and pinyon pine with an understory of black grama, alkali sacaton, blue grama, and galleta. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Proper grazing use, range seeding, and a planned grazing system are needed to maintain or improve the production of forage and to control soil erosion. Brush management improves deteriorated areas of range that are producing too many woody shrubs.

This unit is poorly suited to the production of herbaceous plants and shrubs for wildlife habitat. It is moderately suited to the production of coniferous trees. The wooded areas provide habitat for many species. Fuelwood gatherers should not disturb nest trees.

If this unit is used for homesite development, the main limitations are depth to bedrock and slope. The cuts needed to provide level building sites can expose bedrock. Blowing dust can be reduced during and after construction by moistening the soil and establishing vegetation after construction.

If this soil is used as a site for septic tank absorption fields, the main limitation is the shallow depth to bedrock. An engineer should be consulted for design recommendations. Alternatives are to install holding tanks or to transport the waste and effluent by pipeline to a more suitable site.

The capability subclass is 6E. The range site is Sandstone Upland, 9-13" p.z. The wildlife habitat suitability group is 3.

31—Kech-Rock outcrop complex, 1 to 20 percent slopes

This map unit is on buttes and mesas. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit is 40 percent Kech channery sandy loam and 30 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of moderately deep, loamy, gypsic soils that are similar to Arntz fine sandy loam; shallow loamy soils that are similar to Chedeski sandy loam; moderately deep or deep loamy soils that are similar to Ustollic Haplargids and Ustollic Camborthids; and very shallow soils that are similar to Kech soils. Included areas make up about 30 percent of the total acreage. The percentage varies from one area to another.

The Kech soil is shallow and well drained. It formed in alluvium derived dominantly from sandstone and mudstone. Typically, the surface layer is reddish brown channery sandy loam 2 inches thick. The subsoil is reddish brown channery loam 10 inches thick over sandstone. Depth to bedrock ranges from 10 to 20 inches. In some areas the surface layer is loam or sandy clay loam and the lower portion of the substratum is sandy clay loam.

Permeability is moderate in the Kech soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. In areas where the bedrock is fractured, roots can extend to a depth of 30 inches or more. Runoff is medium to very rapid, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

Rock outcrop consists of exposed areas of sandstone and mudstone. The mesas and buttes are covered by sandstone caps. The moderately steep side slopes expose the horizontal interbedding of sandstone and mudstone. These layers are 1 foot to 20 feet thick. In some areas a 4- to 14-inch thick strata of rocklike gypsum is in the mudstone.

Most areas of this unit are used for recreation and livestock grazing. A few areas are used for homesite development.

The potential plant community is scattered juniper and pinyon pine with an understory of black grama, alkali sacaton, blue grama, and galleta. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Proper grazing use, range seeding, and a planned grazing system are needed to maintain or improve the production of forage and to help control soil erosion.

Brush management improves deteriorated areas of range that are producing too many woody shrubs.

This unit is poorly suited to the production of herbaceous plants and shrubs for wildlife habitat. It is moderately suited to the production of coniferous trees. These wooded areas provide habitat for many species. Fuelwood gatherers should not disturb nest trees.

The Rock outcrop part of this unit supports no vegetation but is important for nest sites, resting cover, hunting perches, escape routes, and dens.

If this unit is used for homesite development, the main limitations are depth to bedrock, slope, and the high shrink-swell potential of the mudstone. The cuts needed to provide level building sites can expose bedrock. Blowing dust can be reduced during and after construction by moistening soil and establishing vegetation after construction. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has a low shrink-swell potential.

If this unit is used as a site for septic tank absorption fields, the main limitations are depth to rock, slope, and the very slow permeability of the mudstone. An engineer should be consulted for design recommendations and for the installation of onsite sewage treatment facilities. Alternatives are to install holding tanks or to transport the waste and effluent by pipeline to a more suitable site.

The capability class is 8 for Rock outcrop. The capability subclass is 6E for the Kech soil. The range site is Sandstone Upland, 9-13" p.z., for the Kech soil; and the wildlife habitat suitability group is 3. Rock outcrop is not assigned a range site or a wildlife habitat suitability group.

32—Kinan loamy sand, 1 to 5 percent slopes

This very deep, somewhat excessively drained soil is on plateaus. It formed in eolian sediments overlying alluvium derived dominantly from sandstone, limestone, and mudstone. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is reddish brown loamy sand 1 inch thick. The subsoil is calcareous, reddish brown and reddish yellow sandy loam and fine sandy loam about 53 inches thick. The lower subsoil is calcareous, light reddish brown sandy clay loam to a depth of 60 inches or more. This soil is moderately alkaline throughout and contains moderate amounts of lime. In some areas the sandy loam and loamy sands extend to a depth of more than 60 inches and surface textures can include sandy loam and loamy fine sand.

Included in this unit are small areas of a soil that is similar to the Kinan soil but contains moderate amounts of gravel throughout the profile. Also included are small areas of very deep loamy soils that are similar to Grieta loamy sand and very deep sandy soils that are similar to Sheppard loamy sand. Included areas make up about 30 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately rapid in the Kinan soil. Available water capacity is moderate or high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is high.

This unit is used for livestock grazing, recreation, and homesite development. It can be used for irrigated crops if good quality water is available.

The potential plant community is mainly Indian ricegrass, blue grama, black grama, and galleta. Mormon tea, sand sagebrush, and fourwing saltbush are in some areas. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained and soil erosion is held to a minimum. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

If this unit is used for hay and pasture, the main limitations are slope and the low available water capacity. Leveling helps to ensure the uniform application of water. Irrigation water can be applied by the sprinkler and corrugation methods.

If this unit is used for irrigated crops, the main limitations are the hazard of wind erosion, slope, and the low available water capacity. Because of the slope, sprinkler or drip irrigation is most suitable for row crops. Water should be applied in amounts sufficient enough to wet the root zone but small enough to minimize the leaching of plant nutrients. Wind erosion can be reduced by returning crop residue to the soil and minimizing tillage.

Under good management, irrigated cropland and pastureland in this unit is capable of annually producing about 60 to 65 bushels of barley, 45 to 50 bushels of wheat, 20 to 25 tons of corn silage, 5 to 6 tons of alfalfa hay, and 16 to 20 AUM's (animal unit months) per acre.

This unit is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat. Burrowing animals find this unit to be a suitable site for digging.

If this unit is used for homesite development, the main limitations are slope and the hazard of wind erosion. Revegetating disturbed areas around construction sites as soon as possible helps to control wind erosion.

If this unit is used as a site for septic tank absorption fields, the main limitations are slope and seepage. Effluent

from septic tank absorption fields can surface in downslope areas, thus creating a health hazard.

The capability subclass is 3E, irrigated, and 7E, nonirrigated. The range site is Sandy Upland, 5-9" p.z. The wildlife habitat suitability group is 3.

33—Leanto-Bisoodi complex, 1 to 12 percent slopes

This map unit is on plateaus. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the annual frost-free period is 130 to 160 days.

This unit is 40 percent Leanto channery loamy sand and 30 percent Bisoodi channery fine sandy loam. Generally, both soils are found in each delineation, but percentages of each vary greatly according to the area. The Leanto soil tends to dominate areas in the eastern half of the survey area while the Bisoodi soil dominates areas in the western part. The proximity of limestone tends to increase the presence of the Bisoodi soil.

Included in this unit are small areas of rock outcrop; very deep loamy soils that are similar to Cerrillos sandy loam; very deep, very gravelly, loamy soils that are similar to Sheza gravelly sandy loam; a moderately deep loamy soil overlying sandstone that is similar to Nuffel sandy clay loam; and shallow loamy soils that are similar to Mellenthin channery loam. Included areas make up about 30 percent of the total acreage.

The Leanto soil is shallow and well drained. It formed in alluvium and eolian material derived dominantly from sandstone and mudstone. Typically, the surface layer is reddish yellow channery loamy sand 1 inch thick. The upper 9 inches of the subsoil is reddish brown channery fine sandy loam. The lower 4 inches is light reddish brown calcareous channery loam. Sandstone is at a depth of 14 inches. Depth to bedrock ranges from 10 to 20 inches. In some areas the surface layer is channery and very channery loam, sandy loam, or fine sandy loam, and the subsoil is channery sandy clay loam or loam.

Permeability is moderate in the Leanto soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is slight. The hazard of wind erosion is high.

The Bisoodi soil is shallow and well drained. It formed in alluvium derived dominantly from sandstone and limestone. Typically, the surface layer is light brown channery fine sandy loam 1 inch thick. The subsurface layer is reddish yellow and pink, calcareous loam 13 inches thick. The substratum is very pale brown highly weathered sandstone 4 inches thick over unweathered calcareous sandstone. Depth to bedrock ranges from 10 to 20 inches. In some areas the surface layer is channery fine sandy loam.

Permeability is moderate in the Bisoodi soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is medium to rapid, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

Most areas of this unit are used for recreation and livestock grazing. A few areas are used for homesite development.

The potential plant community is mainly black grama, blue grama, galleta, needleandthread, and alkali sacaton. It has a brushy appearance because of fourwing saltbush, broom snakeweed, rabbitbrush, and Mormon tea and a few scattered juniper and pinyon pine. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is poorly suited to the production of herbaceous plants and shrubs for wildlife habitat. Wildlife use of this site is limited to transients from adjacent sites.

If this unit is used for homesite development, the main limitations are depth to rock, wind erosion, and slope. The cuts needed to provide level building sites can expose bedrock. In some places excavation for houses and access roads exposes material that is highly susceptible to wind erosion. Revegetating disturbed areas around construction sites as soon as possible helps to control wind erosion.

If this unit is used as a site for septic tank absorption fields, the main limitation is the shallow depth to bedrock. An engineer should be consulted for design recommendations and installation of onsite sewage treatment facilities. Alternatives are to install holding tanks and to transport the waste and effluent to a more suitable site.

The capability subclass is 7E. The range site is Sandstone Upland, 9-13" p.z., for the Leanto soil and Shallow Loamy, 9-13" p.z., for the Bisoodi soil. The wildlife habitat suitability group is 2 for both soils.

34—Leanto-Bisoodi-Rock outcrop complex, 1 to 20 percent slopes

This map unit is on mesas and buttes. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit is 30 percent Leanto channery sandy loam, 25 percent Bisoodi channery fine sandy loam, and 25 percent Rock outcrop. Generally, both soils are found in each delineation, but percentages of each vary greatly

according to the area. The percentage of Rock outcrop generally is constant in all mapped areas and is so intricately intermingled that it was not practical to map separately. The Leanto soil tends to dominate areas in the eastern half of the survey area, while the Bisoodi soil dominates areas in the western part. The proximity of limestone tends to increase the presence of the Bisoodi soil.

Included in this unit are small areas of very deep loamy soils that are similar to Cerrillos sandy loam; very deep, very gravelly, loamy soils that are similar to Sheza gravelly sandy loam; moderately deep, loamy, gypsic soils that are similar to Arntz fine sandy loam; a shallow to moderately deep clayey soil that overlies mudstone and is similar to Claysprings sandy clay loam; and a moderately deep loamy soil that overlies sandstone and is similar to Nuffel sandy clay loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Leanto soil is shallow and well drained. It formed in alluvium and eolian material derived dominantly from sandstone and mudstone. Typically, the surface layer is reddish yellow channery sandy loam 1 inch thick. The upper 9 inches of the subsoil is reddish brown channery loam. The lower 4 inches is light reddish brown calcareous channery loam. Sandstone is at a depth of 14 inches. Depth to bedrock ranges from 10 to 20 inches. In some areas the surface layer is channery, very channery, flaggy or very flaggy loam, sandy loam, or fine sandy loam and the subsoil is channery sandy clay loam or loam.

Permeability is moderate in the Leanto soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is medium to very rapid, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

The Bisoodi soil is shallow and well drained. It formed in alluvium derived dominantly from sandstone and limestone. Typically, the surface layer is light brown channery fine sandy loam 1 inch thick. The subsurface layer is reddish yellow and pink, calcareous loam 13 inches thick. The substratum is very pale brown highly weathered sandstone 4 inches thick over unweathered calcareous sandstone. Depth to bedrock ranges from 10 to 20 inches. In some areas the surface layer is channery fine sandy loam.

Permeability is moderate in the Bisoodi soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is medium to very rapid, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

Rock outcrop consists of exposed areas of limestone, sandstone, and mudstone. The mesas, buttes, and escarpments are covered by sandstone caps. The moderately steep to vertical side slopes of buttes and mesas expose the horizontal interbedding of sandstone and mudstone. The layers are about 1 foot to 20 feet thick. In some areas 4- to 14-inch thick strata of rocklike crystalline gypsum is interbedded in the mudstone.

Most areas of this unit are used for recreation and livestock grazing. A few areas are used for homesite development.

The potential plant community on the Leanto and Bisoodi soils is mainly black grama, needleandthread, blue grama, galleta, and alkali sacaton. It has a brushy appearance because of fourwing saltbush, broom snakeweed, rabbitbrush, and Mormon tea and a few scattered juniper and pinyon pine. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained and soil erosion is kept to a minimum. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed in places to encourage livestock to graze in areas where access is limited.

The Leanto and Bisoodi soils are poorly suited to the production of herbaceous plants and shrubs for wildlife habitat. Wildlife use of this site is limited to transients from adjacent sites.

The Rock outcrop supports no vegetation but is important for nest sites, resting cover, hunting perches, escape routes, and dens.

If this unit is used for homesite development, the main limitations are depth to rock, slope, blowing dust, and the high shrink-swell potential of the mudstone. The cuts needed to provide level building sites can expose bedrock. Blowing dust can be reduced by moistening the soils during construction and establishing vegetation after construction. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has a low shrink-swell potential.

If this unit is used as a site for septic tank absorption fields, the main limitations are depth to rock and slope. An engineer should be consulted for design recommendations and installation of onsite sewage treatment facilities. Alternatives are to install holding tanks or to transport the waste and effluent to a more suitable site.

The capability class is 8 for Rock outcrop. The capability subclass is 7E for the Leanto and Bisoodi soils. The range site is Sandstone Upland, 9-13" p.z., for the Leanto soil and Shallow Loamy, 9-13" p.z., for the Bisoodi soil. The wildlife habitat suitability group is 2 for the Leanto and Bisoodi soils. Rock outcrop is not assigned a range site or a wildlife habitat suitability group.

35—Lozinta extremely cindery loam, 20 to 60 percent slopes

This very deep and somewhat excessively drained soil is on cinder cones. It formed in materials derived dominantly from cinders. Elevation is 6,000 to 7,000 feet. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 50 to 53 degrees F, and the frost-free period is 110 to 140 days.

Typically, the surface layer is dark brown extremely cindery loam 2 inches thick. The upper 19 inches of the subsoil is dark brown extremely cindery loam. The substratum to a depth of 60 inches or more is pinkish gray and reddish yellow calcium carbonate coated cinders. The amount of calcium carbonate decreases with depth. Depth to cinders ranges from 20 to 30 inches. This soil is neutral.

Included in this unit are small areas of deep clayey soils that are similar to Springerville very gravelly clay loam, moderately deep clayey soils that are similar to Thunderbird gravelly clay loam, and rock outcrop. Slopes of 5 to 20 percent are included on summits and foot slopes. Included areas make up about 5 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderate to a depth of 19 inches and very rapid below this depth in the Lozinta soil. Available water capacity is very low. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is moderate to severe. The hazard of wind erosion is very slight.

This unit is used for livestock grazing, recreation, and fuelwood production. This unit is also a good source of cinders that can be used for road construction, manufacturing cinder blocks, and landscaping.

The potential plant community is mainly blue grama, black grama, needleandthread, pinyon pine, and juniper. Ponderosa pine is on the north-facing slopes. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. In some areas slope limits access by livestock, which results in overgrazing of the less sloping areas.

If this unit is used for fuelwood production, the main limitation is the limited access caused by the slope. On slopes of less than 30 percent, this unit can produce 4 to 6 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Minimizing the risk of erosion is essential in harvesting.

This unit is moderately suited to the production of herbaceous plants, shrubs, and coniferous trees for wildlife habitat. The diverse vegetation provides habitat for many species. Fuelwood gatherers should not disturb nest trees.

If this unit is used for homesite development, the main limitations are slope and seepage. Slope is also a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Effluent from septic tank absorption fields can surface in downslope areas, thus creating a health hazard. Access roads should be designed to provide adequate cut-slope grade, and drains are needed to control surface runoff and keep soil loss to a minimum.

The capability subclass is 7E. The woodland site is Cinder Hills (P.J.), 13-17" p.z. The wildlife habitat suitability group is 3.

36—Manzano sandy clay loam, 0 to 3 percent slopes

This very deep, well drained soil is on flood plains. It formed in mixed alluvium derived dominantly from sandstone, limestone, mudstone, and basalt. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer is brown sandy clay loam 3 inches thick. The subsurface and the upper part of the subsoil is brown and light brown sandy clay loam 24 inches thick. The lower part of the subsoil is light brown, slightly calcareous sandy clay loam 9 inches thick. The substratum to a depth of 60 inches or more is brown calcareous sandy clay loam.

Included in this unit are small areas of very deep loamy soils that are similar to Bagley sandy clay loam and Nuffel silty clay loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in the Manzano soil. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is slight. This soil is subject to occasional, brief periods of flooding from July to September.

This unit is used for irrigated crops and pasture, livestock grazing, and recreation.

This unit is well suited to hay and pasture. Use of nitrogen and phosphorous fertilizer promotes the growth of forage plants. Leveling helps to ensure the uniform application of water. Under good management this unit is capable of annually producing about 6 or 7 tons of alfalfa hay or 20 to 24 AUM's (animal unit months) per acre.

This unit is well suited to irrigated crops. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this unit. The method used generally is governed by the crop. Under

good management this unit is capable of annually producing about 60 to 65 bushels of barley, 50 to 55 bushels of wheat, or 25 to 30 tons of corn silage per acre.

The potential plant community is mainly blue grama, spike muhly, western wheatgrass, and bottlebrush squirreltail. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Good accessibility, a large variety of palatable plants, and the availability of water encourage a constant grazing pressure. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. If water-spreading dikes are installed and grazing is controlled, this unit is highly productive.

This unit is well suited to the production of herbaceous plants, shrubs, and riparian plants for wildlife habitat. Riparian plants such as cottonwood, willow, ash, and walnut grow near water courses in areas where soil moisture is adequate. This type of vegetation provides habitat for a large number of wildlife species. Riparian vegetation should be replanted in drainageways where the soil is moist. Protection from grazing is essential. Competition between cattle and wildlife is high throughout the year.

If this unit is used for homesite development, the main limitations are flooding and the shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Roads and streets should be located above the expected flood level. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has a low shrink-swell potential.

If this unit is used as a site for septic tank absorption fields, the main limitations are flooding and the moderately slow permeability. The permeability limitation can be partially overcome by increasing the size of the absorption field.

The capability subclass is 2W, irrigated, and 6W, nonirrigated. The range site is Loamy Bottom, 9-13" p.z. The wildlife habitat suitability group is 4.

37—Marcou loamy sand, 1 to 8 percent slopes

This very deep, somewhat excessively drained, sodic soil is on stabilized transverse and coppice dunes. It formed in eolian materials over alluvium derived dominantly from various kinds of sedimentary rock. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is light reddish brown, loamy sand about 6 inches thick. The upper 41 inches of the substratum is reddish brown sodic sandy loam. The lower 7 inches is light reddish brown, sodic, sandy clay loam. The buried subsoil to a depth of 60 inches or more is light reddish brown, sodic, loamy coarse sand. This soil has a moderate to high sodium hazard and a sodium absorption ratio of 13 or more. Reaction is moderately alkaline or strongly alkaline. In some areas the surface texture is fine sandy loam and sandy loam and the upper part of the substratum is stratified sandy loam, loamy fine sand, and fine sandy loam. Depth to the finer textured materials ranges from 40 to more than 60 inches.

Included in this unit are small areas of very deep, loamy, sodic soils that are similar to Burnswick sandy loam; shallow clayey soils that are similar to Claysprings clay; very deep loamy soils that are similar to Jocity sandy clay loam; and badland. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately rapid in the Marcou soil. Available water capacity is low or moderate. The salinity hazard is moderate, and the sodium hazard is moderate to strong. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is high.

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

The potential plant community is mainly Indian ricegrass, black grama, galleta, alkali sacaton, and sandhill muhly. It has scattered areas of fourwing saltbush, Mormon tea, shadscale, and yucca. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained and erosion is controlled. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. The production of vegetation suitable for livestock grazing is limited by the content of toxic salts.

This unit is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat.

If this unit is used for homesite development, the main limitations are the hazard of wind erosion, low strength, and sulfate damage to concrete. Preserving the existing plant cover during construction helps to control erosion. Revegetating disturbed areas around construction sites as soon as possible helps to control wind erosion. Buildings and roads should be designed to offset the limited ability of the Marcou soil to support a load. Type 5 cement is recommended to minimize sulfate damage.

If this unit is used as a site for septic tank absorption fields, the main limitation is seepage. Effluent from septic tank absorption fields can surface in downslope areas, thus creating a health hazard. If the density of housing is moderate to high, community sewage systems are needed to prevent a health hazard as a result of seepage from onsite sewage disposal systems.

The capability subclass is 7E. The range site is Sandy Upland (sodic), 5-9" p.z. The wildlife habitat suitability group is 3.

38—Medisaprists, saline, 0 to 1 percent slopes

This very deep, poorly drained soil is on flood plains and in the seep areas of Obed Meadow, Hugo Meadow, and McDonald's Spring along the Little Colorado River. It formed in decomposed plant material and mixed alluvium derived dominantly from sandstone and mudstone. Slope is 0 or 1 percent. Elevation is 5,000 to 5,100 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is very dark gray sapric material (fibrous organic material) 6 inches thick. The upper 6 inches of the substratum is very pale brown silt loam, the next 38 inches is very dark gray sapric material (highly decomposed herbaceous fibers), and the lower part to a depth of 62 inches is light gray silty clay.

Included in this unit are small areas of very deep, poorly drained, coarse loamy soils that are similar to Ives fine sandy loam (wet); very deep, poorly drained, clayey soils that are similar to Navajo silty clay (wet); and very deep, somewhat poorly drained, loamy soils that are similar to Jocity silty clay (wet). Included areas make up about 10 percent of the total acreage.

Permeability is moderate in the Medisaprists. Available water capacity is high. The salinity hazard is high, and the sodium hazard is slight. The effective rooting depth varies with the depth to the water table. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is high. Frequent, brief periods of flooding can occur year round. The water table is at or near the surface most of the year.

This unit is used for recreation and livestock grazing. The potential plant community is mainly saltgrass, redtop bent grass, sedge, and plantain. The production of vegetation suitable for livestock grazing is limited by the high water table and excess salts.

This unit is well suited to the production of herbaceous plants and shrubs for wildlife habitat. This vegetation provides habitat for a large number of wildlife species. Competition between cattle and wildlife is high throughout the year.

The capability subclass is 6W. The range site is Saline Subirrigated, 5-9" p.z. The wildlife habitat suitability group is 4.

39—Mellenthin-Rock outcrop complex, 1 to 20 percent slopes

This map unit is on buttes and mesas. Elevation is 5,000 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit is 50 percent Mellenthin very channery fine sandy loam and 25 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of shallow loamy soils that are similar to Bisoodi and Leanto channery sandy loams; a moderately deep, clayey, moist variant of Navajo silty clay; and a moderately deep loamy soil that is similar to Nuffel silty clay loam. Included areas make up about 25 percent of the total acreage. The percentage varies from one area to another.

The Mellenthin soil is very shallow and shallow and well drained. It formed in alluvium derived dominantly from limestone and calcareous sandstone. Typically, the surface layer is reddish brown very channery fine sandy loam 1 inch thick. The upper 5 inches of the subsoil is light reddish brown very channery loam. The lower part to a depth of 12 inches is pink calcareous very channery loam. Fractured limestone is at a depth of 12 to 20 inches. Limestone is at a depth of 20 inches. Depth to bedrock ranges from 8 to 20 inches. In some areas the surface layer is very channery sandy loam. This soil contains moderate to high amounts of lime. It is moderately alkaline.

Permeability is moderate in the Mellenthin soil. Available water capacity is very low. The effective rooting depth is 8 to 20 inches. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is very slight.

Rock outcrop consists of exposed areas of limestone and calcareous sandstone. Vertical cliffs of exposed limestone are 10 to 100 feet high. Sink holes also expose limestone.

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

The potential plant community is mainly needleandthread, New Mexico feathergrass, black grama, and blue grama. Winterfat, Mormon tea, Bigelow sagebrush, and shrubby buckwheat are in some places. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are

fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat. Scattered pinyon-juniper trees add structural diversity to this open grassland.

The Rock outcrop supports no vegetation but is important for nest sites, resting cover, hunting perches, escape routes, and dens.

If this unit is used for homesite development, the main limitation is depth to rock. The cuts needed to provide level building sites can expose bedrock. Lawn grasses, shrubs, and trees that are not sensitive to lime-induced chlorosis are well suited to use in landscaping. An annual application of iron chelates reduces the chlorosis. Removal of channers and flagstone in disturbed areas is needed for best results when landscaping, particularly in areas used for lawns.

If this unit is used as a site for septic tank absorption fields, the main limitation is depth to rock. An engineer should be consulted for design recommendations and installation of onsite sewage treatment facilities. An alternate method of waste disposal is installing a holding tank and transporting the waste and effluent off site to a more suitable soil.

The capability subclass is 7S for the Mellenthin soil. The capability class is 8 for Rock outcrop. The range site is Shallow Loamy, 9-13" p.z., for the Mellenthin soil; and the wildlife habitat suitability group is 3. Rock outcrop is not assigned a range site or a wildlife habitat suitability group.

40—Navajo silty clay, saline-sodic, 0 to 1 percent slopes

This very deep, well drained saline-sodic soil is on flood plains. It formed in mixed alluvium derived dominantly from sandstone, mudstone, and basalt. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is reddish brown silty clay 5 inches thick. The upper 15 inches of the underlying material is reddish brown silty clay. The lower part to a depth of 60 inches is reddish brown clay. In some areas the surface texture is clay and silty clay loam. This soil is strongly saline and moderately to strongly alkaline throughout.

Included in this unit are small areas of shallow clayey soils that are similar to Claysprings clay, very deep loamy soils that are similar to Jocity sandy clay loam and Tours silty clay loam, and shallow loamy soils that are similar to Epikom sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is very slow in the Navajo soil. Available water capacity is very low. The salinity hazard is high, and the sodium hazard is moderate. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is moderate. This soil is subject to occasional, brief periods of flooding from July to September.

This unit is used for irrigated pasture, irrigated crops, livestock grazing, and recreation.

If this unit is used for hay and pasture, the main limitations are the very slow permeability, the flooding hazard, and the content of toxic salts. Levees, dikes, and channels can be used to limit flood damage. The toxic salts are difficult to leach from the root zone even with good quality water. Leveling helps to ensure the uniform application of water. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Use of nitrogen and phosphorous fertilizer promotes the growth of forage plants. Under intensive management about 12 to 15 AUM's (animal unit months) or 3 to 4 tons of alfalfa hay per acre can be produced annually on this soil.

If this unit is used for irrigated crops, the main limitations are the content of toxic salts, the flooding hazard, and the very slow permeability. The content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. For the efficient application and removal of irrigation water, leveling is helpful in sloping areas. Because of the very slow permeability, the length of irrigation runs should be adjusted to permit adequate infiltration of water. Subsoiling improves water infiltration and allows salts to be leached downward. Levees, dikes, and channels can be used to limit flood damage. Under intensive management about 15 to 20 tons of corn silage, 30 to 40 bushels of wheat, or 40 to 50 bushels of barley per acre can be produced annually on this soil.

The potential plant community is mainly alkali sacaton, inland saltgrass, and galleta. Fourwing saltbush, black greasewood, mound saltbush, and seepweed are in some areas. If the range is overgrazed, the proportion of desirable forage plant decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Proper grazing use and a planned grazing system are needed to maintain or improve the production of forage. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment. Grazing should be delayed until the soil has drained sufficiently and is firm enough to withstand trampling by livestock.

This unit is moderately suited to the production of wild herbaceous plants and shrubs for wildlife habitat. Water can stand in the flat areas after rain storms. Competition

between cattle and wildlife can be high during the growing season.

If this unit is used for homesite development, the main limitations are flooding, sulfate damage to concrete, and the shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Roads and streets should be located above the expected flood level. Type 5 cement is recommended to minimize sulfate damage. If buildings are constructed on this soil, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling.

If this unit is used as a site for septic tank absorption fields, the main limitations are flooding and the very slow permeability. An engineer should be consulted for design recommendations for the installation of onsite sewage treatment facilities.

The capability subclass is 5W, irrigated, and 7W, nonirrigated. The range site is Saline Bottom, 5-9" p.z. The wildlife habitat suitability group is 3.

41—Navajo silty clay, saline-sodic, 1 to 3 percent slopes

This very deep, well drained, saline-sodic soil is on flood plains and alluvial fans. It formed in mixed alluvium derived dominantly from sandstone, mudstone, and basalt. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is reddish brown silty clay 5 inches thick. The upper 15 inches of the underlying material is reddish brown silty clay. The lower part to a depth of 60 inches or more is reddish brown clay. In some areas the surface layer is silty clay loam. The soil is strongly saline and moderately alkaline throughout.

Included in this unit are small areas of very deep loamy soils that are similar to Tours clay loam and shallow to moderately deep clayey soils that are similar to Claysprings silty clay. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is very slow in the Navajo soil. Available water capacity is very low. The salinity hazard is high, and the sodium hazard is moderate. The effective rooting depth is 60 inches or more. Runoff is moderate, and the hazard of water erosion is slight. The hazard of wind erosion is moderate. This soil is subject to occasional, brief periods of flooding from July to September.

This unit is used for rangeland and recreation. It can be used for irrigated pasture and crops if good quality water is available.

The potential plant community is mainly alkali sacaton, inland saltgrass, and galleta. Fourwing saltbush, black greasewood, and mound saltbush are in some areas. The production of vegetation suitable for livestock grazing is limited by the content of toxic salts. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. This results in overgrazing and the subsequent deterioration of the vegetation. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

If this unit is used for hay and pasture, the main limitations are the content of toxic salts and the very slow permeability. The toxic salts are difficult to leach from the root zone, even with good quality water. All adapted pasture plants can be grown, but bunch-type species planted alone generally are not suitable because of the hazard of erosion. Use of nitrogen and phosphorous fertilizer promotes the growth of forage plants. Leveling helps to ensure the uniform application of water. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Under intensive management about 12 to 15 AUM's (animal unit months) or 3 to 4 tons of alfalfa hay per acre can be produced annually on this soil.

If this unit is used for irrigated crops, the main limitations are the content of toxic salts and the very slow permeability. The content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. For the efficient application and removal of irrigation water, leveling is helpful in sloping areas. Because of the very slow permeability, the length of irrigation runs should be adjusted to permit adequate infiltration of water. Subsoiling improves water infiltration and allows salts to be leached downward. Under intensive management about 15 to 20 tons of corn silage, 30 to 40 bushels of wheat, or 40 to 50 bushels of barley per acre can be produced annually on this soil.

This unit is moderately suited to the production of wild herbaceous plants and shrubs for wildlife habitat. Water can stand in the flat areas after rain storms. Competition between cattle and wildlife can be high during the growing season.

If this unit is used for homesite development, the main limitations are flooding, sulfate damage to concrete, and the shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Roads and streets should be located above the expected flood level.

Type 5 concrete is recommended to minimize sulfate damage. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling.

If this unit is used as a site for septic tank absorption fields, the main limitations are flooding and the very slow permeability. An engineer should be consulted for design recommendations for the installation of onsite sewage treatment facilities.

The capability subclass is 5W, irrigated, and 7W, nonirrigated. The range site is Saline Bottom, 5-9" p.z. The wildlife habitat suitability group is 3.

42—Navajo silty clay, wet, 0 to 1 percent slopes

This very deep, poorly drained, saline soil is on flood plains. It formed in mixed alluvium derived dominantly from sandstone and mudstone. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, a 1- to 5-millimeter thick white salt crust partially covers the surface. The surface layer is reddish brown silty clay 5 inches thick. The upper 15 inches of the underlying material is reddish brown silty clay. The lower part to a depth of 60 inches is reddish brown clay. Salt crystals are common throughout the profile. In some areas a 3- to 8-inch thick organic mat is on the surface. Seeps and springs or a seasonal high water table keep this soil wet year round in some areas.

Included in this unit are small areas of very deep, poorly drained, coarse loamy soils that are similar to Ives fine sandy loam, wet, and very deep, somewhat poorly drained, saline soils that are similar to Tours silty clay loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is very slow in the Navajo soil. Available water capacity is very low. Seeps and springs keep this soil wet in some areas. Other areas have a seasonal high water table. The effective rooting depth varies with the depth to the water table. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is moderate. This soil is subject to occasional, brief periods of flooding from July to September. The water table is at or near the surface most of the year.

This unit is used for recreation and livestock grazing.

The potential plant community is mainly alkali sacaton, inland saltgrass, galleta, and vine mesquite. Fourwing saltbush, black greasewood, mound saltbush, and seepweed are in some places. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Proper grazing use, range seeding, and a planned grazing system are needed to maintain or improve the production of forage. Plants that tolerate wetness should be seeded. Areas that are heavily infested with undesirable plants can be improved by chemical or mechanical treatment.

This unit is well suited to the production of herbaceous plants, shrubs, and riparian plants for wildlife habitat. This vegetation provides habitat for a large number of wildlife species. Competition between cattle and wildlife is high throughout the year.

If this unit is used for homesite development, the main limitations are flooding, wetness, sulfate damage to concrete, and the shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Drainage is needed if roads and building foundations are constructed. Type 5 cement is recommended to minimize sulfate damage. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling.

This unit is not suited to sites for septic tank absorption fields. The main limitations are flooding, the seasonal high water table, and the very slow permeability.

The capability subclass is 7W. The range site is Saline Subirrigated, 5-9" p.z. The wildlife habitat suitability group is 4.

43—Nuffel silt loam, 0 to 3 percent slopes

This very deep, well drained soil is on flood plains and alluvial fans. It formed in mixed alluvium derived dominantly from sandstone, limestone, mudstone, and basalt. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer is light reddish brown silt loam 2 inches thick. The subsurface layer and substratum to a depth of 60 inches or more are stratified reddish brown and light reddish brown silty clay loam. The substratum is stratified with thin strata of silt, silt loam, and silty clay. This soil is slightly alkaline to moderately alkaline throughout.

Included in this unit are small areas of very deep loamy soils that are similar to Bagley clay loam and Lynx silt loam and a very deep clayey soil that is similar to this Nuffel soil. Some areas of soils in the Millett Swale area are poorly drained. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in the Nuffel soil. Available water capacity is very high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion is slight. This soil is subject to occasional, very brief periods of flooding from July to September.

This unit is used for livestock grazing, irrigated crops and pasture, and recreation.

The potential plant community is mainly blue grama, western wheatgrass, and bottlebrush squirreltail. It also has a few scattered juniper and cottonwood trees. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Fencing and deferred grazing are important in planned grazing systems. Range seeding is suitable if the range is in poor condition.

This unit is well suited to the production of herbaceous plants, shrubs, and riparian plants for wildlife habitat. Riparian plants such as cottonwood, willow, ash, and walnut grow near water courses where soil moisture is adequate. These types of vegetation provide habitat for a large number of wildlife species. Riparian vegetation should be replanted in drainageways in areas where the soil is moist. Protection from grazing is essential. Competition between cattle and wildlife is high throughout the year.

This unit is well suited to hay and pasture. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Leveling helps to ensure the uniform application of water. Annual applications of nitrogen and phosphorous fertilizers are needed to maintain production of high quality irrigated pasture. Levees, dikes, and channels can help limit damage from flooding. Under good management about 20 to 24 AUM's (animal unit months) or 6 to 7 tons of alfalfa hay per acre can be produced annually on this unit.

This unit is well suited to adapted, irrigated crops. Because of the slow permeability of the soil, the length of runs should be adjusted to permit adequate infiltration of water. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Returning crop residue to the soil or regularly adding other organic matter improves fertility, reduces crusting, and increases the water intake rate. Levees, dikes, and channels can help limit damage from flooding. Under good management about 65 to 70 bushels of barley, 50 to 55 bushels of wheat, and 25 to 30 tons of corn silage per acre can be produced annually on this unit.

If this unit is used for homesite development, the main limitations are flooding and the shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

The capability subclass is 3W, irrigated, and 6W, nonirrigated. The range site is Loamy Bottom, 9-13" p.z. The wildlife habitat suitability group is 3.

44—Padilla-Cerrillos complex, 1 to 10 percent slopes

This map unit is on fan terraces. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit is 55 percent Padilla sandy clay loam and 30 percent Cerrillos sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of very deep loamy soils that are similar to Barx sandy loam, very deep clayey soils that are similar to Poley clay loam, and very deep loamy soils that are similar to Lynx sandy clay loam and Nuffel silt loam. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

The Padilla soil is very deep and well drained. It formed in mixed alluvium derived dominantly from mudstone and sandstone. Slopes are 1 to 5 percent. Typically the surface and subsurface layers are reddish brown sandy clay loam 8 inches thick. The subsoil is reddish brown clay to a depth of 60 inches. This soil is slightly alkaline to moderately alkaline in the surface layer and moderately alkaline below the surface layer. In some areas the surface texture is fine sandy loam or gravelly loam. Weathered mudstone can occur at depths of 40 to 60 inches or more.

Permeability is slow in the Padilla soil. Available water capacity is high or very high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is slight.

The Cerrillos soil is very deep and well drained. It formed in mixed alluvium derived dominantly from sandstone, mudstone, and basalt. Slopes are 1 to 10 percent. Typically, the surface layer is reddish brown sandy loam 2 inches thick. The subsoil is reddish brown and light reddish brown sandy clay loam 13 inches thick. The upper 19 inches of the underlying material is reddish yellow calcareous clay loam. The lower part to a depth of 60 inches is light reddish brown sandy clay loam. This soil is

moderately alkaline throughout. In some areas the surface is gravelly sandy loam, fine sandy loam, or sandy clay loam. Depth to highly calcareous material ranges from 10 to 20 inches.

Permeability is moderately slow in the Cerrillos soil. Available water capacity is high or very high. The effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

This unit is used mainly for recreation and livestock grazing. It also is used for homesite development.

The potential plant community on the Padilla soil is mainly blue grama, western wheatgrass, galleta, alkali sacaton, and sideoats grama. The potential plant community on the Cerrillos soil is juniper and pinyon pine that have an understory of black grama, blue grama, sideoats grama, galleta, and fourwing saltbush. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Range seeding is suitable if the range is in poor condition. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Fencing and deferred grazing are important in planned grazing systems.

The Padilla soil is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat. Competition between wildlife and cattle can be severe throughout the year.

The Cerrillos soil is moderately suited to the production of herbaceous plants and shrubs. This vegetation is preferred by open rangeland wildlife. This soil is moderately suited to the production of coniferous trees. These pinyon-juniper woodlands provide habitat for many species. Fuelwood gatherers should not disturb nest trees.

If the Padilla soil is used for homesite development, the main limitations are the high shrink-swell potential and the slow permeability. If buildings are constructed on this soil, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling. If onsite sewage disposal is to be used, an engineer should be consulted for design recommendations to compensate for the slow permeability.

If the Cerrillos soil is used for homesite development, the main limitation is slope.

The capability subclass is 6S for the Padilla soil and 6E for the Cerrillos soil. The range site is Clay Loam Upland, 9-13" p.z., for the Padilla soil and Sandy Loam Upland, 9-13" p.z, for the Cerrillos soil. The wildlife habitat suitability group is 3 for both soils.

45—Pensom-Chedeski complex, 1 to 5 percent slopes

This map unit is on broad plateaus that have coppice dunes. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit is 40 percent Pensom fine sand on coppice dunes and 40 percent Chedeski sandy loam between the dunes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of rock outcrop, very deep loamy soils that are similar to Barx sandy loam, very deep clayey soils that are similar to Poley sandy clay loam, very deep loamy soils that are similar to Nuffel sandy clay loam, and other loamy to sandy, shallow to deep soils over sandstone. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Pensom soil is deep and excessively drained. It formed in eolian sediments over mixed alluvium derived dominantly from sandstone with a minor influence from mudstone and limestone. Typically, the surface layer is yellowish red fine sand about 17 inches thick. The next layer is yellowish red loamy fine sand about 24 inches thick. The subsoil is light reddish brown calcareous fine sandy loam and loam about 10 inches thick over sandstone. Sandstone is at a depth of 51 inches. Depth to bedrock ranges from 45 to 60 inches.

Permeability is rapid in the Pensom soil. Available water capacity is low or moderate. The effective rooting depth is 45 to 60 inches. Runoff is very slow, and the hazard of water erosion is moderate. The hazard of wind erosion is high.

The Chedeski soil is shallow and well drained. It formed in mixed alluvium derived dominantly from sandstone, mudstone, and limestone. Typically, the surface layer is yellowish red sandy loam about 1 inch thick. The upper subsoil is red sandy loam and sandy clay loam about 12 inches thick. The next layer is reddish yellow, calcareous, sandy clay loam about 3 inches thick. The underlying material to a depth of 26 inches is highly weathered sandstone over hard, unweathered bedrock at depths ranging from 20 to 35 inches.

Permeability is moderate in the Chedeski soil. Available water capacity is low. The effective rooting depth is 10 to 20 inches. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

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

The potential plant community on the Pensom soil is mainly black grama, galleta, sideoats grama, and blue

grama with a woody overstory of pinyon pine and oneseed juniper. The potential plant community on the Chedeski soil is mainly black grama and blue grama with a woody overstory of pinyon pine and oneseed juniper. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Brush management improves deteriorated areas of range that are reproducing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning or by chemical or mechanical methods are subject to a greater hazard of erosion. Range seeding is suitable if the range is in poor condition. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is poorly suited to the production of herbaceous plants and shrubs for wildlife habitat. Wildlife use of this site is limited to transients from adjacent sites. Fuelwood gatherers should not disturb nest trees.

This unit is moderately suited to fuelwood production. It can produce 3 to 4 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Minimizing the risk of erosion is essential in harvesting fuelwood.

If this unit is used for homesite development, the main limitations are wind and water erosion, depth to bedrock, and seepage.

The capability subclass is 6E for the Pensom and Chedeski soils. The range site is Sandy Upland, 9-13" p.z., for the Pensom soil and Sandstone Upland, 9-13" p.z., for the Chedeski soil. The wildlife habitat suitability group is 1 for both soils.

46—Penzance-Grieta complex, 0 to 5 percent slopes

This map unit is on fan terraces on plateaus. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit is 55 percent Penzance clay loam and 25 percent Grieta sandy loam. The Penzance soils are in swales and on toe slopes. The Grieta soils are on toe slopes and foot slopes of surrounding hills.

Included in this unit are small areas of shallow clayey soils that are similar to Claysprings clay loam; very deep sandy soils that are similar to Sheppard loamy sand and Kinan sandy loam; and moderately deep, loamy, gypsic soils that are similar to Purgatory sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Penzance soil is very deep and well drained. It formed in mixed alluvium derived dominantly from sandstone and mudstone. Slopes are 0 to 2 percent. Typically, the surface layer is reddish brown clay loam 3 inches thick. The subsoil is light reddish brown and reddish brown clay to a depth of 60 inches or more. In some areas the surface layer is clay loam, sandy clay, and sandy loam. This soil is moderately alkaline to strongly alkaline and nonsaline to slightly saline throughout.

Permeability is slow in the Penzance soil. Available water capacity is moderate to very high. Saline and sodium hazards are low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is slight.

The Grieta soil is very deep and well drained. It formed in alluvium derived dominantly from sandstone and mudstone. Slopes are 1 to 5 percent. Typically, the surface layer is reddish brown sandy loam 3 inches thick. The upper 17 inches of the subsoil is reddish brown sandy clay loam. The lower 24 inches is light reddish brown calcareous sandy clay loam. The substratum to a depth of 60 inches or more is light reddish brown sandy loam. This soil is moderately alkaline and nonsaline throughout. In some areas the surface layer is sandy clay loam, fine sandy loam, or gravelly sandy loam. Depth to maximum lime accumulation ranges from 20 to 24 inches. Depth to coarse textured material ranges from 36 to 50 inches or more.

Permeability is moderate in the Grieta soil. Available water capacity is moderate or high. Saline and sodium hazards are low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

This unit is used for livestock grazing, recreation, and homesite development. It can be used for irrigated crops and pasture if good quality water is available.

The potential plant community on the Penzance soil is mainly alkali sacaton, western wheatgrass, blue grama, and needleandthread. The potential plant community on the Grieta soil is mainly Indian ricegrass, New Mexico feathergrass, and needleandthread. It has a brushy appearance due to fourwing saltbush, Mormon tea, Bigelow sagebrush, and winterfat.

Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. This results in overgrazing and subsequent deterioration of vegetation. Planned grazing systems are essential to maintain plant vigor and forage production. Fencing and deferred grazing are important in planned grazing systems. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat.

Competition between wildlife and cattle can be severe during all seasons.

If the Penzance soil is used for homesite development, the main limitation is the high shrink-swell potential. The Grieta soil is well suited to homesite development. If buildings are constructed on the Penzance soil, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

If the Penzance soil is used as a site for septic tank absorption fields, the slow permeability is a limitation. It can be partially overcome by increasing the size of the absorption field. An engineer should be consulted for design recommendations for the installation of onsite sewage disposal systems. The Grieta soil is well suited for use as septic tank absorption fields.

If the Penzance soil is used for irrigated crops, the main limitations are slow permeability and ponding. Proper row arrangement, field ditches, and vegetated outlets are needed to remove excess water on the surface. Sprinkler irrigation can be used but water needs to be applied slowly to minimize runoff. For the efficient application and removal of irrigation water, leveling is helpful in sloping areas.

The Grieta soil is well suited to irrigated crops. It is limited mainly by slope and wind erosion. Because of the slope, sprinkler or drip irrigation is most suitable for crops. To avoid overirrigating and leaching of plant nutrients, applications of irrigation water should be adjusted to the available water capacity, the water intake rate, and the needs of the crop. For the efficient application and removal of irrigation water, leveling is helpful in sloping areas. Under good management and with an adequate supply of good water about 60 to 65 bushels of barley, 45 to 50 bushels of winter wheat, or 20 to 25 tons of corn silage per acre can be produced annually on these soils.

If the Penzance soil is used for hay and pasture, the main limitations are slow permeability and compaction. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Excessive water on the surface can be removed by proper leveling and field design with outlets to remove excess water. Rotation grazing helps to maintain the quality of forage. Irrigation water can be applied by the sprinkler, border, or corrugation methods.

The Grieta soil is well suited to hay and pasture. The main limitation is wind erosion. All adapted pasture plants can be grown but bunch-type species planted alone generally are not suitable because of the hazard of erosion. Rotation grazing helps to maintain the quality of forage. Irrigation water can be applied by the sprinkler, border, or corrugation methods. Fertilizer is needed to ensure optimum growth of grasses and legumes. Under good management and with an adequate supply of good quality water about 5 to 6 tons of alfalfa hay and about 10 to 15 AUM's (animal unit months) per acre can be produced annually on these soils.

The capability subclass is 3S, irrigated, and 7S, nonirrigated, for the Penzance soil and 3E, irrigated, and 7E, nonirrigated, for the Grieta soil. The range site is Clay Loam Upland, 5-9" p.z., for the Penzance soil and Sandy Loam Upland, 5-9" p.z. for the Grieta soil. The wildlife habitat suitability group is 3 for both soils.

47—Poley fine sandy loam, 1 to 5 percent slopes

This very deep, well drained soil is on fan terraces on plateaus. It formed in mixed alluvium derived dominantly from sandstone, limestone, mudstone, and basalt. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer is light brown fine sandy loam 1 inch thick. The subsurface layer is light reddish brown loam 3 inches thick. The upper 9 inches of the subsoil is reddish brown clay loam. The middle 9 inches is light reddish brown clay. The lower 25 inches is light reddish brown calcareous clay. The underlying material to a depth of 60 inches or more is reddish yellow, calcareous, sandy clay loam. In some areas the surface layer is sandy loam, loam, and sandy clay loam. This soil is slightly to moderately alkaline throughout.

Included in this unit are small areas of very deep loamy soils that are similar to Barx sandy loam and Cerrillos sandy loam and very deep fine silty soils that are similar to Nuffel silt loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is slow in the Poley soil. Available water capacity is high or very high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

This unit is used mainly for livestock grazing, irrigated crops and pastures, and recreation. It is also used for homesites.

The potential plant community is mainly black grama, blue grama, sideoats grama, and galleta with scattered fourwing saltbush and juniper. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained and the

risk of soil erosion is reduced. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Fencing and deferred grazing are important in planned grazing systems. Range seeding is suitable if the range is in poor condition.

This unit is moderately suited to the production of herbaceous plants and shrubs. Open rangeland wildlife prefer this site.

This unit is moderately suited to irrigated crops. It is limited mainly by slope, slow permeability, and wind erosion. Proper row arrangement, field ditches, and vegetated outlets are helpful in removing excess water on the surface. Sprinkler irrigation can be used, but water needs to be applied slowly to minimize runoff. For efficient application and removal of irrigation water, leveling is helpful in sloping areas. Under good management about 60 to 65 bushels of barley, 45 to 50 bushels of wheat, or 20 to 25 tons of corn silage per acre can be produced annually on this soil.

This unit is moderately suited to hay and pasture. The main limitations are slow permeability, slope, and compaction. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Excessive water on the surface can be removed by proper leveling and field design with outlets to remove excess water. Rotation grazing helps to maintain the quality of forage. Irrigation water can be applied by the sprinkler, border, or corrugation methods. Under good management about 5 to 6 tons of alfalfa hay or about 16 to 20 AUM's (animal unit months) per acre can be produced annually on this soil.

If this unit is used for homesite development, the main limitations are the moderate shrink-swell potential and the hazard of wind erosion. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has a low shrink-swell potential. Preserving the existing plant cover during construction helps to control erosion. Revegetating disturbed areas around construction sites as soon as possible helps to control wind erosion.

The capability subclass is 3E, irrigated, and 6E, nonirrigated. The range site is Loamy Upland, 9-13" p.z. The wildlife habitat suitability group is 3.

48—Purgatory fine sandy loam, 1 to 8 percent slopes

This moderately deep, well drained soil is on plateaus. It formed in residuum and eolian material derived dominantly from gypsiferous mudstone and sandstone. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the annual frost-free period is 150 to 180 days.

Typically, the surface layer is light brown fine sandy loam 1 inch thick. The upper 19 inches of the subsoil is pink gypsiferous loam. The lower part to a depth of 27 inches is reddish brown gypsiferous clay loam. The underlying material to a depth of 49 inches is weathered gypsiferous mudstone over rippable mudstone. In some areas the surface layer is gravelly loam or gravelly sandy loam. Depth to weathered gypsiferous mudstone ranges from 20 to 40 inches. Crystalline gypsum is in moderate to high amounts throughout the profile.

Included in this unit are small areas of gypsum mounds, shallow clayey soils that are similar to Claysprings clay, very deep fine silty soils that are similar to Tours clay loam, very deep clayey soils that are similar to Navajo silty clay, very deep loamy soils that are similar to Grieta sandy loam, and mudstone and sandstone outcrops. Included areas make up about 25 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in the Purgatory soil. Available water capacity is low. The high content of gypsum is easily leached, and subsidence occurs. The effective rooting depth is 20 to 40 inches. Roots can extend to a depth of more than 60 inches in areas where the mudstone and gypsum lenses are fractured. Runoff is slow to medium, and the hazard of water erosion is moderate to severe. The hazard of wind erosion is moderately high.

This unit is used for recreation and livestock grazing.

The potential plant community is mainly galleta, gyp dropseed, alkali sacaton, and Indian ricegrass. Fourwing saltbush, Mormon tea, Bigelow sagebrush, and shadscale are in some areas. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is moderately suited to the production of herbaceous plants and shrubs. It has good plant diversity for wildlife use. Competition between wildlife and livestock can be severe during all seasons.

If this unit is used for homesite development, the main limitations are subsidence, sulfate damage to concrete, and wind erosion. Construction of homes and other buildings on this unit tends to alter the runoff pattern of the rainfall. Large amounts of water concentrate in areas, and the water leaches gypsum from the soil. The weight of the building then causes this leached soil to subside, and structural damage results.

The limited ability of this soil to support a load can be

partially overcome by diverting runoff away from the building, sloping the surface of the soil away from the building, installing rain gutters and downspouts on the eaves, excavating and packing the subsoil or replacing it with material that has a high load-bearing capacity, and putting extra reinforcement in the wide foundations needed to support buildings on this soil. An engineer should be consulted for design recommendations when developing any area in or near this unit. Type 5 cement is recommended to minimize sulfate damage.

This soil erodes easily. When disturbed, erosion by wind and water is accelerated. Special care must be taken to minimize erosion during the construction of homes, roads, and trails.

The capability subclass is 7E. The range site is Gypsum Upland, 5-9" p.z. The wildlife habitat suitability group is 3.

49—Radnik silt loam, 0 to 3 percent slopes

This very deep, well drained soil is on flood plains and alluvial fans. It formed in mixed alluvium derived dominantly from sandstone and mudstone. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer is brown silt loam 4 inches thick. The substratum to a depth of 45 inches or more is light yellowish brown and brown highly stratified silt loam to loamy fine sand. The underlying material to a depth of 60 inches or more is brown sandy clay loam. This soil is moderately alkaline throughout. In areas the surface layer is fine sandy loam.

Included in this unit are small areas of very deep loamy soils that are similar to Nuffel silt loam, moderately deep soils that are similar to this Radnik soil, and coppice sand dunes. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderate in the Radnik soil. Available water capacity is high or very high. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is also slight. This soil is subject to occasional, brief periods of flooding from July to September.

This unit is used for recreation and livestock grazing.

The potential plant community is mainly western wheatgrass, fourwing saltbush, bottlebrush squirreltail, and sand dropseed. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Range seeding is suitable if the range is in poor condition. Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. This results in overgrazing and the subsequent deterioration of the vegetation. This unit is limited as a site for livestock watering ponds and other water impoundments because of the seepage potential.

This unit is moderately suited to the production of wild herbaceous plants and shrubs for wildlife habitat. Water can stand in the flat areas after rain storms. Competition between cattle and wildlife can be high during the growing season.

If this unit is used for homesite development, the main limitation is the flooding. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding.

The capability subclass is 6W. The range site is Loamy Bottom, 9-13" p.z. The wildlife habitat suitability group is 4.

50—Riverwash-Typic Torrifluvents complex, 0 to 5 percent slopes

This map unit is in drainageways. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit is 50 percent Riverwash and 35 percent Typic Torrifluvents. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of sand dunes such as Torripsamments, deep organic deposits such as Torric Medisaprists, and wetlands. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Riverwash is deep or very deep and somewhat poorly drained. It formed in mixed alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. Riverwash is unstabilized highly stratified, gravelly to cobbly, sandy, silty, and clayey sediment that has been flooded, washed, and reworked by the Little Colorado River and its tributaries so frequently that it supports little or no vegetation.

Typic Torrifluvents are deep or very deep and poorly to well drained. They formed in mixed alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. A typical pedon has a light reddish brown sand surface layer 9 inches thick. The substratum to a depth of 60 inches or more is light reddish brown loamy sand stratified with silt loam and fine gravel. Typic Torrifluvents are highly stratified clay, silt, and sand with varying amounts of coarse fragments. Depth to bedrock ranges from 40 to more than 60 inches. They commonly are saline, and they support stands of saltcedar and cottonwood trees. This soil is subject to frequent, brief periods of flooding from March through September.

Permeability is generally moderate in the Typic

Torrifluvents, but it ranges from slow to rapid depending on the nature and number of the thin strata and the depth to the strata. Available water capacity is low.

This unit is used for recreation and livestock grazing.

The potential plant community is mainly cottonwood, saltcedar, and willow trees with an understory of western wheatgrass, Indian ricegrass, bottlebrush squirreltail, and sand dropseed. The diversity of vegetation, which includes an abundance of streamside plants, and the availability of water encourage a constant grazing pressure. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community.

This unit is well suited to the production of herbaceous plants, shrubs, and riparian plants for wildlife habitat. Riparian plants such as cottonwood, willow, ash, and walnut grow near water courses where soil moisture is adequate. These types of vegetation provide habitat for a large number of wildlife species.

Riparian vegetation should be replanted in drainageways where the soil is moist. Protection from grazing is essential. Competition between livestock and wildlife is high throughout the year.

This unit provides habitat for an abundance of wildlife in areas near a permanent water supply. The cliffs of the Little Colorado River, Silver Creek, Clear Creek, and Chevelon Canyon are used as nesting places for the rare and endangered Golden Eagle and Peregrine Falcon.

The capability class is 8 for Riverwash. The capability subclass is 7W for Typic Torrifluvents. The range site is Loamy Bottom, 5-9" p.z., for Typic Torrifluvents; and the wildlife habitat suitability group is 4. Riverwash is not assigned a range site or a wildlife habitat suitability group.

51—Riverwash-Ustic Torrifluvents complex, 0 to 5 percent slopes

This map unit is in drainageways. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit is 50 percent Riverwash and 35 percent Ustic Torrifluvents. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of sand dunes such as Torripsamments, deep organic deposits such as Torric Medisaprists, and wetlands. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Riverwash is deep or very deep and somewhat poorly drained. It formed in mixed alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. Riverwash is unstabilized highly stratified, gravelly to cobbly, sandy, silty, and clayey sediment that has been flooded, washed, and reworked by the Little Colorado River and its tributaries so frequently that it supports little or no vegetation.

Ustic Torrifluvents are deep or very deep and poorly drained to well drained. They formed in mixed alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. A typical pedon has a surface layer of brown gravelly sandy loam that is 10 inches thick. The substratum to a depth of 60 inches or more is brown gravelly sandy loam stratified with strata of fine gravel and silty clay loam. Ustic Torrifluvents are highly stratified clay, silt, and sand with varying amounts of coarse fragments. Depth to bedrock ranges from 40 to more than 60 inches. Ustic Torrifluvents commonly are saline. They support stands of saltcedar and cottonwood trees. They are subject to frequent, brief periods of flooding from March to September.

Permeability is generally moderate in the Ustic Torrifluvents, but it ranges from slow to rapid depending on the nature and number of the thin strata and the depth to the strata. Available water capacity is low.

This unit is used for recreation and livestock grazing.

The potential plant community is mainly cottonwood, saltcedar, and willow trees with an understory of western wheatgrass, Indian ricegrass, bottlebrush squirreltail, and sand dropseed. The diversity of vegetation, which includes an abundance of streamside plants, and the availability of water encourage a constant grazing pressure. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community.

This unit is well suited to the production of herbaceous plants, shrubs, and riparian plants for wildlife habitat. Riparian plants such as cottonwood, willow, ash, and walnut grow near water courses where soil moisture is adequate. These types of vegetation provide habitat for a large number of wildlife species.

Riparian vegetation should be replanted in drainageways where the soil is moist. Protection from grazing is essential. Competition between livestock and wildlife is high throughout the year.

This unit provides habitat for an abundance of wildlife in areas near a permanent water supply. The cliffs of the Little Colorado River, Silver Creek, Clear Creek, and Chevelon Canyon are used as nesting places for the rare

and endangered Golden Eagle and Peregrine Falcon.

The capability class is 8 for Riverwash. The capability subclass is 7W for Ustic Torrifluvents. The range site is Loamy Bottom, 9-13" p.z., for Ustic Torrifluvents; and the wildlife habitat suitability group is 4. Riverwash is not assigned a range site or a wildlife habitat suitability group.

52—Rock outcrop-Arches complex, 2 to 30 percent slopes

This map unit is on plateaus and along narrow canyons formed by Silver, Chevelon, and Clear Creeks and their tributaries. Elevation is 5,500 to 6,500 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit is 45 percent Rock outcrop and 35 percent Arches loamy fine sand. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of soils that are similar to the Arches soil but are loamy coarse sand and loamy very fine sand, moderately deep limy soils that may be classified as Torrifluvents, moderately deep coppice dunes that may be classified as Torripsamments, and shallow loamy soils over bedrock that may be classified as Lithic Torriorthents. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Rock outcrop consists of exposed areas of sandstone between the coppice dunes and of vertical canyon walls.

The Arches soil is shallow and excessively drained. It formed in eolian deposits derived dominantly from sandstone. Typically, the Arches soil is yellowish red loamy fine sand 13 inches deep over sandstone. Depth to bedrock ranges from 10 to 20 inches. Soil textures also include fine sand.

Permeability is rapid in the Arches soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is medium to very rapid, and the hazard of water erosion is moderate to severe. The hazard of wind erosion is very high.

This unit is used for recreation and livestock grazing.

The potential plant community on the Arches soil is mainly galleta, sideoats grama, and black grama with an overstory of pinyon pine and juniper. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained and soil erosion is kept to a minimum. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

The Arches soil is poorly suited to the production of herbaceous plants and shrubs for wildlife habitat. Wildlife use of this site is limited to transients from adjacent sites.

Rock outcrop supports no vegetation but is important for nest sites, resting cover, hunting perches, escape routes, and dens.

The capability class is 8 for Rock outcrop. The capability subclass is 7E for the Arches soil. The range site is Sandstone Upland, 9-13" p.z., for the Arches soil; and the wildlife habitat suitability group is 2. Rock outcrop is not assigned a range site or a wildlife habitat suitability group.

53—Rock outcrop-Deama complex, 20 to 60 percent slopes

This map unit is in canyons and on buttes and mesas. Elevation is 6,500 to 7,000 feet. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 50 to 53 degrees F, and the frost-free period is 120 to 150 days.

This unit is 55 percent Rock outcrop and 30 percent Deama very flaggy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of a moderately deep to deep loamy soil similar to a moist phase of Nuffel silty clay loam and a moderately deep loamy soil similar to the Deama soil. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Rock outcrop consists of exposed areas of limestone and sandstone. It forms the vertical and nearly vertical walls of canyons and limestone sinks and the sides of buttes. Erosion has exposed large areas of bedrock in the gently sloping to steep areas of this unit.

The Deama soil is shallow and well drained. It formed in alluvium derived dominantly from limestone. Typically, the surface layer is grayish brown very flaggy loam about 3 inches thick. The upper 9 inches of the subsoil is pale brown very channery loam. The lower 7 inches is very pale brown extremely channery loam. Limestone is at a depth of 19 inches. Depth to bedrock ranges from 10 to 20 inches. In some areas the surface layer is flaggy or very channery loam. This soil is highly calcareous throughout.

Permeability is moderate in the Deama soil. Available water capacity is very low. The effective rooting depth is 4 to 20 inches. Runoff is very rapid, and the hazard of water erosion is severe. The hazard of wind erosion is very slight.

This unit is used for livestock grazing, recreation, and fuelwood production.

The potential plant community on the Deama soil is pinyon pine and oneseed juniper with an understory of sideoats grama, blue grama, black grama,

needleandthread, and bottlebrush squirreltail. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community.

The Deama soil is moderately suited to the production of herbaceous plants, shrubs, and coniferous trees. The small amount of vegetation produced is offset by the variety, which attracts many species. The steep slopes and broken topography provide habitat for many wildlife species. Fuelwood gatherers should not disturb nest trees.

Rock outcrop supports no vegetation but is important for nest sites, resting cover, hunting perches, escape routes, and dens.

The Deama soil is fairly well suited to fuelwood production. The Deama soil has an average site index of 43. It can produce 5.5 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. In areas that are used mainly for livestock grazing, the thinning of dense stands of trees may be desirable. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees.

If this unit is used for homesite development, the main limitations are depth to bedrock and slope. The cuts needed to provide level building sites can expose bedrock. If this unit is used as a site for septic tank absorption fields, extreme care should be taken in selecting a site. The shallow soil can become saturated with effluent and create a health hazard. Transporting sewage effluent to a more suitable site is highly recommended. An engineer should be consulted for design recommendations and the installation of onsite sewage disposal facilities.

The capability class is 8 for Rock outcrop. The capability subclass is 7E for the Deama soil. The woodland site is Shallow Loamy, 13-17" p.z., for the Deama soil; and the wildlife habitat suitability group is 3. Rock outcrop is not assigned a woodland site or a wildlife habitat suitability group.

54—Rock outcrop-Epikom complex, 20 to 60 percent slopes

This map unit is on buttes, mesas, and escarpments. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit is 50 percent Rock outcrop and 30 percent Epikom channery sandy loam. Rock outcrop is on the tops, side slopes, and vertical breaks of escarpments, buttes, and mesas. Epikom soils are on the tops of buttes and mesas.

Included in this unit are small areas of moderately deep, loamy, gypsic soils that are similar to Purgatory gravelly sandy loam; shallow clayey soils that are similar to Claysprings clay and Shalet silty clay; and moderately deep or deep loamy soils similar to Grieta gravelly sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Rock outcrop consists of exposed areas of sandstone and mudstone. The mesas, buttes, and escarpments have sandstone caps. The very steep and vertical side slopes expose the horizontal interbedding of sandstone and mudstone. These layers range from 1 to 20 feet in thickness. In some areas 4- to 14-inch strata of rocklike gypsum are in the mudstone.

The Epikom soil is shallow and well drained. It formed in alluvium derived dominantly from sandstone and mudstone. Typically, the surface layer is reddish brown channery sandy loam 3 inches thick. The substratum is reddish brown heavy channery loam 11 inches thick over sandstone. This soil is moderately alkaline and nonsaline throughout. Depth to bedrock ranges from 10 to 20 inches. In some areas the surface layer is very channery, flaggy or very flaggy loam or sandy loam. The amount of carbonates increases with increasing depth.

Permeability is moderate in the Epikom soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is moderate to severe. The hazard of wind erosion is moderately high.

This unit is used for recreation and livestock grazing.

The potential plant community on the Epikom soil is mainly blue grama, black grama, and galleta. Bigelow sagebrush, Mormon tea, fourwing saltbush, and scattered juniper are in some areas. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community. Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed to encourage livestock to graze in areas where access is limited. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

The Epikom soil is poorly suited to the production of herbaceous plants and shrubs for wildlife habitat. Wildlife use of this site is limited to transients from adjacent sites.

The Rock outcrop supports no vegetation but is

important for nest sites, resting cover, hunting perches, escape routes, and dens.

Homesite development on this unit is limited to the tops of buttes and mesas and to foot slopes and toe slopes. The shrink-swell potential severely limits construction of buildings in or around the mudstone deposits. When building on the tops of buttes and mesas, excavation for foundations, water lines, and waste disposal is limited by depth to rock. Onsite investigation is needed before building on this unit.

The capability class is 8 for Rock outcrop. The capability subclass is 7E for the Epikom soil. The range site is Sandstone Upland, 5-9" p.z., for the Epikom soil; and the wildlife habitat suitability group is 2. Rock outcrop is not assigned a range site or a wildlife habitat suitability group.

55—Rock outcrop-Kech complex, 20 to 60 percent slopes

This map unit is on mesas, buttes, and escarpments. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit is 50 percent Rock outcrop and 30 percent Kech channery sandy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of moderately deep, loamy, gypsic soils that are similar to Arntz fine sandy loam; shallow loamy soils over bedrock that are similar to Chedeski sandy loam; and moderately deep loamy soils that may be classified as Ustollic Haplargids and Ustollic Camborthids. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Rock outcrop consists of exposed areas of sandstone and mudstone. The mesas, buttes, and escarpments are covered by sandstone caps. The very steep to vertical side slopes expose the horizontal interbedding of sandstone and mudstone. These layers are 1 foot to 20 feet thick. In some areas 4- to 14-inch thick strata of rocklike gypsum are in the mudstone.

The Kech soil is shallow and well drained. It formed in alluvium derived dominantly from sandstone and mudstone. Typically, the surface layer is reddish brown channery sandy loam 2 inches thick. The subsoil is light reddish brown channery loam 10 inches thick. The substratum is light reddish brown, calcareous, channery clay loam 4 inches thick over sandstone. Depth to bedrock ranges from 10 to 20 inches. In some areas the surface layer is loam or sandy clay loam that has sandstone channers covering 10 to 40 percent of the surface.

Permeability is moderate in the Kech soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. In areas where the bedrock is fractured, roots can extend to a depth of 30 inches or more. Runoff is very rapid, and the hazard of water erosion is moderate to severe. The hazard of wind erosion is moderately high.

Most areas of this unit are used for recreation and livestock grazing. A few areas are used for homesite development.

The potential plant community on the Kech soil is juniper and pinyon pine with an understory of black grama, alkali sacaton, blue grama, and galleta. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed to encourage livestock to graze in areas where access is limited. Proper grazing use, range seeding, and a planned grazing system are needed to maintain or improve the production of forage.

The Rock outcrop supports no vegetation but is important for nest sites, resting cover, hunting perches, escape routes, and dens.

The Kech soil is poorly suited to the production of herbaceous plants and shrubs and is moderately suited to the production of coniferous trees. The wooded areas provide habitat for many species. Fuelwood gatherers should not disturb nest trees.

Homesite development is limited in this unit to the tops of plateaus, mesas, and buttes and to foot slopes and toe slopes. Development in and around the mudstone deposits is severely limited. The high shrink-swell potential of the mudstone and the alluvium derived from the mudstone causes failure of foundations, crumbling of walls, and buckling of floors. When building on the tops of plateaus, mesas, and buttes, depth to rock limits excavation for foundations, water lines, and waste disposal.

The capability class is 8 for Rock outcrop. The capability subclass is 7E for the Kech soil. The range site is Sandstone Upland, 9-13" p.z., for the Kech soil; and the wildlife habitat suitability group is 3. Rock outcrop is not assigned a range site or a wildlife habitat suitability group.

56—Rock outcrop-Leanto complex, 20 to 60 percent slopes

This map unit is on mesas and buttes (fig. 5). Elevation is 5,500 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit is 40 percent Rock outcrop and 30 percent Leanto channery sandy loam. The components of this

Figure 5.—An area of Rock outcrop-Leanto complex, 20 to 60 percent slopes, in Silver Creek Canyon, south of Woodruff, Arizona.

unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of moderately deep, loamy, gypsic soils that are similar to Arntz fine sandy loam; moderately deep or deep loamy soils that are similar to Cerrillos sandy loam; moderately deep to deep, very gravelly soils that are similar to Sheza gravelly sandy loam; and shallow to moderately deep clayey soils over mudstone that are similar to Claysprings clay. Included areas make up about 30 percent of the total acreage. The percentage varies from one area to another.

Rock outcrop consists of exposed areas of sandstone and mudstone. The mesas, buttes, and escarpments are covered by sandstone caps. The moderately steep to vertical side slopes of buttes, mesas, and escarpments expose the horizontal interbedding of sandstone and mudstone. These layers are 1 to 20 feet thick. In some areas 4- to 14-inch thick strata of rocklike crystalline gypsum are interbedded in the mudstone.

The Leanto soil is shallow and well drained. It formed in local alluvium and eolian sediments derived dominantly from sandstone and mudstone. Typically, the surface layer is reddish yellow channery sandy loam 1 inch thick. The upper 9 inches of the subsoil is reddish brown channery loam. The lower 4 inches is light reddish brown calcareous channery loam. Sandstone is at a depth of 14 inches. Depth to bedrock ranges from 10 to 20 inches. In some areas the surface layer is channery, very channery, flaggy and very flaggy loam, sandy loam, and fine sandy loam. This soil is moderately alkaline throughout. Moderate

amounts of lime accumulate just above and on the bedrock.

Permeability is moderate in the Leanto soil. Available water capacity is very low. The effective rooting depth is 10 to 20 inches. Runoff is very rapid, and the hazard of water erosion is moderate to severe. The hazard of wind erosion is moderately high.

Most areas of this unit are used for recreation and livestock grazing. A few areas are used for homesite development.

The potential plant community on the Leanto soil is mainly black grama, blue grama, galleta, and alkali sacaton. It has a brushy appearance because of fourwing saltbush, Mormon tea, and scattered juniper. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed to encourage livestock to graze in areas where access is limited.

The Rock outcrop supports no vegetation but is important for nest sites, resting cover, hunting perches, escape routes, and dens.

The Leanto soil is moderately suited to the production of herbaceous plants, shrubs, and coniferous trees. The small amount of vegetation produced is offset by the variety, which attracts many species. The steep slopes and broken topography provide safety from danger for wildlife.

If this unit is used for homesite development, the main limitations are depth to rock, slope, and the high shrink-swell potential of the mudstone. Homesite development is limited to the tops of mesas, buttes, and escarpments and to foot slopes and toe slopes. Development in and around the mudstone deposits is severely limited. The high shrink-swell potential of the mudstone and the alluvium derived from the mudstone can cause failure of foundations, crumbling of walls, and buckling of floors. When building on the tops of mesas, buttes, and escarpments, depth to extremely hard sandstone bedrock limits excavation for foundations, water lines, and waste disposal.

If this unit is used as a site for septic tank absorption fields, the main limitations are depth to bedrock and slope. An engineer should be consulted for design recommendations and the installation of onsite sewage disposal facilities. Alternatives are to install holding tanks or transport the waste and effluent by pipeline to a more suitable site.

The capability class is 8 for Rock outcrop. The capability subclass is 7E for the Leanto soil. The range site is Sandstone Upland, 9-13" p.z., for the Leanto soil; and the wildlife habitat suitability group is 3. Rock outcrop is not assigned a range site or a wildlife habitat suitability group.

57—Rock outcrop-Mellenthin complex, 20 to 60 percent slopes

This map unit is on mesas and buttes. Slopes are 20 to 60 percent with vertical to nearly vertical exposures of limestone and sandstone. Elevation is 5,000 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit is about 60 percent Rock outcrop and 25 percent Mellenthin very flaggy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of shallow loamy soils that are similar to Leanto and Bisoodi channery sandy loams and loamy soil materials that are 1 to 4 inches thick over bedrock. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Rock outcrop consists of exposed areas of limestone and, to a limited extent, sandstone and mudstone. The sandstone and mudstone occur at small pinnacles throughout some areas and are absent in other areas. Limestone forms the vertical sides of sinks and canyons and the steep sloping sides adjacent to vertical exposures.

The Mellenthin soil is very shallow and shallow and well drained. It formed in alluvium derived dominantly from limestone with a limited influence from sandstone. Typically, the surface is covered with 40 to 60 percent flagstone and channers. The surface layer is light brown very flaggy loam about 5 inches thick. The upper 6 inches of the subsoil is pink, calcareous, very flaggy loam. The lower 3 inches of the subsoil is reddish yellow, calcareous, extremely flaggy loam over limestone at a depth of 14 inches. Depth to bedrock ranges from 8 to 20 inches.

Permeability is moderate in the Mellenthin soil. Available water capacity is very low. The effective rooting depth is 8 to 20 inches. Runoff is very rapid, and the hazard of water erosion is moderate to severe. The hazard of wind erosion is very slight.

This unit is used for recreation and livestock grazing. The use of this unit is extremely limited by slope and depth to rock. This unit has scenic beauty. Its main use is for water sports, such as fishing and swimming, in areas where parks have been developed.

In the less sloping areas of this unit, the potential plant community on the Mellenthin soil is black grama, alkali sacaton, galleta, and blue grama with a few scattered shrubs, consisting of fourwing saltbush, Bigelow sagebrush, and Mormon tea.

The Rock outcrop supports no vegetation but is important for nest sites, resting cover, hunting perches, escape routes, and dens.

The Mellenthin soil is moderately suited to the production of herbaceous plants, shrubs, and coniferous trees. The small amount of vegetation produced is offset by the variety, which attracts many species. The steep slopes and broken topography provide safety from danger for wildlife.

The capability class is 8 for Rock outcrop. The capability subclass is 7E for the Mellenthin soil. The range site is Shallow Loamy, 9-13" p.z., for the Mellenthin soil; and the wildlife habitat suitability group is 3. Rock outcrop is not assigned a range site or a wildlife habitat suitability group.

58—Rock outcrop-Needle complex, 1 to 10 percent slopes

This map unit is on plateaus. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit is 50 percent Rock outcrop and 35 percent Needle fine sand. The Needle soil occurs as small coppice dunes on the rock surface. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of moderately deep loamy soils classified as Typic Torrifluvents, moderately deep sandy soils classified as Typic Torripsamments, and shallow loamy soils classified as Lithic Torriorthents. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Rock outcrop consists of exposed areas of sandstone that forms canyon walls and is in interdune areas.

The Needle soil is very shallow and shallow and is excessively drained. It formed in eolian material derived dominantly from sandstone. Typically, the surface layer is yellowish red fine sand 7 inches thick. The substratum is red loamy fine sand 2 inches thick over sandstone. Depth to bedrock ranges from 5 to 20 inches. Profile textures include loamy very fine sand and fine sand.

Permeability is rapid in the Needle soil. Available water capacity is very low. The effective rooting depth is 5 to 20 inches. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is very high.

This unit is used for recreation and livestock grazing.

The potential plant community on the Needle soil is mainly black grama, sideoats grama, galleta, blue grama, and Indian ricegrass. Juniper and fourwing saltbush are scattered throughout the area. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

The Rock outcrop supports no vegetation but is important for nest sites, resting cover, hunting perches, escape routes, and dens.

The Needle soil is poorly suited to the production of herbaceous plants and shrubs for wildlife habitat. Wildlife use of this site is limited to transients from adjacent sites.

The capability class is 8 for Rock outcrop. The capability subclass is 7E for the Needle soil. The range site is Sandstone Upland, 5-9" p.z., for the Needle soil; and the wildlife habitat suitability group is 2. Rock outcrop is not assigned a range site or a wildlife habitat suitability group.

59—Shalet silty clay loam, 0 to 3 percent slopes

This very shallow and shallow, well drained soil is on plateaus. It formed in alluvium derived dominantly from mudstone. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is reddish brown silty clay loam 1 inch thick. The subsurface layer is reddish brown clay loam 3 inches thick. The upper 3 inches of the substratum is weathered mudstone. The lower part to a depth of 60 inches is mudstone interbedded with sandstone. Depth to mudstone ranges from 4 to 15 inches, and depth to sandstone ranges from 25 to 45 inches. Surface textures include clay loam, silty clay, and clay. Subsurface textures include clay and silty clay.

Included in this unit are small areas of moderately deep, loamy, gypsic soils that are similar to Purgatory sandy loam; shallow clayey soils that are similar to Claysprings clay; shallow loamy soils that are similar to Epikom sandy loam; moderately deep loamy soils that are similar to Tours clay loam; and scattered small coppice dunes. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability is slow in the Shalet soil. Available water capacity is very low. The salinity hazard is low to moderate, and the sodium hazard is slight. The effective rooting depth is 4 to 15 inches. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is moderate. Water tends to stand on this soil for days after a rainstorm.

This unit is used for recreation and livestock grazing.

The potential plant community is mainly alkali sacaton, galleta, mound saltbush, and shadscale. The present vegetation in most areas is mainly very sparse stands of alkali sacaton and annual buckwheat. If the range is

overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. 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.

This unit is poorly suited to the production of herbaceous plants, shrubs, and vines for wildlife habitat. Any wildlife found in this unit is transient from adjacent sites.

If this unit is used for homesite development, the main limitations are the high shrink-swell potential, depth to rock, sulfate damage to concrete, and very slow permeability. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling. Type 5 cement is recommended to minimize sulfate damage.

If this soil is used as a site for septic tank absorption fields, the very slow permeability and the shallow depth to rock can be partially overcome by increasing the size of the absorption field and by using fill material over the leach lines. An engineer should be consulted for design recommendations. Alternatives are to install holding tanks or transport the sewage effluent to a more suitable site.

The capability subclass is 7S. The range site is Shale Upland, 5-9" p.z. The wildlife habitat suitability group is 2.

60—Sheppard-Grieta complex, 1 to 12 percent slopes

This map unit is a dune and interdune complex on fan terraces. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit is 45 percent Sheppard loamy sand and 35 percent Grieta sandy loam. The Sheppard soil is on stabilized, longitudinal dunes, and the Grieta soil is between the dunes. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of very deep clayey soils that are similar to Penzance sandy clay loam, very deep fine silty soils that are similar to Tours sandy clay loam, and very deep sandy soils that are similar to Kinan sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Sheppard soil is very deep and somewhat excessively drained. It formed in eolian sand overlying mixed alluvium derived from mixed sources. Typically, the soil is reddish brown and yellowish red loamy fine sand to a depth of 60 inches or more. In some areas soil textures include loamy sand, sand, and very fine sandy loam. Some areas may have a buried horizon of sandy loam or sandy clay loam below a depth of 50 inches. This soil is moderately alkaline and nonsaline throughout.

Permeability is rapid in the Sheppard soil. Available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is high.

The Grieta soil is very deep and well drained. It formed in mixed alluvium derived dominantly from sandstone, mudstone, and basic igneous rock. Typically, the surface layer is reddish brown sandy loam 3 inches thick. The subsoil is reddish brown sandy clay loam 18 inches thick. The substratum to a depth of 60 inches or more is light reddish brown calcareous sandy loam. In some areas the surface layer is sandy clay loam and the subsoil is clay loam. Depth to maximum lime accumulation ranges from 20 to 24 inches. This soil is moderately alkaline and nonsaline throughout.

Permeability is moderate in the Grieta soil. Available water capacity is moderate or high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is moderately high.

This unit is used for livestock grazing, homesite development, and recreation.

The potential plant community on the Sheppard soil is mainly black grama, blue grama, Indian ricegrass, needleandthread, and dropseeds with scattered fourwing saltbush, Mormon tea, and sand sagebrush. The potential plant community on the Grieta soil is mainly Indian ricegrass, black grama, blue grama, bush muhly, and alkali sacaton with scattered winterfat, fourwing saltbush, and Mormon tea. Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water. This results in overgrazing and the subsequent deterioration of the vegetation. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

The Sheppard soil is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat. Burrowing animals find this site suitable for digging.

The Grieta soil is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat.

If this unit is used for homesite development, the main limitations are blowing sand on both the Sheppard and Grieta soils and low soil strength and seepage on the Sheppard soil. Excavation for roads and buildings increases the hazard of erosion. Preserving the existing plant cover during construction helps to control erosion.

Cutbanks are not stable and are subject to slumping. Effluent from septic tank absorption fields can surface in downslope areas and create a health hazard. If the density of housing is moderate to high, community sewage systems are needed to prevent a health hazard as a result of seepage from onsite sewage disposal systems.

The capability subclass is 7E for both soils. The range site is Sandy Upland, 5-9" p.z., for the Sheppard soil and Sandy Loam Upland, 5-9" p.z., for the Grieta soil. The wildlife habitat suitability group is 3 for both soils.

61—Sheppard loamy sand, 1 to 12 percent slopes

This very deep, somewhat excessively drained soil is on somewhat stabilized dunes adjacent to intermittent major drainageways and on stabilized longitudinal dunes on plateaus. It formed in eolian material derived from mixed sources. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the soil is reddish brown and yellowish red loamy sand to a depth of 60 inches or more. In some areas textures include loamy fine sand and fine sand. This soil is moderately alkaline and nonsaline throughout.

Included in this unit are small areas of very deep fine loamy soils that are similar to Grieta sandy loam; dune land; very deep fine silty sands that are similar to Tours sandy loam; very deep, fine loamy, sodic soils that are similar to Burnswick sandy clay loam; very deep, coarse loamy, sodic soils that are similar to Marcou loamy sand; and sandy to loamy soils in drainageways. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is rapid in the Sheppard soil. Available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is high.

This unit is used for recreation and livestock grazing.

The potential plant community is mainly Indian ricegrass, needleandthread, black grama, galleta, and sandhill muhly. Fourwing saltbush, winterfat, Mormon tea, and sand sagebrush are in some areas. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat. Burrowing animals find this site suitable for digging.

The capability subclass is 7E. The range site is Sandy Upland, 5-9" p.z. The wildlife habitat suitability group is 3.

62—Sheza gravelly sandy loam, 2 to 20 percent slopes

This very deep, well drained soil is on fan terraces. It formed in mixed alluvium derived dominantly from acid and basic igneous and sedimentary rocks. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer is reddish brown gravelly sandy loam 4 inches thick. The upper part of the subsoil is reddish brown gravelly clay loam 11 inches thick. The next 13 inches of the subsoil is pink and pinkish white very gravelly and extremely gravelly loam, weakly calcium carbonate cemented. The underlying material to a depth of 60 inches or more is reddish brown extremely gravelly loamy coarse sand that is stratified sand and gravel. Areas on shoulder slopes and back slopes may be slightly coarser textured on the surface and contain more coarse fragments.

Included in this unit are small areas of very deep loamy soils that are similar to Cerrillos gravelly sandy loam, shallow loamy soils over sandstone that are similar to Leanto sandy loam, and mudstone and sandstone outcrops. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in the upper part of the Sheza soil and moderately rapid in the lower part. Available water capacity is very low or low. The effective rooting depth is 60 inches or more. Runoff is slow to medium, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is moderate.

This unit is used for livestock grazing, recreation, and wildlife habitat. It is also a good source of sand and gravel.

The potential plant community is mainly blue grama, black grama, galleta, and Indian ricegrass. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is moderately suited to the production of herbaceous plants and shrubs. Open rangeland wildlife frequent this site.

If this unit is used for homesite development, the main limitation is slope. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. Removal of gravel and cobbles in disturbed areas is needed for best results when landscaping, particularly in areas used for lawns.

The capability subclass is 6S. The range site is Loamy Upland, 9-13" p.z. The wildlife habitat suitability group is 3.

63—Springerville clay, 0 to 3 percent slopes

This very deep, well drained soil is on fan terraces. It formed in mixed alluvium derived dominantly from clayey mudstone. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

Typically, the surface layer is brown clay 5 inches thick. The subsoil to a depth of 60 inches or more is brown and grayish brown clay. This soil cracks widely and deeply as it dries. It is slightly alkaline or moderately alkaline throughout.

Included in this unit are small areas of very deep loamy soils that are similar to Lynx and Bagley clay loams and very deep clayey soils that are similar to Poley and Padilla clay loams. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is very slow in the Springerville soil. Available water capacity is high. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The hazard of wind erosion is slight. The shrink-swell potential is high.

This unit is used for cropland, livestock grazing, and recreation.

If this unit is used for hay and pasture, the main limitations are the very slow permeability and susceptibility of the soil to compaction. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, and excessive runoff. Irrigation water can be applied by the sprinkler, corrugation, and border methods. Leveling helps to ensure the uniform application of water. Fertilizer is needed to ensure optimum growth of grasses and legumes. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion.

If this unit is used for irrigated crops, the main limitations are the very slow permeability and susceptibility of the soil to compaction. In summer, irrigation is needed for the maximum production of most crops. Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Use of pipe, ditch lining, or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion. Tillage should be kept to a minimum. Tilth and fertility can be improved by returning crop residue to the soil.

Under good management, this unit is capable of annually producing about 60 to 65 bushels of barley, 45 to 50 bushels of wheat, 5 to 6 tons of alfalfa hay, or about 16 to 20 AUM's (animal unit months) per acre for irrigated crops and pasture.

The potential plant community is mainly sideoats grama, blue grama, galleta, and western wheatgrass. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Livestock prefer this soil to most others in the survey area because of its accessibility and the availability of water. This results in overgrazing and the subsequent deterioration of the vegetation. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Fencing and deferred grazing are important in planned grazing systems.

This unit is moderately suited to the production of herbaceous plants and shrubs for wildlife habitat. Competition between wildlife and livestock can be severe during all seasons.

If this unit is used for homesite development, the main limitations are the high shrink-swell potential and the very slow permeability. If buildings are constructed on this soil, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling. An engineer should be consulted for proper design, installation, and maintenance of foundations for buildings.

If this soil is used as a site for septic tank absorption fields, an engineer should be consulted for design recommendations and the installation of onsite sewage treatment facilities.

The capability subclass is 6S. The range site is Clayey Upland, 9-13" p.z. The wildlife habitat suitability group is 3.

64—Springerville family silty clay, 1 to 8 percent slopes

This very deep, well drained soil is on mesas and plateaus. It formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Elevation is 6,000 to 7,000 feet. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 50 to 53 degrees F, and the frost-free period is 120 to 150 days.

Typically, the surface layer and upper subsoil are reddish brown silty clay 9 inches thick. The lower subsoil is

reddish brown clay to a depth of 60 inches or more. This soil cracks widely and deeply as it dries.

Included in this unit are small areas of moderately deep clayey soils that are similar to Thunderbird cobbly clay loam, shallow loamy soils over bedrock that are similar to Deama family very gravelly loam, and deep to very deep loamy soils that are similar to Bagley clay loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is very slow in the Springerville family soil. Available water capacity is high or very high. The effective rooting depth is 40 to 70 inches. Runoff is medium, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is slight.

This unit is used for livestock grazing, recreation, and homesite development.

The potential plant community is mainly blue grama, western wheatgrass, bottlebrush squirreltail, and sideoats grama with an overstory of juniper. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is well suited to the production of herbaceous plants and shrubs. It is moderately suited to the production of coniferous trees for wildlife habitat. The plant diversity attracts many wildlife species.

If this unit is used for homesite development, the main limitation is the shrink-swell potential. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling.

If this unit is used as a site for septic tank absorption fields, the main limitation is the very slow permeability. An engineer should be consulted for design recommendations and the installation of onsite sewage disposal facilities.

The capability subclass is 6S. The range site is Clayey Upland, 13-17" p.z. The wildlife habitat suitability group is 4.

65—Thunderbird cobbly silty clay loam, 1 to 12 percent slopes

This moderately deep, well drained soil is on hills and mesas. It formed in alluvium derived dominantly from basalt and pyroclastics. Elevation is 6,000 to 7,000 feet. The mean annual precipitation is 14 to 16 inches, the mean annual air temperature is 50 to 53 degrees F, and the frost-free period is 120 to 150 days.

Typically, the surface layer is brown cobbly silty clay loam 2 inches thick. The upper 16 inches of the subsoil is dark brown clay. The next 9 inches is reddish brown cobbly clay. The lower subsoil is pink calcareous very cobbly clay loam 4 inches thick over basalt that is coated with calcium carbonate. Depth to bedrock ranges from 20 to 40 inches. In some areas the surface layer is very cobbly silty clay. This soil is slightly alkaline to moderately alkaline throughout.

Included in this unit are small areas of shallow loamy soils over basalt that are similar to Deama family gravelly loam, deep clayey soils that are similar to Springerville cobbly silty clay, and shallow clayey soils over basalt. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is very slow in the Thunderbird soil. Available water capacity is low. The effective rooting depth is 20 to 40 inches. Runoff is medium, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is moderate. The shrink-swell potential is high.

This unit is used for livestock grazing, recreation, and fuelwood production.

The potential plant community is mainly western wheatgrass, blue grama, and galleta with an overstory of juniper and pinyon. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Proper grazing use, range seeding, and a planned grazing system are needed to maintain or improve the production of forage.

This unit is moderately suited to the production of herbaceous plants, shrubs, and coniferous trees for wildlife habitat. The wide variety of vegetation provides habitat for many species. Competition between wildlife and livestock can be severe during all seasons. Fuelwood gatherers should not disturb nest trees.

If this unit is used for fuelwood production, the main limitations are limited access caused by large rock fragments on the surface and clayey surface textures. This unit can produce 4 to 6 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Minimizing the risk of erosion is essential in harvesting.

If this unit is used for homesite development, the main limitations are the shrink-swell potential and depth to rock. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling. The cuts needed to provide level building sites can expose bedrock.

If this unit is used as a site for septic tank absorption fields, the main limitations are the slow permeability and depth to rock. Use of sandy backfill for the trench and long absorption lines helps to compensate for the slow permeability.

The capability subclass is 6S. The woodland site is Basalt Slopes Upland (P.J.), 13-17" p.z. The wildlife habitat suitability group is 3.

66—Torriorthents-Typic Calciorthids association, 20 to 60 percent slopes

This map unit is on mesa escarpments. Slopes are 20 to 60 percent with some vertical and nearly vertical exposures of weakly to strongly calcium carbonate cemented gravelly soil material. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

This unit is about 40 percent Torriorthents and 35 percent Typic Calciorthids. Torriorthents tend to occur on the foot slopes and back slopes, and Calciorthids tend to occur on the summits and shoulders; however, either component can occur anywhere in the unit.

Included in this unit are small areas of moderately deep to very deep loamy soils that may be classified as either Haplargids, Camborthids, or both, and moderately deep to very deep sandy soils that may be classified as Torripsamments. Included areas make up about 25 percent of the total acreage. The percentage varies from one area to another.

Torriorthents are very deep and well drained. They formed in alluvium derived from mixed sources. Slope ranges from 20 to 60 percent. The texture, color, and thickness of the layers of Torriorthents vary from one area to another. A typical area has a surface layer of light reddish brown sandy loam about 2 inches thick. The subsurface layer is reddish brown and light reddish brown sandy clay loam about 10 inches thick. The substratum to a depth of 60 inches or more is reddish yellow and pink stratified gravelly sandy loam and sandy clay loam. In areas the surface layer is gravelly sandy loam, sandy clay loam, or gravelly sandy clay loam.

Permeability is moderately slow or moderate in the Torriorthents. Available water capacity is low or moderate. The effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is moderate to severe. The hazard of wind erosion is moderately high.

Calciorthids are very deep and well drained. They formed in alluvium derived dominantly from mixed sources. Slopes range from 20 to 60 percent. The texture, color, and thickness of the layers of Calciorthids vary from one area to another. A typical area has about 30 percent of the surface covered with gravel. The surface layer is reddish brown gravelly sandy loam about 3 inches thick. The upper part of the subsoil is reddish brown coarse sandy loam about 10 inches thick. The lower part of the subsoil to a depth of 60 inches or more is yellowish red, weakly lime cemented, stratified gravelly sandy loam and gravelly sandy clay loam. In areas mudstone or slightly weathered sandstone occurs at depths ranging from 30 to 50 inches.

Permeability is moderate or moderately rapid in the Calciorthids. Available water capacity is low or moderate. The effective rooting depth is more than 60 inches. Runoff is rapid, and the hazard of water erosion is severe. The hazard of wind erosion is moderate.

This unit is used for rangeland and recreation.

The potential plant community is mainly alkali sacaton, galleta, black grama, blue grama, Indian ricegrass, and annuals. It has a few scattered shrubs, consisting of fourwing saltbush, Mormon tea, and Bigelow sagebrush. The production of vegetation suitable for livestock grazing is limited by slope and active geologic erosion. In areas slope limits access by livestock and results in overgrazing of the less sloping areas. Trails or walkways can be constructed to encourage livestock to graze in areas where access is limited. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is moderately suited to the production of herbaceous plants and shrubs. The small amount of vegetation produced is offset by the variety, which attracts many species. The steep slopes and broken topography provide safety from danger for wildlife.

The capability subclass is 7E. The range site is Breaks, 5-9" p.z. The wildlife habitat suitability group is 3.

67—Tours clay loam, 1 to 3 percent slopes

This very deep, well drained soil is on alluvial fans. It formed in mixed alluvium derived dominantly from sandstone, limestone, mudstone, and basalt. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is light reddish brown clay loam 6 inches thick. The upper 30 inches of the substratum is reddish brown and light reddish brown silty clay loam stratified with silt loam. The lower substratum to a depth of 60 inches or more is light reddish brown, pink, and pinkish gray stratified silt loam, loamy fine sand, and very fine sandy loam. This soil is moderately alkaline and nonsaline throughout.

Included in this unit are small areas of very deep fine loamy soils that are similar to Jocity sandy clay loam, very deep clayey soils that are similar to Navajo silty clay, shallow clayey soils that are similar to Claysprings clay, very deep coarse loamy soils that are similar to Ives sandy

loam, very deep sandy soils that are similar to Trail fine sandy loam, very deep loamy sands that are similar to Grieta sandy loam, and moderately deep soils that are similar to this Tours soil. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in this Tours soil. Available water capacity is high or very high. Saline and sodium hazards are slight or none. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate. This soil is subject to occasional, very brief periods of flooding from July to September.

This unit is used for recreation and livestock grazing. It can be used for irrigated crops if good quality water is available.

The potential plant community is mainly alkali sacaton, blue grama, western wheatgrass, vine mesquite, and fourwing saltbush. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion. Good accessibility, a large variety of palatable plants, and the availability of water encourage a constant grazing pressure. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is well suited to hay and pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Grasses and legumes grow well if adequate water and fertilizer are used. Leveling helps to ensure the uniform application of water. Annual applications of nitrogen and phosphorous fertilizer are needed to maintain production of high quality irrigated pasture. Under good management this unit is capable of annually producing about 16 to 20 AUM's (animal unit months) or 5 to 6 tons of alfalfa hay per acre.

This unit is well suited to irrigated crops. For the efficient application and removal of irrigation water, leveling is helpful in sloping areas. Subsoiling improves water infiltration and allows salts to be leached downward. Crusting of the surface and compaction can be reduced by returning crop residue to the soil. Levees, dikes, and channels can help limit damage from flooding. Under good management this unit is capable of annually producing about 60 to 65 bushels of barley, 45 to 50 bushels of wheat, or 20 to 25 tons of corn silage per acre.

This unit is well suited to the production of herbaceous plants and shrubs for wildlife habitat. The high levels of production make this unit attractive to many species of wildlife.

If this unit is used for homesite development, the main limitations are flooding and the shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Roads and streets should be located above the expected flood level. Buildings and roads should be designed to offset the effects of shrinking and swelling. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential.

If this unit is used as a site for septic tank absorption fields, the main limitations are flooding and the moderately slow permeability. The permeability limitation can be partially overcome by increasing the size of the absorption field.

The capability subclass is 3W, irrigated, and 7W, nonirrigated. The range site is Clayey Bottom, 5-9" p.z. The wildlife habitat suitability group is 4.

68—Tours silty clay loam, saline-sodic, 0 to 1 percent slopes

This very deep, well drained, saline-sodic soil is on flood plains. It formed in mixed alluvium derived dominantly from sandstone, limestone, mudstone, and basalt. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is light reddish brown silty clay loam 6 inches thick. The upper 41 inches of the substratum is reddish brown and light reddish brown silty clay loam stratified with silt loam. The lower substratum to a depth of 60 inches or more is pink and pinkish gray stratified silt loam and very fine sandy loam. This soil is moderately alkaline and strongly saline throughout. In some places, a thin crust of salt is on the surface and the surface layer is clay loam or sandy loam.

Included in this unit are small areas of very deep, fine loamy, sodic soils that are similar to Burnswick sandy clay loam; very deep coarse loamy soils that are similar to Ives sandy loam; very deep fine loamy soils that are similar to Jocity sandy clay loam; very deep clayey soils that are similar to Navajo silty clay; and very deep sandy soils that are similar to Trail fine sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in this Tours soil. Available water capacity is very low or low. Salinity is strong, and the sodium hazard is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion also is moderate. This soil is subject to occasional, very brief periods of flooding from July to September. The shrink-swell potential is moderate.

This unit is used for irrigated pasture and crops, livestock grazing, and recreation.

If this unit is used for hay and pasture, the main limitation is the content of toxic salts. The salts can be partially leached from the root zone with good quality water. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Leveling helps to ensure the uniform application of water. Annual applications of nitrogen and phosphorous fertilizer are needed to maintain production of high quality irrigated pasture. Under intensive management about 12 to 15 AUM's (animal unit months) or 3 to 4 tons of alfalfa hay per acre can be produced annually on this soil.

If this unit is used for irrigated crops, the main limitations are the content of toxic salts, flooding, and the moderately slow permeability. The content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. The hazard of flooding can be reduced by the use of dikes, channels, and levees. For the efficient application and removal of irrigation water, leveling is needed in sloping areas. Subsoiling when the soil is dry helps to improve water infiltration, thus allowing salts to be leached downward. Crusting of the surface and compaction can be reduced by returning crop residue to the soil. Under intensive management about 40 to 50 bushels of barley, 30 to 40 bushels of wheat, or 15 to 20 tons of corn silage per acre can be produced annually on this soil.

The potential plant community is mainly alkali sacaton, galleta, blue grama, and vine mesquite. Fourwing saltbush, black greasewood, shadscale, and seepweed are in some areas. The production of vegetation suitable for livestock grazing is limited by the content of toxic salts. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is moderately suited to the production of wild herbaceous plants and shrubs for wildlife habitat. Water may stand in the flat areas after rain storms. Competition with livestock can be high during the growing season.

If this unit is used for homesite development, the main limitations are flooding, sulfate damage to concrete, and the shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Roads and streets should be located above the expected flood level. Type 5 cement is recommended to minimize sulfate damage. Buildings and roads should be designed to offset the effects of shrinking and swelling. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling.

If this unit is used as a site for septic tank absorption fields, the main limitations are flooding and the moderately slow permeability. The permeability limitation can be partially overcome by increasing the size of the absorption field.

The capability subclass is 4W, irrigated, and 7W, nonirrigated. The range site is Saline Bottom, 5-9" p.z. The wildlife habitat suitability group is 3.

69—Tours silty clay loam, saline-sodic, 1 to 3 percent slopes

This very deep, well drained, saline-sodic soil is on flood plains and alluvial fans. It formed in mixed alluvium derived dominantly from sandstone, limestone, mudstone, and basalt. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is light reddish brown silty clay loam 6 inches thick. The upper 41 inches of the substratum is reddish brown and light reddish brown silty clay loam stratified with silt loam. The lower substratum to a depth of 60 inches or more is light reddish brown, pink, and pinkish gray stratified silt loam, loamy fine sand, and very fine sandy loam. This soil is moderately alkaline and strongly saline. In some areas, a thin crust of salt is on the surface and the surface layer textures include sandy clay loam, sandy loam, and silty clay loam.

Included in this unit are small areas of very deep fine loamy soils that are similar to Jocity sandy clay loam; very deep clayey soils that are similar to Navajo silty clay; very deep sandy soils that are similar to Trail loamy sand; very deep coarse loamy soils that are similar to Ives sandy loam; very deep, loamy, sodic soils that are similar to Brunswick sandy clay loam; very deep sandy soils that are similar to Sheppard loamy sand; and moderately deep soils that are similar to this Tours soil. Included areas make up about 25 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately slow in this Tours soil. Available water capacity is very low or low. Salinity is strong, and the sodium hazard is moderate. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. The hazard of wind erosion also is moderate. This soil is subject to occasional, very brief periods of flooding from July to September.

This unit is used for recreation and livestock grazing. It can be used for irrigated crops and pasture if good quality water is made available.

The potential plant community is mainly alkali sacaton, galleta, blue grama, and vine mesquite. Fourwing saltbush, black greasewood, shadscale, and seepweed are in some areas. The production of vegetation suitable for livestock grazing is limited by the content of toxic salts. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. If the plant cover is disturbed, protection from flooding is needed to control gullying, streambank cutting, and sheet erosion. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

If this unit is used for hay and pasture, the main limitations are the content of toxic salts and flooding. The salts can be partially leached from the root zone with good quality water. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Leveling helps to ensure the uniform application of water. Levees, dikes, and channels can help limit damage from flooding. Annual applications of nitrogen fertilizer are needed to maintain production of high quality irrigated pasture. Under intensive management about 12 to 15 AUM's (animal unit months) or 4 to 5 tons of alfalfa hay per acre can be produced annually on this soil.

If this unit is used for irrigated crops, the main limitations are the content of toxic salts and flooding. The content of toxic salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. For the efficient application and removal of irrigation water, leveling is helpful in sloping areas. Subsoiling improves water infiltration and allows salts to be leached downward. Crusting of the surface and compaction can be reduced by returning crop residue to the soil. Levees, dikes, and channels can help limit damage from flooding. Under intensive management about 40 to 50 bushels of barley, 30 to 40 bushels of wheat, or 15 to 20 tons of corn silage per acre can be produced annually on this soil.

This unit is moderately suited to the production of wild herbaceous plants and shrubs for wildlife habitat. Water may stand in the flat areas after rain storms. Competition with livestock can be high during the growing season.

If this unit is used for homesite development, the main limitations are flooding, sulfate damage to concrete, and the shrink-swell potential. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Roads and streets should be located above the expected flood level. Type 5 cement is recommended to minimize sulfate damage. Buildings and roads should be designed to offset the effects of shrinking and swelling. If buildings are constructed on this unit, properly designing foundations and footings and diverting runoff away from buildings help to prevent structural damage caused by shrinking and swelling.

If this unit is used as a site for septic tank absorption fields, the main limitations are flooding and the moderately slow permeability. The permeability limitation can be partially overcome by increasing the size of the absorption field.

The capability subclass is 4W, irrigated, and 7W, nonirrigated. The range site is Saline Bottom, 5-9" p.z. The wildlife habitat suitability group is 3.

70—Trail loamy sand, 0 to 3 percent slopes

This very deep, somewhat excessively drained soil is on flood plains. It formed in mixed alluvium derived dominantly from sandstone and mudstone. Elevation is 4,800 to 5,500 feet. The mean annual precipitation is 8 to 10 inches, the mean annual air temperature is 53 to 56 degrees F, and the frost-free period is 150 to 180 days.

Typically, the surface layer is light brown loamy sand 3 inches thick. The substratum to a depth of 60 inches or more is light brown and light reddish brown stratified fine sandy loam to loamy sand. It also includes thin strata of silt loam and clay loam. The substratum is loamy sand when mixed. In areas the surface layer is loamy fine sand or sandy loam. This soil is moderately alkaline and slightly saline to nonsaline throughout.

Included in this unit are small areas of very deep coarse loamy soils that are similar to Ives sandy loam, very deep fine loamy soils that are similar to Jocity sandy loam, and very deep fine silty soils that are similar to Tours sandy loam. In areas a seasonal high water table is present, depending on the flow and proximity of the present river channel. Included areas make up about 15 percent of the total acreage. The percentage varies from one area to another.

Permeability is moderately rapid in the Trail soil, but it ranges from moderately slow to rapid depending on the nature, number, and thickness of the thin, fine-textured strata. Available water capacity is low. The effective rooting depth is 60 inches or more. Runoff is slow, and the hazard

of water erosion is slight. The hazard of wind erosion is high. This soil is subject to occasional, very brief periods of flooding from July to September.

This unit is used for irrigated cropland, livestock grazing, and recreation.

If this unit is used for hay and pasture, the main limitations are the low available water capacity and flooding. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition and to protect the soil from erosion. Levees, dikes, and channels can help limit damage by flooding. Leveling helps to ensure the uniform application of water. Annual applications of nitrogen, phosphorous, and potassium fertilizer are needed to maintain production of high quality irrigated pasture. Under intensive management about 12 to 15 AUM's (animal unit months) or 3 to 4 tons of alfalfa hay per acre can be produced annually on this soil.

If this unit is used for irrigated crops, the main limitations are the low available water capacity, flooding, and wind erosion. Because the soil in this unit is droughty, applications of irrigation water should be light and frequent. Water should be applied in amounts that are sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients. For the efficient application and removal of irrigation water, leveling is helpful in sloping areas. The use of dikes, channels, and levees can reduce the hazard of flooding. The hazard of wind erosion can be reduced by returning crop residue to the soil and minimizing tillage. Under intensive management about 40 to 50 bushels of barley, 30 to 40 bushels of wheat, or 15 to 20 tons of corn silage per acre can be produced annually on this soil.

The potential plant community is mainly western wheatgrass, Indian ricegrass, bottlebrush squirreltail, and alkali sacaton. It has scattered fourwing saltbush and cottonwood trees. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Good accessibility, a large variety of palatable plants, and the availability of water encourage a constant grazing pressure. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities.

This unit is well suited to the production of herbaceous plants, shrubs, and riparian plants for wildlife habitat. Riparian plants, such as cottonwood, willow, ash, and walnut, will grow near water courses where soil moisture is adequate. These types of vegetation provide habitat for a large number of wildlife species.

Riparian vegetation should be replanted in drainageways where the soil is moist. Protection from grazing is essential. Competition between livestock and wildlife is high throughout the year.

If this unit is used for homesite development, the main limitations are flooding and seepage. Dikes and channels that have outlets for floodwater can be used to protect buildings and onsite sewage disposal systems from flooding. Seepage from sewage disposal systems can cause health hazards downslope. Roads and streets should be located above the expected flood level.

The capability subclass is 4W, irrigated, and 7W, nonirrigated. The range site is Sandy Bottom, 5-9" p.z. The wildlife habitat suitability group is 4.

71—Ustollic Haplargids association, 1 to 30 percent slopes

This map unit is on hills and fan terraces. Elevation is 5,500 to 6,000 feet. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is 51 to 54 degrees F, and the frost-free period is 130 to 160 days.

This unit is 35 percent Ustollic Haplargids that have a loamy subsoil, 30 percent Ustollic Haplargids that have a very gravelly and loamy subsoil, and 15 percent Ustollic Haplargids that have a very cobbly and clayey subsoil. The loamy Ustollic Haplargids are on foot slopes, the very gravelly and loamy Ustollic Haplargids are on back slopes and shoulders of hills, and the very cobbly and clayey Ustollic Haplargids are on the summits. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are small areas of very deep fine silty soils that are similar to Nuffel silty clay loam; very deep fine loamy soils that are similar to Lynx silty clay loam; and very deep, highly calcareous, loamy soils that are similar to Ubank gravelly sandy loam. Included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The loamy Ustollic Haplargids are deep or very deep and well drained. They formed in mixed alluvium and colluvium derived dominantly from sandstone, mudstone, limestone, and basalt. The texture, color, and thickness of the layers of these soils vary from one area to another. A typical profile has a surface layer of light reddish brown gravelly sandy loam 3 inches thick. The upper subsoil is reddish brown gravelly sandy clay loam and clay loam that has 5 to 30 percent gravel and is 22 inches thick. The lower subsoil to a depth of 60 inches or more is reddish yellow stratified very gravelly loamy sand, gravelly sandy loam, and fragments of mudstone. In some areas highly weathered mudstone is at a depth of more than 40 inches.

Permeability is moderately slow in the loamy Ustollic

Haplargids. Available water capacity is low or moderate. The effective rooting depth is 40 to 60 inches or more. Runoff is slow to rapid, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is moderate.

The very gravelly and loamy Ustollic Haplargids are deep and very deep and well drained. They formed in mixed alluvium and colluvium derived dominantly from sandstone, mudstone, limestone, and basalt. The texture, color, and thickness of the layers of these soils vary from one area to another. A typical profile has a surface layer of reddish brown very gravelly fine sandy loam 3 inches thick. The subsoil is yellowish red very gravelly sandy clay loam and very gravelly clay loam 26 inches thick. The substratum to a depth of 60 inches or more is pinkish white or pink stratified loam, clay loam, and sandy clay loam. It contains 5 to 15 percent pebbles. In areas highly weathered mudstone is at a depth of more than 40 inches.

Permeability is moderately slow in the very gravelly and loamy Ustollic Haplargids. Available water capacity is moderate or high. The effective rooting depth is 40 to 60 inches or more. Runoff is slow to rapid, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is very slight.

The very cobbly and clayey Ustollic Haplargids are deep or very deep and well drained. They formed in mixed alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. The texture, color, and thickness of the layers of these soils vary from one area to another. A typical profile has a surface layer of reddish brown extremely gravelly fine sandy loam 5 inches thick. The subsoil is yellowish red extremely cobbly clay and extremely cobbly clay loam 23 inches thick. The substratum to a depth of 60 inches or more is white, pinkish white, and pink stratified loam, clay loam and sandy clay loam. It has 5 to 15 percent pebbles. In areas highly weathered mudstone is at a depth of more than 40 inches.

Permeability is slow in the very cobbly and clayey Ustollic Haplargids. Available water capacity is low or moderate. The effective rooting depth is 40 to 60 inches or more. Runoff is slow to rapid, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is very slight.

This unit is used for livestock grazing, fuelwood production, and recreation.

The potential plant community is mainly juniper and pinyon pine with an understory of blue grama, sideoats grama, needleandthread, galleta, and bottlebrush squirreltail. If the range is overgrazed, the proportion of desirable forage plants decreases and the proportion of undesirable forage plants increases. Therefore, livestock grazing should be managed so that a proper balance of desirable species is maintained. Suitable range management practices are fencing, using planned grazing systems, and developing livestock watering facilities. Fencing and deferred grazing are important in planned grazing systems.

This unit is moderately suited to the production of herbaceous plants and shrubs. Open rangeland wildlife prefer this site. Fuelwood production on this unit is limited by slope. This unit can produce 3 to 4 cords per acre in a stand of trees that average 5 inches in diameter at a height of 1 foot. Minimizing the risk of erosion is essential in harvesting fuelwood.

This unit is moderately suited to the production of coniferous trees. The pinyon-juniper woodlands provide habitat for many species. Fuelwood gatherers should not disturb nest trees.

The capability subclass is 6S. The range site is Loamy Upland, 9-13" p.z. The wildlife habitat suitability group is 3.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forest land, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 2,190 acres in the survey area, or nearly 0.1 percent of the total acreage, meets the soil requirements for prime farmland if an adaquate and dependable supply of irrigation water is available.

The map units in the survey area that are considered prime farmland are Bagley clay loam, 0 to 3 percent slopes, and Manzano sandy clay loam, 0 to 3 percent slopes.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or forage plants best suited to the soils are identified, and the system of land capability classification used by the Natural Resources Conservation Service is explained.

Planners of management systems for individual fields or farms should consider the detailed information, including estimated yields of the main crops grown, given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

About 8,500 acres of land in the survey area is used for irrigated agriculture. About half of this land is found in the Snowflake-Taylor area. Other farming areas include Hay Hollow, Holbrook, Joseph City, Shumway, Woodruff, and Winslow. The main crops grown are alfalfa hay, field corn, small grains, and pasture grasses.

The irrigated acreage in the survey area is presently declining primarily because of increased production costs and low crop prices. Fuel costs and the costs associated with pumping irrigation water have risen significantly over the last few years. Other factors contributing to the decrease in farm acreage in some areas include urbanization and low crop yields that result from soil limitations or low quality irrigation water.

Proper use and management of the irrigated soils of the area require proper land use. The goal of proper land use is to produce the greatest amount of the most needed crops while protecting and improving the soil. If this goal is to be achieved, the land must be protected according to its needs and used within its capabilities. Plants that are well suited to the soil should be grown, soil management practices that protect the soil should be applied, and the soil condition should be maintained or improved.

The following paragraphs generally describe the principal soil management practices needed in the survey area. Although the soils in the area differ in management needs, certain practices apply to all the soils that are cropped.

Conservation Crop Rotation

Conservation crop rotation is the growing of crops in combination with needed cultural and management measures. In a successful conservation crop rotation system, the soil-improving crops and practices more than offset the soil-depleting crops and deteriorating practices.

Soil-improving practices include the use of rotations of grasses and legumes, the return of crop residue to the soil, proper tillage, proper fertilization, weed and pest control measures, and other good management practices.

A typical crop rotation used in the survey area is alfalfa grown for 6 to 8 years, small grain or field corn grown for 2 years, and then back to alfalfa. The crop residue of the small grain or field corn is returned to the soil, and tillage is reduced to only those operations that are necessary.

Crop Residue Management

Crop residue is the plant residue that remains in the field after harvesting a crop. Crop residue management involves incorporating this residue into the soil or leaving it on the surface during the part of the year when erosion is likely to occur. Plant residue adds organic matter to the soil. It benefits the development and stabilization of the soil. Organic matter functions mainly as it decomposes. The application of nitrogen fertilizer to the soil aids in the decomposition process. Most importantly, organic matter should be continuously returned to the soil. The easiest and most common way to add organic matter to the soil is to return plant residue produced by a crop. Unless sufficient crop residue is returned to the soil, the physical condition of the soil declines, soil compaction starts, and slower water infiltration and poorer aeration result.

Irrigation Water Management

Irrigation water management is the regulation of applications of irrigation water at rates and amounts that will ensure high crop production and minimum soil and water losses. It is needed in all irrigated areas. Good irrigation is the efficient application of water according to crop needs and at rates and in amounts consistent with the characteristics of the soil.

Efficient delivery of water to farms is the first step in supplying the moisture needed by crops. A good distribution system is one that has enough capacity to meet the needs of the irrigated crops and efficiently conveys water without excessive seepage and without causing erosion. Next, the water must be delivered from the distribution system to the individual fields. Irrigation pipelines, irrigation ponds, and pumpback systems are common components of efficient farm irrigation systems.

Surface or flood irrigation is the most commonly used type of irrigation system in the survey area. This method of irrigation utilizes borders or furrows to control the application of water. Leveling fields to uniform slopes is required for high irrigation efficiency. On land that can not be leveled because of high expense or soil limitations, sprinkler or drip irrigation systems can be used. Sprinkler and drip systems often are more efficient than surface irrigation systems, but they normally require a greater initial cost for installation.

If water is to be applied efficiently, special attention needs to be given to the kind of crop and the soil to be irrigated. Efficient irrigation adjusts to the needs of the crop, the soil-moisture relationship at the time of irrigation, the slope of the field, the length of irrigation runs, the time it takes to apply the water, the intake rate of the soil, and other factors that may be significant at the specific time of irrigation. A soil moisture check can be made 24 to 48 hours after irrigation (depending on soil texture) to determine if the desired moisture was added.

Pasture Management

Proper pasture management is grazing pasture in a manner that maintains grasses and legumes of high quality, provides an adequate supply of forage, and protects the soil from erosion. These objectives can be accomplished by using several pastures in a rotation system that allows for controlled grazing periods and adequate rest periods for each field. Proper rotation of livestock should allow a stubble height of 3 to 4 inches following each grazing period to be maintained throughout the growing season for most grasses. A regrowth period of 24 to 30 days between each grazing period of a field is usually recommended for most grasses. Care should be taken to keep livestock off the pastures when they are wet. Grazing when pastures are wet causes the soil to compact and the water intake rate to decrease.

Pastures should have proper irrigation water management. Over-irrigating reduces yields by leaching nutrients below the root zone and reducing oxygen availability in the soil for proper root growth. Commercial fertilizers and barnyard manure, if it is available, should be applied to increase yields. Weeds can generally be controlled by mowing.

Hayland Management

Hayland management is the proper treatment and use of hayland to prolong the life of desirable forage species, to maintain or improve the quality and quantity of the forage, and to protect the soil and reduce water loss. Adapted varieties of alfalfa or other hayland species should be used to increase crop yields. These plants must be able to withstand climatic extremes and still produce high yields during the relatively short growing season. Inoculated seed should be used in planting. A companion crop may be needed when planting if soil blowing is a hazard.

The proper management of established stands of hay should regulate the frequency and amount of irrigation water applied. The recommended time to cut alfalfa is when approximately 25 percent of the stems have one or more flowers open. A mowing height of 2 to 3 inches should be maintained to prevent injury to new buds and shoots. Fertilization is essential to ensure proper growth and good crop yields. Fertilization rates are dependent upon the soil and the crop grown.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland and for engineering purposes (USDA 1961).

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by numerals 1 through 8. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class 5 soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation.

Class 7 soils have very severe limitations that make them unsuitable for cultivation.

Class 8 soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a capital letter, *E, W, S,* or *C,* to the class numeral, for example, 2E. The letter *E* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *W* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *S* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *C,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *W, S,* or *C* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Rangeland

Larry D. Ellicott, area range conservationist, Natural Resources Conservation Service, prepared this section.

Approximately 80 percent of the survey area is rangeland or grazeable woodland.

The northwestern part of the survey area is in the Colorado Plateau Cold Desert Shrub Land Resource Unit. Vegetation is related to the Great Basin Desert plants that have evolved from both cold-temperate and warm-temperate predecessors. Sagebrush, saltbush, and winterfat are the major cold-temperate plants. The warm-temperate plant communities are low in diversity with a dominant shrub occurring to the virtual exclusion of other shrubs. This type of warm-temperate plant community is represented along the Little Colorado River west of Holbrook.

Except for a small amount of woodland in the southeast and southwest corners of the survey area, this survey area is in the Colorado Plateau Mixed Grass Plains Land Resource Unit. These grasslands are situated on open and exposed topography that subjects them to direct sunlight and long windy periods, particularly during winter and early spring. The principal species in these mixed or short-grass communities are blue grama, Indian ricegrass, and galleta. In lesser amounts are other species of grama, prairie junegrass, wolftail, or Texas timothy and alkali sacaton.

Because most grasslands are grazed, there is less fuel to carry wildfires. As a result of grazing and fire suppression, shrubs such as fourwing saltbush, sagebrush, winterfat, and especially snakeweed may be scattered throughout the plant community. Junipers also have invaded large areas that were formerly grassland.

Effective management of rangeland is dependent upon many factors. The season and intensity of use, the kind and distribution of grazing animals, and a knowledge of the resource capability are important considerations. In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. The relationship among the soils, vegetation, and water determines the resource capability.

Table 5 shows, for each soil that supports rangeland vegetation suitable for grazing, the range site and the

potential annual production of vegetation in favorable, average, and unfavorable years. An explanation of the column headings in table 5 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 6 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 6 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from the local office of the Natural Resources Conservation Service or of the Cooperative Extension Service or from a commercial nursery.

Recreation

The soils of the survey area are rated in table 7 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 7, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that

limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 7 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 9 and interpretations for dwellings without basements and for local roads and streets in table 8.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

David W. Seery, wildlife biologist, Natural Resources Conservation Service, prepared this section.

The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. Soils also affect the construction of water impoundments. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

There are five main types of wildlife habitat in the survey area. These habitats are described in the following paragraphs.

Hillslopes, Terraces, and Plateaus

These areas contain soils that support pinyon-juniper woodlands and grasslands on the gently undulating terraces and plateaus. The side slopes and edges are shallow soils with grasses and shrubs. Many birds and animals use pinyon nuts for food. Hawks and owls nest in juniper trees. Mule deer hide in the woodlands. Woodpeckers and bluebirds use holes in trees for nesting.

Wide Alluvial Valleys

The flood plains and streams support hardwood trees such as cottonwood, willow, ash, and walnut. Many of these trees have been removed and could be replaced in stream beds with wet soil. These areas provide habitat for crows, rabbits, owls, skunks, snakes, and song birds.

Fan terraces and stream terraces are broad areas between the flood plains and the plateaus. These upland sites provide habitat for antelope, badgers, prairie dogs, desert tortoise, and hawks. These grasslands are also used by cattle, sheep, and horses.

Breaks

Breaks are the steep, broken lands on the edges of mesas and mountains. They are areas where geologic erosion has occurred. Breaks have ridges, crevices, gullies, and some vertical rock walls with small caves and ledges. Vegetation grows on breaks but not in large amounts. However, many different kinds of plants and the physical diversity of the terrain attract wildlife. Deer can hide in the breaks and feed on the browse. Small animals such as the fox can find cover easily and must run only a short distance to be out of danger. Scattered trees grow in many of these areas and serve as hunting perches for hawks.

Rock Outcrop

Bluffs and cliffs on canyon walls and mesa edges are rock outcrop. Rock outcrop supports no vegetation but is important to many species of wildlife. Eagles, hawks, owls, and swallows nest on ledges. Bats roost in cracks and caves. Foxes, bobcats, and cougars have dens in overhangs and caves.

Wetlands

Wetlands in the survey area are small, and most are seasonally flooded. They have water-logged soil during dry periods. They are used for resting and feeding by migrating waterfowl. Coyotes, skunks, and bobcats use the wetlands as a source of drinking water.

In Arizona, wetlands provide an oasis in an otherwise dry environment. Habitats with water are highly sought after by wildlife, livestock, and humans.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 8 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require

cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Subsidence Caused by Gypsum

John M. Harrington, design engineer, Natural Resources Conservation Service, prepared this section.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Although subsidence is not shown in table 8, it affects building site development in the survey area.

Gypsum is often associated with other more soluble minerals (Dana 1954). Consequently, when gypsum is encountered, other minerals may be present that may contribute to potential settlement. This could be an important consideration when evaluating sites for structures.

Gypsum is partially soluble in water, and therefore soils that contain gypsum are subject to settlement by leaching. The National Soil Survey Handbook (USDA 1996) indicates that soils containing 10 percent or more of gypsum may subside because of percolating water. This could be a problem around building foundations. An effective treatment to prevent leaching of gypsum is to prevent water from getting to the strata containing the gypsum. Directing drainage water away from structures so that the water does not percolate down through the soils can reduce the amount of settlement. Sandy soils that readily soak up water can be topped with fine grained soils that tend to shed water.

Similar treatments can be effective for roads. Crowning and importing road base material can protect the underlying materials from percolating water. If a high concentration of gypsum is near or at the surface of the road base, initial compaction of the material can be a problem because the material is weak, especially when moist. Removal to a suitable depth and replacement with select material for compaction may solve the problem.

Gypsum affects building foundations not only by subsidence but also as a result of corrosion from sulfates. The presence of sulfates (gypsum is a sulfate) in concentrations of much less than 10 percent can be detrimental to the concrete. Air-entrained concrete, increased cement content, and fly ash are all beneficial in making concrete more durable to sulfate attack. The best solution to protect concrete from soils containing concentrations greater than 1 or 2 percent of sulfates is to over-excavate the soils and backfill with material that is low in sulfates (USDI 1975).

Gypsum should be avoided for dikes or pond sites. Gypsum concentrations of less than 2 or 3 percent are normally considered acceptable for water impoundments, but concentrations of 10 percent or more usually cannot be used (USDA EWP Tech. Guide No. 4).

Sanitary Facilities

Table 9 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 9 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the

soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 9 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 9 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 10 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized

with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 10, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 11 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, and terraces and diversions.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet.

It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 12 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (ASTM 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO 1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of

soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 13 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; *high*, more than 6 percent; and *very high*, greater than 9 percent.

Erosion factor K indicates the susceptibility of a soil to

sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.64. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are very highly erodible, and vegetation is difficult to establish.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are moderately highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are moderately erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.
8. Soils that are very slightly erodible because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 13, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 14 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Table 14 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of flooding is more than 50 percent in any year). *Common* is used when the occasional and frequent classes are grouped for certain purposes. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on observations of the water table at selected sites and on the evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. Indicated in table 14 are the depth to the seasonal high water table, the kind of water table, and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 14. An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (USDA 1975). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 15 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Fluvent (*Fluv*, meaning flood plain sediment, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Torrifluvents (*Torri*, meaning hot and dry, plus *fluvents*, the suborder of the Entisols that formed in flood plain sediment).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Torrifluvents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle size, mineral content, soil temperature regime, soil depth, and reaction. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed (calcareous), mesic Typic Torrifluvents.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the unit in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (USDA 1993). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (USDA 1975). Unless otherwise indicated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Arches Series

The Arches series consists of shallow, rapidly permeable, excessively drained soils overlying sandstone. These soils formed in eolian sands derived from sandstone. They are on plateaus. Slope ranges from 2 to 30 percent.

These soils are mixed, mesic Lithic Torripsamments.

Typical pedon of Arches loamy fine sand, in an area of Rock outcrop-Arches complex, 2 to 30 percent slopes, about 22 miles southwest of Holbrook, about 800 feet south and 1,600 feet west of the northeast corner of sec. 7, T. 15 N., R. 18 E.

A1—0 to 3 inches; yellowish red (5YR 5/6) loamy fine sand, dark reddish brown (5YR 3/4) moist; single grained, loose; many fine roots; many very fine irregular pores; noneffervescent; slightly alkaline (pH 7.4); clear smooth boundary.
A2—3 to 13 inches; yellowish red (5YR 5/6) loamy fine sand, dark reddish brown (5YR 3/4) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine roots; many very fine irregular pores; noneffervescent; slightly alkaline (pH 7.6); abrupt smooth boundary.
2R—13 inches; sandstone.

Depth to bedrock is dominantly 10 to 20 inches. The A horizon has hue of 7.5YR or 5YR, value of 5 or 6 (4 or 5 moist), and chroma of 4 to 6 dry and moist. Some pedons may be slightly effervescent directly above the bedrock.

Arntz Series

The Arntz series consists of moderately deep and deep, well drained, moderately slowly permeable soils on plateaus (fig. 6). These soils formed in alluvium derived dominantly from gypsiferous mudstone. Slope ranges from 1 to 8 percent.

These soils are fine-loamy, gypsic, mesic Cambic Gypsiorthids.

Typical pedon of Arntz fine sandy loam, 1 to 8 percent slopes, about 19 miles south of Holbrook, about 600 feet south and 100 feet east of the northwest corner of sec. 34, T. 15 N., R. 22 E.

A—0 to 2 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; common very fine and fine vesicular pores; strongly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
Bw1—2 to 6 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots; common very fine and fine irregular and tubular pores; few faint clay films on faces of peds and few pressure faces; strongly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
Bw2—6 to 12 inches; reddish brown (2.5YR 5/4) clay loam, reddish brown (2.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine and fine roots; many very fine and fine irregular and tubular pores; few faint clay films on faces of peds and few pressure faces; violently effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.
2By1—12 to 27 inches; light reddish brown (5YR 6/4) and pale yellow (2.5Y 7/4) stratified loam, reddish brown (5YR 5/4) and light yellowish brown (2.5Y 6/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; common very fine and fine tubular pores; 10 to 20 percent gypsum crystals; strongly effervescent; slightly alkaline (pH 7.6); abrupt smooth boundary.
2By2—27 to 32 inches; reddish brown (2.5YR 5/4) loam, reddish brown (2.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine and fine irregular and tubular pores; many fine mudstone fragments; 20 to 30 percent gypsum crystals; strongly effervescent; slightly alkaline (pH 7.6); abrupt smooth boundary.
2By3—32 to 42 inches; reddish brown (2.5YR 5/4) and pale yellow (2.5Y 7/4) clay loam, reddish brown (2.5YR 4/4) and light yellowish brown (2.5Y 6/4) moist; massive; hard, firm, sticky and slightly plastic; few very fine and fine roots; few very fine and fine irregular and tubular pores; many fine mudstone fragments; 20 to 30 percent gypsum crystals; strongly effervescent; slightly alkaline (pH 7.6); abrupt smooth boundary.
3Cr—42 to 60 inches; interbedded gypsiferous mudstone and crystalline gypsum; very hard; violently effervescent.

Depth to mudstone is 30 to 60 inches. Depth to a gypsic horizon is 1 to 10 inches. The gypsic horizon averages more than 40 percent gypsum in amorphous form and has thin to moderately thick layers of crystals.

The A horizon is slightly alkaline or moderately alkaline. The content of rock fragments is 5 to 25 percent. This horizon has hue of 5YR or 7.5YR, value of 5 or 6 (4 to 6 moist), and chroma of 3 to 6 dry and moist.

The By horizon is slightly alkaline or moderately alkaline loam, clay loam, or sandy clay loam (18 to 35 percent clay). It has hue of 5YR, 2.5YR, or 7.5YR; value of 4 to 8 (3 to 7 moist); and chroma of 3 to 6 dry and moist. Some pedons contain thin layers of contrasting 2.5Y hue.

Atarque Series

The Atarque series consists of very shallow and shallow, well drained, moderately permeable soils overlying sandstone. These soils formed in alluvium derived from sandstone and mudstone. They are on plateaus, mesas, and buttes. Slope ranges from 1 to 12 percent.

These soils are loamy, mixed, mesic Lithic Haplustalfs.

Typical pedon of Atarque fine sandy loam, 1 to 12 percent slopes, about 26 miles south of Winslow, about 2,300 feet east and 1,600 feet south of the northwest corner of sec. 34, T. 15 N., R. 15 E.

A—0 to 1 inch; brown (7.5YR 5/4) fine sandy loam, dark

brown (7.5YR 4/4) moist; weak thin platy structure; soft, loose, nonsticky and nonplastic; many fine roots; few very fine tubular pores; 5 percent small channers; noneffervescent; slightly alkaline (pH 7.4); abrupt smooth boundary.

Bt1—1 to 6 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many fine roots; common fine tubular pores; few faint clay films lining pores; 5 percent small channers; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

Bt2—6 to 14 inches; yellowish red (5YR 5/6) loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many fine roots; common fine tubular pores; few faint clay films on faces of peds and lining pores; 5 percent channers; noneffervescent; slightly alkaline (pH 7.6); very abrupt smooth boundary.

2R—14 inches; sandstone that has a thin coating of calcium carbonate on the upper surface.

Depth to bedrock ranges from 6 to 20 inches.

The A horizon contains less than 25 percent channers. It has hue of 7.5YR or 5YR, value of 4 or 5 (3 to 5 moist), and chroma of 2 to 4 dry and moist.

The B horizon is slightly alkaline or moderately alkaline loam (20 to 27 percent clay) that has less than 5 percent rock fragments. It has hue of 7.5YR or 5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 or 4 dry and moist.

Bagley Series

The Bagley series consists of very deep, well drained, moderately slowly permeable soils on flood plains. These soils formed in recent mixed alluvium. Slope ranges from 0 to 3 percent.

These soils are fine, mixed, mesic Cumulic Haplustolls.

Typical pedon of Bagley clay loam, 0 to 3 percent slopes, 1,320 feet south and 1,320 feet east of the northwest corner of sec. 24, T. 13 N., R. 21 E.

Ap—0 to 9 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium and fine granular structure; hard, friable, sticky and plastic; many very fine roots; many very fine irregular pores; slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

A1—9 to 24 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium angular and subangular blocky structure; very hard, firm, very sticky and very plastic; many very fine roots; common fine tubular pores; strongly effervescent; moderately alkaline (pH 8.2); gradual smooth boundary.

A2—24 to 39 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and very plastic; many very fine roots; common fine tubular pores; strongly effervescent; moderately alkaline (pH 8.2); gradual smooth boundary.

C—39 to 60 inches; brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; few fine tubular pores; slightly effervescent; moderately alkaline (pH 8.2).

The A horizon is slightly alkaline or moderately alkaline. It has value of 4 or 5 dry and chroma of 2 or 3 dry and moist.

The C horizon is moderately alkaline loam or clay loam (20 to 40 percent clay). It has value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3 dry and moist.

Barx Series

The Barx series consists of very deep, well drained, moderately permeable soils that formed in mixed alluvium derived dominantly from sandstone and mudstone (fig. 7). These soils are on fan terraces. Slope ranges from 0 to 10 percent.

These soils are fine-loamy, mixed, mesic Ustollic Haplargids.

Typical pedon of Barx fine sandy loam, 3 to 10 percent slopes, about 9.5 miles west of Snowflake; 1,750 feet east and 550 feet south of the northwest corner of sec. 29, T. 12 N., R. 20 E.

A1—0 to 1 inch; reddish brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak thin platy structure in the upper ½-inch and moderate fine granular structure below; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine and few medium roots; many fine and very fine vesicular pores; 10 percent gravel; noneffervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

A2—1 to 3 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and nonplastic; many fine roots; many fine irregular pores; noneffervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bt—3 to 18 inches; red (2.5YR 5/6) clay loam, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; many fine roots; common fine tubular pores; common faint clay films on faces of peds and lining pores; noneffervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Btk1—18 to 25 inches; reddish brown (2.5YR 4/4) sandy clay loam, dark reddish brown (2.5YR 3/4) moist; weak

medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and slightly plastic; common fine roots; common fine tubular pores; common faint clay films on faces of peds and lining pores; common fine calcium carbonate masses and few medium pinkish white (5YR 8/2) coatings on faces of peds; strongly effervescent, 11 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear wavy boundary.

Btk2—25 to 36 inches; reddish brown (2.5YR 5/4) sandy clay loam, reddish brown (2.5YR 4/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and slightly plastic; common fine roots; common fine tubular pores; common faint clay films on faces of peds and lining pores; common fine calcium carbonate masses and common medium pinkish white (5YR 8/2) coatings on faces of peds; strongly effervescent, 11 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt wavy boundary.

Btk3—36 to 42 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; common fine tubular pores; few faint clay films on faces of peds and lining pores; common fine calcium carbonate masses and many medium pinkish white (5YR 8/2) coatings on faces of peds; violently effervescent, 23 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear wavy boundary.

2Bk—42 to 54 inches; reddish brown (2.5YR 5/4) sandy loam, dark reddish brown (2.5YR 3/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; common fine tubular pores; 5 percent gravel; few fine pinkish white (5YR 8/2) calcium carbonate veins; slightly effervescent, 9 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt wavy boundary.

3Btkb—54 to 60 inches; reddish brown (2.5YR 4/4) sandy clay loam, dark reddish brown (2.5YR 3/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many fine tubular pores; few faint clay films on faces of peds and lining pores; 10 percent gravel; common fine calcium carbonate veins, common medium pinkish white (5YR 8/2) coatings on faces of peds, and common medium coatings on gravel; slightly effervescent, 13 percent calcium carbonate equivalent; moderately alkaline (pH 8.2).

Depth to a calcic horizon ranges from 24 to 36 inches. The content of calcium carbonate ranges from 15 to 25 percent. The A horizon is slightly alkaline or moderately alkaline fine sandy loam or sandy loam. It has hue of 2.5YR or 5YR, value of 4 or 5 (3 or 4 moist), and chroma of 3 to 6 dry and moist.

The Bt and Btk horizons are moderately alkaline clay loam or sandy clay loam (20 to 35 percent clay). They have hue of 2.5YR or 5YR, value of 4 or 5 (3 or 4 moist), and chroma of 3 to 6 dry and moist.

The Bk horizon is loam, gravelly loam, sandy loam, or gravelly sandy loam.

Bisoodi Series

The Bisoodi series consists of shallow, well drained, moderately permeable soils that formed in alluvium derived dominantly from calcareous sandstone and limestone. These soils are on broad plateaus, mesas, and buttes. Slope ranges from 1 to 20 percent.

These soils are loamy, mixed, mesic Lithic Ustollic Calciorthids.

Typical pedon of Bisoodi fine sandy loam, 1 to 8 percent slopes, about 16 miles southwest of Holbrook just west of AZ-377; about 900 feet west and 300 feet north of the southeast corner of sec. 10, T. 15 N., R. 19 E.

A1—0 to 1 inch; light brown (7.5YR 6/4) fine sandy loam, strong brown (7.5YR 5/6) moist; weak thin platy structure parting to single grained; soft, very friable, nonsticky and nonplastic; common very fine roots; common fine vesicular pores; 5 percent gravel and 5 percent channers; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

A2—1 to 4 inches; reddish yellow (7.5YR 6/6) loam, strong brown (7.5YR 5/6) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; 5 percent gravel and 5 percent channers; strongly effervescent, 11 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk1—4 to 10 inches; pink (7.5YR 7/4) gravelly loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; 5 percent calcium carbonate coated gravel and 10 percent coated channers; violently effervescent, 17 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk2—10 to 14 inches; pink (7.5YR 7/4) loam, brown (7.5YR 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; common fine and very fine tubular pores; 10 percent calcium carbonate coated channers; violently effervescent, 17 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt wavy boundary.

2Cr—14 to 18 inches; very pale brown (10YR 7/4) weathered, calcareous sandstone; discontinuous thin calcium carbonate coatings on the undersides of

channers and in joints; many very fine roots matted between channers and in joints; abrupt wavy boundary.
3R—18 inches; sandstone capped by a thin discontinuous layer of calcium carbonate.

Depth to bedrock is 10 to 20 inches. Depth to a calcic horizon is 3 to 8 inches.

The A horizon is slightly alkaline or moderately alkaline fine sandy loam or channery fine sandy loam. It has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 to 5 dry and moist. The content of calcium carbonate ranges from 1 to 10 percent in the upper 1 to 2 inches and from 5 to 25 percent in the lower part of the A horizon.

The Bk horizon is loam or sandy loam (5 to 18 percent clay and 15 to 40 percent calcium carbonate equivalent). It has hue of 5YR or 7.5YR, value of 5 to 7 (4 or 5 moist), and chroma of 3 to 6 dry and moist.

The Cr horizon is not present in all pedons.

Burnswick Series

The Burnswick series consists of very deep, well drained, moderately slowly permeable sodic soils on fan terraces. These soils formed in mixed alluvium derived dominantly from mudstone and sandstone. Slope ranges from 1 to 5 percent.

These soils are fine-loamy, mixed, mesic Typic Camborthids.

Typical pedon of Burnswick sandy clay loam, 1 to 5 percent slopes, about 7 miles northwest of Holbrook; about 2,550 feet east of the southwest corner of sec. 33, T. 19 N., R. 20 E.

A—0 to 3 inches; light reddish brown (5YR 6/3) sandy clay loam, reddish brown (5YR 5/3) moist; moderate medium platy structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine vesicular pores; 5 percent gravel; noneffervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.
Bw1—3 to 11 inches; reddish brown (5YR 5/3) sandy clay loam, reddish brown (5YR 4/3) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and plastic; many very fine roots; many very fine tubular pores; noneffervescent; moderately alkaline (pH 8.4); clear smooth boundary.
Bw2—11 to 16 inches; reddish brown (5YR 5/3) sandy clay loam, reddish brown (5YR 4/3) moist; weak fine subangular blocky structure; slightly hard, friable, sticky and plastic; many fine roots; many fine tubular pores; slightly effervescent; moderately alkaline (pH 8.4); clear wavy boundary.
Bkn1—16 to 29 inches; reddish brown (5YR 5/3) sandy clay loam, reddish brown (5YR 4/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common fine roots; common fine tubular pores; slightly effervescent; secondary calcium carbonate filling pores and coating faces of peds; strongly alkaline (pH 8.8); clear smooth boundary.
Bkn2—29 to 41 inches; light reddish brown (5YR 6/3) sandy clay loam, reddish brown (5YR 5/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; common fine and very fine tubular pores; strongly effervescent; secondary calcium carbonate filling pores and coating faces of peds; strongly alkaline (pH 8.8); clear smooth boundary.
BCn—41 to 53 inches; light reddish brown (5YR 6/3) sandy loam, reddish brown (5YR 5/3) moist; massive; slightly hard, friable, slightly sticky and nonplastic; few very fine roots; few very fine tubular and irregular pores; strongly effervescent; disseminated calcium carbonate; strongly alkaline (pH 8.8); abrupt smooth boundary.
2Bknb—53 to 60 inches; light reddish brown (5YR 6/3) sandy clay loam, reddish brown (5YR 5/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and plastic; 10 percent fine gravel; violently effervescent; common fine and medium calcium carbonate nodules and common thin coatings on gravel; strongly alkaline (pH 8.8).

Sodicity is low to moderate (SAR ranges from 6 to 20) in the upper 10 to 20 inches and moderate (SAR ranges from 13 to 30) below a depth of 20 inches. Salinity ranges from nonsaline to slightly saline. The content of rock fragments ranges to 25 percent in any one horizon but averages less than 15 percent in the control section. Depth to the base of the cambic horizon is 10 to 30 inches.

The A horizon is sandy clay loam or sandy loam that has 5 to 25 percent gravel. It has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 or 4 dry and moist.

The Bw and Bk horizons are moderately to strongly alkaline sandy clay loam or clay loam (20 to 35 percent clay). They have hue of 5YR or 2.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 or 4 dry and moist. The content of calcium carbonate ranges from 1 to 15 percent.

The BC and buried Bk horizons are sandy loam, sandy clay loam, or clay loam (5 to 35 percent clay). They have hue of 5YR or 2.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4 dry and moist.

Calciorthids

Calciorthids are shallow to deep, well drained, moderately permeable or moderately slowly permeable soils on escarpments of old volcanic plugs and dikes that form buttes. These soils formed in alluvium and colluvium

derived dominantly from basalt, sandstone, and mudstone. Slope ranges from 15 to 80 percent.

Representative pedon of Calciorthids, in an area of Calciorthids-Torriorthents-Rock outcrop complex, 15 to 80 percent slopes, on Woodruff Butte, about 3,600 feet north and 2,100 feet east of the southwest corner of sec. 8, T. 16 N., R. 22 E.

A1—0 to 1 inch; brown (7.5YR 5/4) very cobbly loam, dark brown (7.5YR 4/4) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine and very fine vesicular and few fine tubular pores; 30 percent cobbles and 20 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

A2—1 to 5 inches; brown (7.5YR 5/4) very cobbly loam, dark brown (7.5YR 4/4) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine and few medium roots; many fine and very fine irregular pores; 30 percent cobbles and 20 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bw—5 to 12 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; many fine and very fine and few medium roots; common fine and very fine tubular and irregular pores; 5 percent cobbles and 5 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bk—12 to 27 inches; pink (5YR 8/3) gravelly loam, light reddish brown (5YR 6/3) moist; massive; hard, firm, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular pores; 5 percent cobbles and 20 percent gravel; violently effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.

2R—27 inches; interbedded sandstone and mudstone.

Calciorthids vary widely in depth, texture, and rock fragment content.

Depth to bedrock ranges from 10 to 50 inches. Bedrock varies from soft mudstone with varying amounts of gypsum to hard sandstone or basalt. The content of calcium carbonate ranges from 15 to 35 percent in the control section. Textures include loam and clay loam, and the content of rock fragments ranges from 5 to 75 percent.

Cerrillos Series

The Cerrillos series consists of very deep, well drained, moderately slowly permeable soils on fan terraces. These soils formed in mixed alluvium derived from sandstone and mudstone. Slope ranges from 1 to 10 percent.

These soils are fine-loamy, mixed, mesic Ustollic Haplargids.

Typical pedon of Cerrillos sandy loam, 1 to 10 percent slopes, about 8 miles south of Woodruff, about 1,100 feet west and 2,000 feet south of the northeast corner of sec. 29, T. 15 N., R. 22 E.

A—0 to 2 inches; reddish brown (5YR 5/4) sandy loam, dark reddish brown (5YR 3/4) moist; weak thin platy structure; slightly hard, very friable, nonsticky and nonplastic; many fine roots; common fine vesicular pores; 5 percent fine gravel; noneffervescent; moderately alkaline (pH 8.2); clear smooth boundary.

Bt1—2 to 5 inches; reddish brown (5YR 4/3) sandy clay loam, dark reddish brown (5YR 3/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; few faint clay films lining pores; 5 percent fine gravel; noneffervescent; moderately alkaline (pH 8.2); clear smooth boundary.

Bt2—5 to 15 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, sticky and slightly plastic; many fine roots; common fine tubular pores; common faint clay films on faces of peds and lining pores; 5 percent fine gravel; slightly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Btk—15 to 23 inches; reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; many very fine roots; common fine tubular pores; common faint clay films on faces of peds and lining pores; violently effervescent; calcium carbonate segregated in common medium irregular masses, 36 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear wavy boundary.

Btkn—23 to 34 inches; light reddish brown (5YR 6/4) clay loam, reddish brown (5YR 5/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; common fine roots; common fine tubular pores; common faint clay films on faces of peds; violently effervescent; calcium carbonate segregated in many medium irregular masses, 23 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); clear wavy boundary.

Bkn1—34 to 47 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; moderate medium subangular blocky structure; hard, firm, sticky and slightly plastic; common fine roots; common fine tubular pores; violently effervescent; calcium carbonate segregated as few fine irregular

masses and common thin coatings on faces of peds, 24 percent calcium carbonate equivalent; strongly effervescent (pH 8.8); clear wavy boundary.

Bkn2—47 to 60 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and nonplastic; few fine roots; common fine tubular pores; strongly effervescent; calcium carbonate segregated as few fine filaments, 12 percent calcium carbonate equivalent; strongly alkaline (pH 8.8).

Depth to a calcic horizon is 10 to 20 inches. The content of calcium carbonate ranges from 15 to 40 percent. Reaction is slightly alkaline or moderately alkaline in the surface horizons and moderately alkaline or strongly alkaline in the subsurface horizons with a low sodium hazard (SAR ranges from 1 to 13). The content of rock fragments is generally less than 15 percent but may range to 30 percent in any one horizon.

The A horizon has hue of 5YR or 7.5YR, value of 5 or 6 (3 or 4 moist), and chroma of 2 to 4 dry and moist.

The Bt and Btk horizons are clay loam or sandy clay loam (25 to 35 percent clay). They have hue of 5YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6 dry and moist.

The Bk horizon has hue of 5YR or 7.5YR, value of 5 or 6 (4 to 6 moist), and chroma of 4 to 6 dry and moist.

Chedeski Series

The Chedeski series consists of shallow, well drained, moderately permeable soils on plateaus. These soils formed in mixed alluvium derived from sedimentary rock. Slope ranges from 1 to 5 percent.

These soils are loamy, mixed, mesic, shallow Ustochreptic Camborthids.

Typical pedon of Chedeski sandy loam, in an area of Pensom-Chedeski complex, 1 to 5 percent slopes, about 19 miles south of Holbrook, east of Arizona Highway 377, 2,400 feet east and 1,600 feet south of the northwest corner of sec. 27, T. 15 N., R. 19 E.

A—0 to 1 inch; yellowish red (5YR 5/6) sandy loam, yellowish red (5YR 4/6) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; common fine tubular pores; many fine roots; noneffervescent; slightly alkaline (pH 7.6); clear smooth boundary.

Bw1—1 to 3 inches; red (2.5YR 5/6) sandy loam, red (2.5YR 4/6) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common fine tubular pores; many fine roots; noneffervescent; slightly alkaline (pH 7.8); clear smooth boundary.

Bw2—3 to 13 inches; red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine tubular pores; common fine roots; noneffervescent; slightly alkaline (pH 7.8); clear smooth boundary.

Bk—13 to 16 inches; reddish yellow (5YR 6/6) sandy clay loam, reddish yellow (5YR 4/6) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine tubular pores; common fine and medium roots; 10 percent channers; violently effervescent, 18 percent calcium carbonate equivalent; calcium carbonate segregated as coatings on rock fragments; moderately alkaline (pH 8.0); abrupt wavy boundary.

2Cr—16 to 26 inches; weathered sandstone with calcium carbonate coatings; abrupt wavy boundary.

2R—26 inches; sandstone.

Depth to paralithic contact ranges from 10 to 20 inches, and depth to lithic contact ranges from 20 to 35 inches. Reaction is slightly alkaline or moderately alkaline. The content of rock fragments is less than 15 percent.

The A horizon has hue of 2.5YR or 5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 to 6 dry and moist.

The Bw horizon is sandy loam or sandy clay loam (12 to 27 percent clay). It has hue of 2.5YR or 5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 to 6 dry and moist.

The Bk horizon is sandy clay loam or loam (18 to 27 percent clay). It has hue of 2.5YR or 5YR, value of 6 or 7 (4 or 5 moist), and chroma of 3 to 6 dry and moist. The content of calcium carbonate ranges from 15 to 25 percent.

Claysprings Series

The Claysprings series consists of shallow and very shallow, well drained, very slowly permeable soils on fan terraces of plateaus. These soils formed in alluvium weathered from siltstone and mudstone. Slope ranges from 1 to 10 percent.

These soils are clayey, montmorillonitic (calcareous), mesic, shallow Typic Torriorthents.

Typical pedon of Claysprings clay, 1 to 10 percent slopes, 2,500 feet south and 1,300 feet west of the northeast corner of sec. 13, T. 19 N., R. 22 E.

A—0 to 3 inches; pinkish gray (5YR 6/2) clay, reddish gray (5YR 5/2) moist; weak medium platy structure in the upper ¼ inch and weak medium subangular blocky below; hard, firm, sticky and plastic; common very fine roots; many very fine tubular pores; strongly effervescent; strongly alkaline (pH 8.5); clear wavy boundary.

C—3 to 18 inches; reddish brown (5YR 5/3) clay, reddish gray (5YR 5/2) moist; weak medium subangular blocky

structure; hard, firm, sticky and very plastic; common very fine roots; many very fine tubular pores; strongly effervescent; strongly alkaline (pH 8.8); gradual wavy boundary.

2Cr—18 to 25 inches; weathered mudstone; few fine roots; slightly effervescent; strongly alkaline (pH 8.8); clear irregular boundary.

2R—25 inches; mudstone.

Depth to weathered mudstone is 6 to 20 inches, and depth to hard or very hard unweathered mudstone is 20 to 40 inches. Reaction is moderately alkaline or strongly alkaline. Salinity is none to strong.

The A horizon has hue of 5YR or 7.5YR, value of 4 to 6 (4 or 5 moist), and chroma of 2 to 4 dry and moist.

The C horizon is clay or silty clay (40 to 55 percent clay). It has hue of 5YR or 7.5YR, value of 4 to 6 (moist), and chroma of 2 to 4 dry and moist.

Deama Family

The Deama family consists of shallow, well drained, moderately permeable soils on basalt mesas. These soils formed in alluvium derived dominantly from basalt. Slope ranges from 1 to 8 percent.

These soils are loamy-skeletal, carbonatic, mesic Lithic Calciustolls.

Typical pedon of Deama family very gravelly loam, 1 to 8 percent slopes, just east of White Mountain Lake, about 1,700 feet east and 2,400 feet north of the southwest corner of sec. 11, T. 11 N., R. 22 E.

A1—0 to 2 inches; dark brown (10YR 4/3) very gravelly loam, dark brown (10YR 3/3) moist; moderate fine granular structure; soft, very friable, slightly sticky and nonplastic; many fine roots; common fine irregular pores; 35 percent mixed gravel; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

A2—2 to 6 inches; dark brown (7.5YR 4/2) very gravelly loam, dark brown (10YR 3/3) moist; moderate medium granular and weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many fine roots; common fine tubular pores; 40 percent gravel; strongly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bk1—6 to 10 inches; brown (7.5YR 5/2) very gravelly loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many fine roots; common fine tubular pores; 50 percent calcium carbonate coated gravel; violently effervescent, 20 percent calcium carbonate equivalent; common fine calcium carbonate masses; moderately alkaline (pH 8.0); clear smooth boundary.

Bk2—10 to 17 inches; pinkish gray (7.5YR 7/2) extremely gravelly loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine roots; common fine tubular pores; 60 percent calcium carbonate coated gravel; violently effervescent, 50 percent calcium carbonate equivalent; common very fine irregular calcium carbonate masses; moderately alkaline (pH 8.0); very abrupt wavy boundary.

2R—17 inches; basalt; calcium carbonate cemented layer, which is 0.5 to 2.0 centimeters thick, on upper boundary.

Depth to bedrock ranges from 15 to 20 inches. Depth to a calcic horizon is 2 to 8 inches. The thick calcium carbonate layer above the bedrock does not occur in all pedons. Calcium carbonate accumulations in the profile occur as coatings that are 1 to 2 millimeters thick on the rock fragments. The content of rock fragments ranges from 35 to 60 percent, occurring as basalt cobbles and gravel. Organic matter content is 1 to 2 percent.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3 dry and moist.

The Bk horizon is very gravelly or very cobbly loam. It has hue of 7.5YR or 10YR, value of 5 to 7 (3 to 5 moist), and chroma of 1 to 3 dry and moist.

Deama Series

The Deama series consists of shallow, well drained, moderately permeable soils on plateaus, mesas, and buttes. These soils formed in alluvium derived dominantly from limestone. Slope ranges from 1 to 60 percent.

These soils are loamy-skeletal, carbonatic, mesic Lithic Calciustolls.

Typical pedon of Deama very channery loam, in an area of Deama-Rock outcrop complex, 1 to 20 percent slopes, about 26 miles south of Winslow, near Chevelon Canyon, about 1,500 feet west and 600 feet north of the southeast corner of sec. 34, T. 15 N., R. 15 E.

A—0 to 1 inch; grayish brown (10YR 5/2) very channery loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; common fine vesicular pores; 35 percent channers and concretions; strongly effervescent, 18 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk1—1 to 4 inches; grayish brown (10YR 5/2) channery loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many fine roots; common fine tubular pores; 15 percent channers and concretions; strongly effervescent, 33 percent calcium carbonate equivalent;

moderately alkaline (pH 8.4); clear smooth boundary.
Bk2—4 to 13 inches; pale brown (10YR 6/3) very channery loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine tubular pores; 50 percent channers and concretions; violently effervescent, 63 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.
Bk3—13 to 20 inches; very pale brown (10YR 7/3) extremely channery loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine tubular pores; 75 percent channers and concretions; violently effervescent, 72 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); very abrupt boundary.
2R—20 inches; limestone.

Depth to bedrock ranges from 10 to 20 inches. The calcium carbonate equivalent is 33 to 75 percent, averaging more than 40 percent in the control section. The content of rock fragments ranges from 35 to 85 percent. Reaction is slightly alkaline or moderately alkaline.

The A horizon is very channery loam or very flaggy loam with more than 35 percent limestone channers or flagstones. It has hue of 10YR or 7.5YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3 dry and moist.

The Bk horizon contains 18 to 27 percent clay with more than 35 percent limestone channers or flagstones. It has hue of 10YR or 7.5YR, value of 5 to 7 (3 to 5 moist), and chroma of 2 or 3 dry and moist.

Epikom Series

The Epikom series consists of shallow, well drained, moderately permeable soils on plateaus, buttes, and mesas. These soils formed in alluvium derived from sandstone and mudstone. Slope ranges from 1 to 60 percent.

These soils are loamy, mixed, mesic Lithic Camborthids.

Typical pedon of Epikom channery sandy loam, 1 to 12 percent slopes, about 1.25 miles south of Woodruff, about 1,000 feet south and 2,200 feet west of the northeast corner of sec. 29, T. 16 N., R. 22 E.

A—0 to 1 inch; light reddish brown (5YR 6/4) channery sandy loam, yellowish red (5YR 4/6) moist; moderate fine and medium platy structure; slightly hard, friable, nonsticky and nonplastic; few very fine roots; many fine and very fine vesicular pores; 20 percent channers; slightly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
AB—1 to 4 inches; light reddish brown (5YR 6/4) loam, yellowish red (5YR 4/6) moist; moderate fine granular structure; slightly hard, very friable, sticky and slightly plastic; common fine roots; many fine irregular and few fine tubular pores; 10 percent channers; strongly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.
Bw—4 to 10 inches; light reddish brown (5YR 6/4) loam, yellowish red (5YR 4/6) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; many fine roots; common fine tubular pores; 10 percent channers; strongly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
Bk—10 to 14 inches; light reddish brown (5YR 6/4) very flaggy loam, yellowish red (5YR 4/6) moist; massive; loose, sticky and slightly plastic; common fine roots; common fine tubular pores; 35 percent calcium carbonate coated channers and 25 percent calcium carbonate coated flagstones; strongly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.
2R—14 inches; Moenkopie sandstone.

Depth to bedrock ranges from 10 to 20 inches. Depth to maximum calcium carbonate accumulation ranges from 10 to 20 inches. The content of calcium carbonate ranges from 5 to 15 percent.

The A horizon contains 5 to 45 percent sandstone channers, flagstone, or both. It has hue of 5YR or 7.5YR, value of 5 or 6 (3 or 4 moist), and chroma of 4 to 6 dry and moist.

The Bw horizon is loam or sandy loam (15 to 18 percent clay) with 5 to 25 percent sandstone channers. It has hue of 5YR or 2.5YR, value of 5 or 6 (3 to 5 moist), and chroma of 3 to 6 dry and moist.

The Bk horizon contains 15 to 50 percent sandstone channers, flagstone, or both. It has value of 5 or 6 (4 or 5 moist) and chroma of 4 to 6 dry and moist.

Escavada Family

The Escavada family consists of very deep, moderately rapidly permeable, somewhat excessively drained soils on flood plains. These soils formed in mixed alluvium derived dominantly from sandstone and mudstone. They have slopes of 0 to 3 percent.

These soils are sandy, mixed, mesic Ustic Torrifluvents.

Typical pedon of Escavada family sandy loam, 0 to 3 percent slopes, about 2.5 miles west of Snowflake, north of Cottonwood Wash, about 1,200 feet south and 300 feet west of the northeast corner of sec. 5, T. 12 N., R. 21 E.

Ap—0 to 10 inches; brown (7.5YRF 5/3) sandy loam, brown (7.5YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; many fine and very fine tubular pores; 5 percent

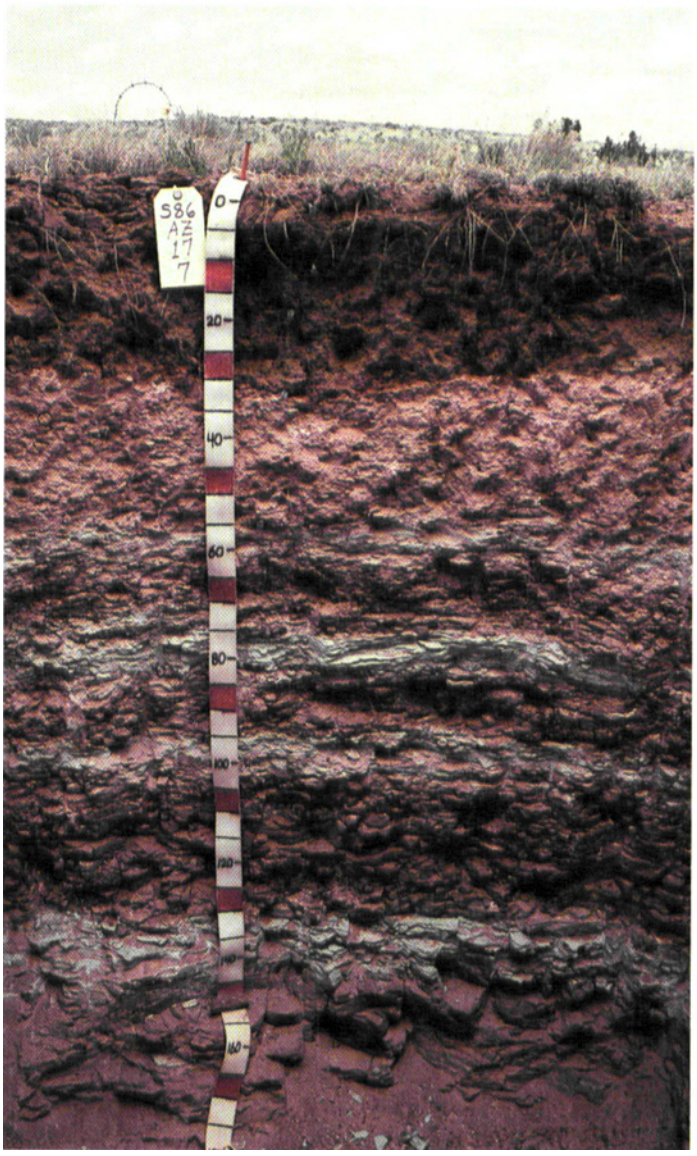


Figure 6.—Profile of Arntz fine sandy loam. Depth is marked in centimeters.

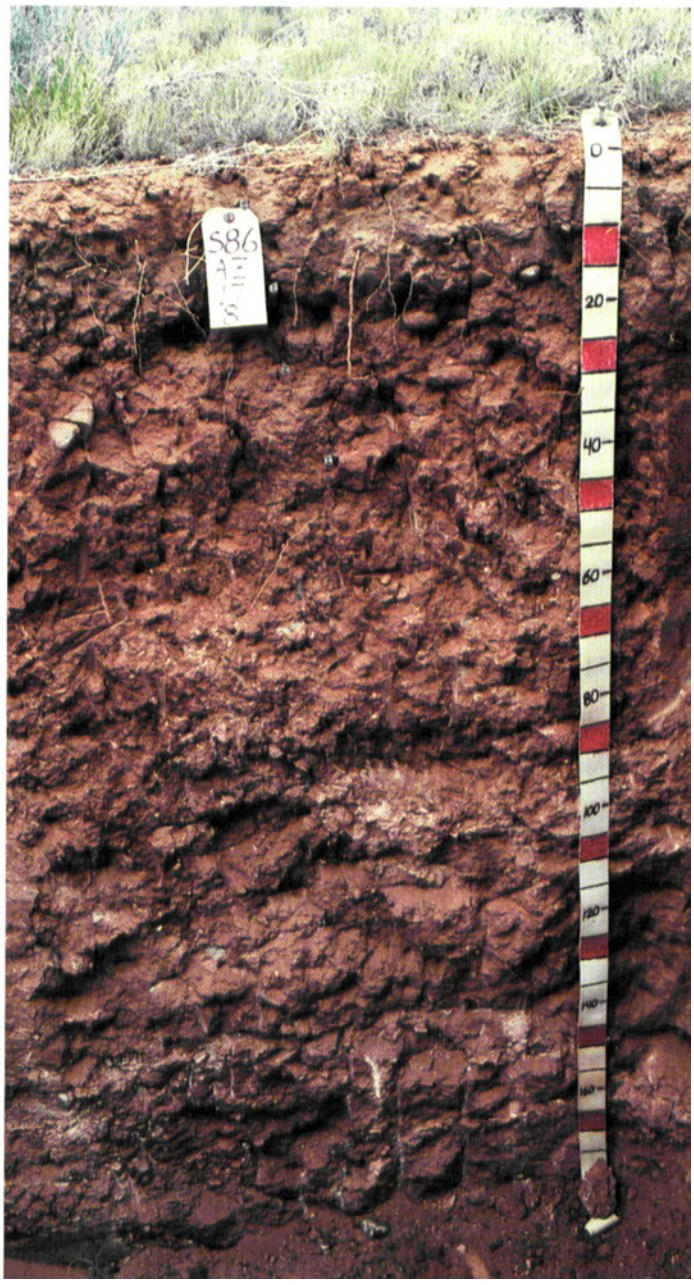


Figure 7.—Profile of Barx fine sandy loam. Depth is marked in centimeters.

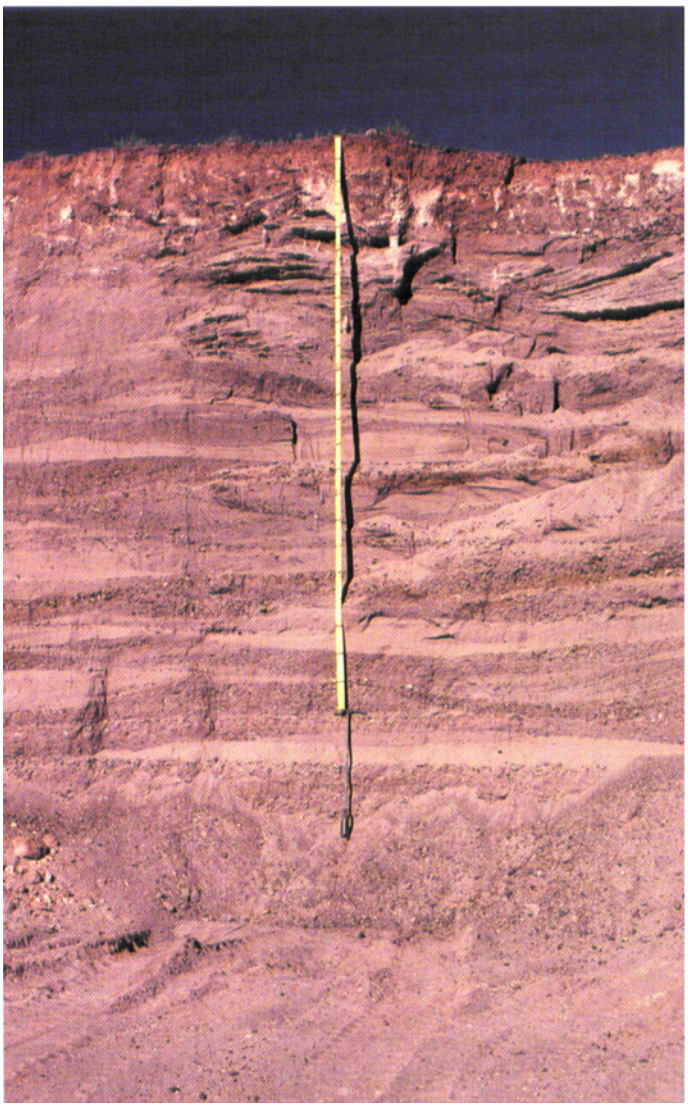


Figure 8.—Profile of Gypsiorthids. The white areas in the upper few feet are accumulations of gypsum and carbonates. Depth is marked in feet.

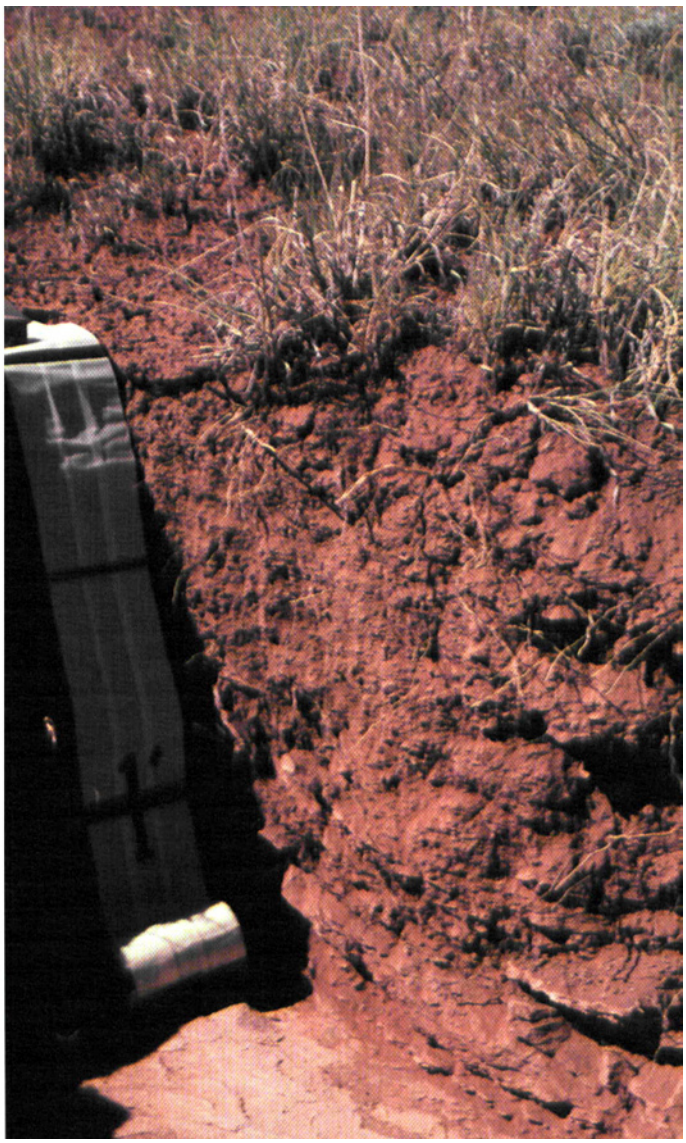


Figure 9.—Profile of Kech fine sandy loam. Depth is marked in feet.

Figure 10.—Profile of Leanto channery loamy sand. Depth is marked in centimeters.

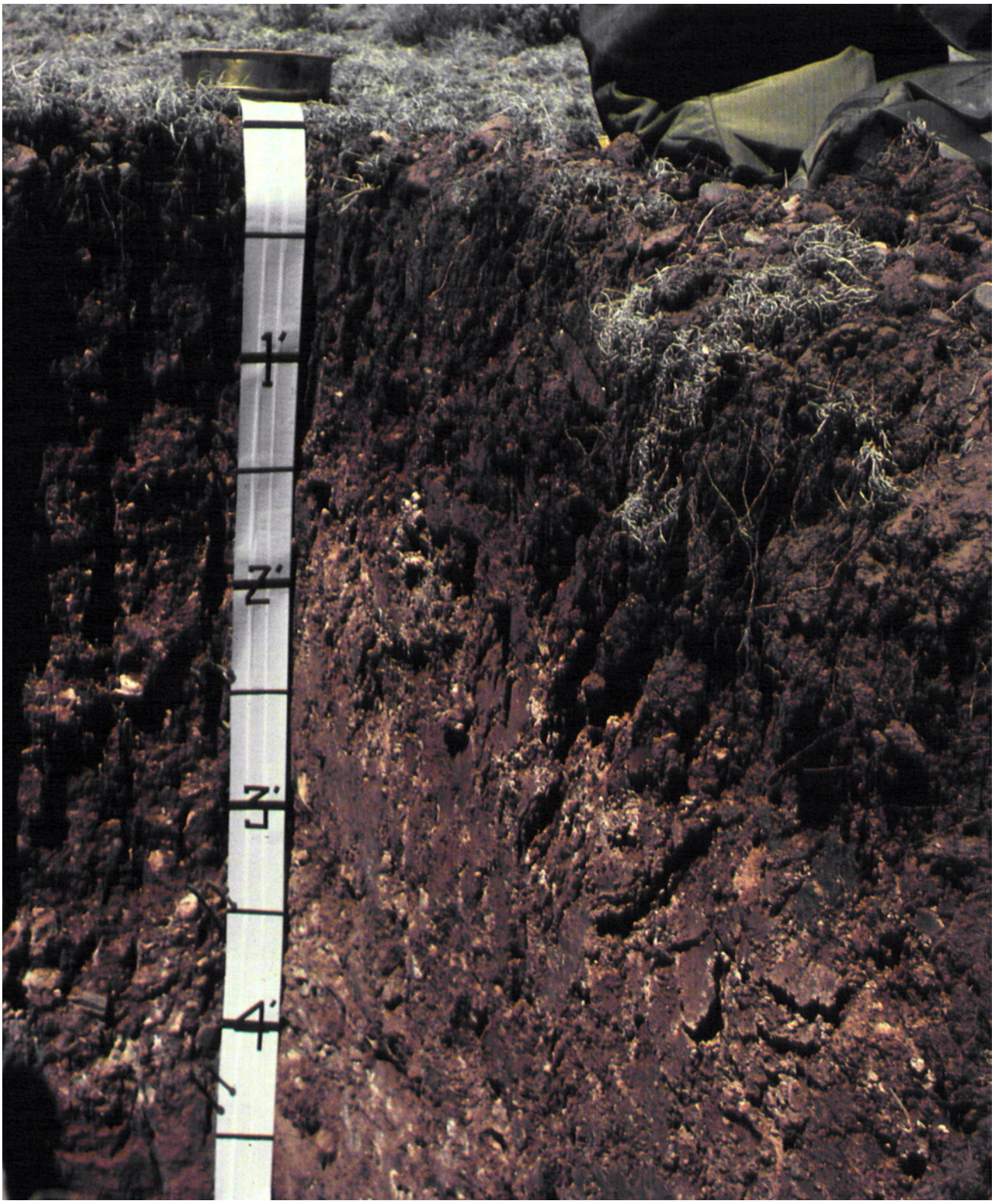


Figure 11.—Profile of Padilla clay loam. Depth is marked in feet.

fine gravel; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

C1—10 to 33 inches; light brown (7.5YRF 6/4) stratified loamy sand, brown (7.5YR 5/4) moist; massive; soft, very friable, nonsticky and nonplastic; many fine and very fine roots; many fine and very fine tubular pores; few thin strata of finer and coarser materials; 10 percent fine gravel; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

C2—33 to 60 inches; light reddish brown (5YRF 6/4) stratified sandy loam, reddish brown (5YR 5/4) moist; massive; slightly hard, friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; few thin strata of finer and coarser materials; 10 percent gravel; strongly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

The content of rock fragments averages less than 15 percent. These soils are stratified loamy sand, loamy fine sand, and sandy loam throughout. They have hue of 7.5YR or 5YR, value of 5 to 7 (3 or 4 moist), and chroma of 2 to 4 dry and moist. The content of calcium carbonate ranges from 0 to 10 percent in the upper 10 inches and from 5 to 15 percent below a depth of 10 inches.

Grieta Series

The Grieta series consists of very deep, well drained, moderately permeable soils on fan terraces. These soils formed in alluvium weathered dominantly from sandstone and mudstone. Slope ranges from 1 to 12 percent.

These soils are fine-loamy, mixed, mesic Typic Haplargids.

Typical pedon of Grieta sandy loam, 3 to 10 percent slopes, about 17 miles east of Holbrook, about 1,200 feet west and 400 feet north of the southeast corner of sec. 2, T. 18 N., R. 23 E.

A—0 to 3 inches; reddish brown (5YR 5/3) sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bt—3 to 11 inches; reddish brown (5YR 5/3) sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium and coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; common very fine tubular pores; few faint clay films lining pores and bridging sand grains; strongly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Btk1—11 to 20 inches; reddish brown (5YR 5/4) sandy clay loam, yellowish red (5YR 4/6) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; few faint clay films on faces of peds, lining pores, and bridging sand grains; strongly effervescent; few fine soft irregularly-shaped white calcium carbonate masses; moderately alkaline (pH 8.2); clear wavy boundary.

Btk2—20 to 27 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; weak moderate prismatic structure parting to weak fine subangular blocky; hard, very friable, slightly sticky and slightly plastic; few very fine roots; many very fine tubular pores; few faint clay films on faces of peds; strongly effervescent; common soft irregularly-shaped (10YR 8/2) calcium carbonate masses; moderately alkaline (pH 8.4); clear wavy boundary.

Bk—27 to 44 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; massive; hard, very friable, slightly sticky and slightly plastic; very few very fine roots; common very fine tubular pores; violently effervescent; many fine soft irregularly-shaped (10YR 8/2) calcium carbonate masses; moderately alkaline (pH 8.2); clear wavy boundary.

C—44 to 60 inches; light reddish brown (5YR 6/4) sandy loam, yellowish red (5YR 4/6) moist; massive; hard, very friable; common very fine tubular pores; strongly effervescent; moderately alkaline (pH 8.2).

Depth to the maximum carbonate accumulation is 20 to 24 inches. The content of calcium carbonate ranges from 5 to 30 percent. The content of rock fragments averages less than 10 percent.

The A horizon has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 to 6 dry and moist.

The Bt and Btk horizons are clay loam and sandy clay loam (20 to 35 percent clay). They have hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 to 6 dry and moist.

The Bk and C horizons are sandy clay loam or sandy loam. They have hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 4 to 6 dry and moist.

Gypsiorthids

Gypsiorthids are deep and very deep, somewhat excessively drained, moderately permeable or moderately slowly permeable soils on hills (fig. 8). These soils formed in alluvium and colluvium derived from mixed sources. Slope ranges from 5 to 60 percent.

Representative pedon of Gypsiorthids, in an area of Gypsiorthids-Torriorthents association, 5 to 60 percent slopes, about 5 miles west of Holbrook, about 200 feet

south and 800 feet east of the northwest corner of sec. 29, T. 18 N., R. 20 E.

A1—0 to 1 inch; reddish brown (5YR 5/4) very gravelly loam, reddish brown (5YR 4/4) moist; weak thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine and very fine vesicular pores; 55 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

A2—1 to 3 inches; reddish brown (5YR 5/4) very gravelly loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine and few medium roots; common fine and very fine tubular pores; 55 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bw—3 to 8 inches; reddish brown (5YR 5/4) gravelly clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine and few medium roots; common fine and very fine tubular and irregular pores; 30 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

2Bky1—8 to 14 inches; olive yellow (2.5Y 6/6) very gravelly sandy clay loam, light olive yellow (2.5Y 5/6) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine and few medium roots; common fine and very fine tubular pores; 50 percent gravel; many fine and medium white masses of gypsum crystals; strongly effervescent, 13 percent calcium carbonate equivalent; slightly alkaline (pH 7.8); clear smooth boundary.

2Bky2—14 to 20 inches; light brownish gray (2.5Y 6/2) gravelly clay loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; common fine and very fine tubular pores; 30 percent gravel; many fine and medium white masses of gypsum crystals; horizontal strata of crystalline gypsum that are 2 centimeters thick at base of horizon; common calcium carbonate coatings on rock fragments; strongly effervescent, 7 percent calcium carbonate equivalent; slightly alkaline (pH 7.8); abrupt smooth boundary.

3By—20 to 27 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate medium angular blocky structure; hard, firm, sticky and plastic; few very fine roots; few fine and very fine tubular and irregular pores; 5 percent fine gravel; common fine and medium masses of white gypsum crystals; slightly effervescent, 3 percent calcium carbonate equivalent; slightly alkaline (pH 7.6); abrupt smooth boundary.

4By—27 to 33 inches; light yellowish brown (2.5Y 6/4) very gravelly sandy clay, olive brown (2.5Y 4/4) moist; massive; hard, friable, sticky and plastic; few fine and very fine roots; common fine and very fine tubular pores; 40 percent gravel; common fine and medium masses of white gypsum crystals; slightly effervescent; slightly alkaline (pH 7.6); clear smooth boundary.

5By—33 to 60 inches; variegated yellow, pale yellow, and red (2.5Y 7/6 and 7/4 and 2.5YR 4/6) stratified very gravelly sand, olive yellow, olive brown, and dark red (2.5Y 6/6 and 4/4 and 2.5YR 3/6) moist; massive; few fine and very fine roots; many fine and very fine irregular pores; common thin and medium strata of coarser and finer materials; 45 percent gravel; common strata of gypsum crystals that are 2 to 3 centimeters thick; common fine and medium masses of gypsum crystals; noneffervescent; slightly alkaline (pH 7.6).

Gypsiorthids vary in texture, color, and thickness of layers.

Depth to bedrock ranges from 40 to 60 inches or more. Depth to the gypsic horizon ranges from 4 to 30 inches. The content of gypsum ranges from 5 to 50 percent. Depth to stratified sand and gravel ranges from 4 to 36 inches.

Ives Series

The Ives series consists of very deep, somewhat excessively drained, moderately permeable soils on flood plains and alluvial fans. These soils formed in highly stratified, recent mixed alluvium weathered dominantly from sandstone and mudstone. Slope ranges from 0 to 3 percent.

These soils are coarse-loamy, mixed (calcareous), mesic Typic Torrifluvents.

Typical pedon of Ives very fine sandy loam, saline-sodic, 0 to 1 percent slopes, about 1 mile northeast of Winslow, about 2,590 feet south and 20 feet east of the northwest corner of sec. 21, T. 19 N., R. 16 E.

A—0 to 13 inches; light reddish brown (5YR 6/4) stratified very fine sandy loam, reddish brown (5YR 4/4) moist; weak thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine irregular pores; slightly effervescent; strongly alkaline (pH 8.6); clear smooth boundary.

C1—13 to 55 inches; light reddish brown and pink (5YR 6/3 and 7/3) stratified sandy loam, reddish brown (5YR 5/3) moist; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

C2—55 to 62 inches; pink (5YR 7/3) stratified loamy sand,

reddish brown (5YR 5/3) moist; massive; soft, very friable, slightly sticky and nonplastic; common very fine roots; common very fine tubular pores; slightly effervescent; moderately alkaline (pH 8.2).

Reaction is moderately alkaline or strongly alkaline. Calcium carbonate is disseminated throughout. Sodicity is slight (SAR ranges from 4 to 13), and salinity is slight to strong (electrical conductivity ranges from 4 to more than 16 dS/m).

The A horizon is fine sandy loam, sandy loam, or very fine sandy loam.

The C horizons are stratified sandy loam (5 to 18 percent clay) with strata of loamy sand below a depth of 40 inches. A few fine strata of silt loam and very fine sandy loam occur throughout the profile. These horizons have hue of 5YR or 7.5YR, value of 5 to 7 (4 or 5 moist), and chroma of 3 to 6 dry and moist.

Jocity Series

The Jocity series consists of very deep, well drained, moderately slowly permeable soils on alluvial fans and flood plains. These soils formed in recent mixed alluvium weathered dominantly from sandstone, mudstone, and basalt. Slope ranges from 0 to 3 percent.

These soils are fine-loamy, mixed (calcareous), mesic Typic Torrifluvents.

Typical pedon of Jocity sandy clay loam, saline-sodic, 0 to 1 percent slopes, about 1 mile north of Interstate 40, west of Joseph City, about 1,000 feet north and 1,300 feet east of the southwest corner of sec. 7, T. 18 N., R. 19 E.

A—0 to 9 inches; reddish gray (5YR 5/2) sandy clay loam, reddish brown (5YR 4/3) moist; weak fine and medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; common very fine tubular pores; slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

C1—9 to 41 inches; reddish gray (5YR 5/2) sandy clay loam, reddish brown (5YR 4/3) moist; massive; very hard, friable, sticky and plastic; few fine and medium roots; few very fine tubular pores; common fine white salt crystals; few thin strata of fine sandy loam and sandy loam that are 1/4-inch thick; strongly effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.

C2—41 to 60 inches; gray (5YR 5/1) fine sandy loam, dark gray (5YR 4/1) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; many very fine tubular pores; few to common white gypsum crystals; few thin strata of very fine sand, loamy fine sand, sandy loam, and silt loam that are 1/2-inch thick; strongly effervescent; moderately alkaline (pH 8.2).

Sodicity is slight (SAR ranges from 4 to 13), and salinity is slight to strong (electrical conductivity ranges from 4 to more than 16 dS/m). Calcium carbonate is disseminated throughout. The content of calcium carbonate ranges from 1 to 15 percent. Reaction is moderately alkaline or strongly alkaline.

The A horizon is sandy clay loam or silty clay. It has hue of 5YR or 7.5YR, value of 5 to 7 (4 or 5 moist), and chroma of 1 to 3 dry and moist.

The C horizon is dominantly sandy clay loam (20 to 35 percent clay) with thin strata of finer and coarser materials. Sandy loam and fine sandy loam occur below a depth of 40 inches. This horizon has hue of 5YR or 7.5YR, value of 5 to 7 (4 or 5 moist), and chroma of 1 to 3 dry and moist.

Kech Series

The Kech series consists of shallow, well drained, moderately permeable soils overlying sandstone (fig. 9). These soils formed in alluvium derived from sandstone and mudstone. They are on plateaus, mesas, and buttes. Slope ranges from 1 to 60 percent.

These soils are loamy, mixed, mesic Lithic Ustollic Haplargids.

Typical pedon of Kech fine sandy loam, 1 to 12 percent slopes, about 6 miles west of Taylor, about 1,200 feet east and 2,400 feet south of the northwest corner of sec. 35, T. 13 N., R. 20 E.

A—0 to 2 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky and nonplastic; many fine roots; many very fine vesicular pores; 5 percent channers; slightly effervescent, moderately alkaline (pH 8.0); abrupt smooth boundary.

BA—2 to 5 inches; reddish yellow (5YR 6/6) loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many fine roots; common fine tubular pores; 5 percent channers; slightly effervescent, moderately alkaline (pH 8.0); clear wavy boundary.

Bt—5 to 11 inches; light reddish brown (5YR 6/4) channery loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; few faint clay films on faces of peds and lining pores; 15 percent channers; slightly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Btk—11 to 15 inches; light reddish brown (5YR 6/4) channery clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many fine roots; common fine tubular pores; few faint clay films

lining pores; 15 percent calcium carbonate coated channers; strongly effervescent, 20 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

2R—15 inches; sandstone.

Depth to bedrock ranges from 10 to 20 inches.

The A horizon is fine sandy loam or sandy loam with 5 to 35 percent sandstone channers. It has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 or 4 dry and moist.

The B horizon is loam or clay loam (18 to 30 percent clay) with 5 to 35 percent sandstone channers. It has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 or 4 dry and moist. It has a slight accumulation of calcium carbonate in the lower part directly above the bedrock and, in some areas, coating the upper surface of the bedrock. This horizon averages less than 15 percent calcium carbonate equivalent or is less than 6 inches thick.

Kinan Series

The Kinan series consists of very deep, somewhat excessively drained, moderately rapidly permeable soils on plateaus. These soils formed in eolian sediments overlying alluvium derived dominantly from sandstone, limestone, and mudstone. Slope ranges from 1 to 5 percent.

These soils are coarse-loamy, mixed, mesic Typic Calciorthids.

Typical pedon of Kinan loamy sand, 1 to 5 percent slopes, about 5.5 miles north of Joseph City on Marcou Mesa, about 800 feet north and 2,200 feet east of the southwest corner of sec. 24, T. 19 N., R. 19 E.

A—0 to 1 inch; reddish brown (5YR 5/3) loamy sand, reddish brown (5YR 4/3) moist; weak thin platy structure; loose; many fine roots; many very fine vesicular pores; slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

Bw1—1 to 7 inches; reddish brown (5YR 5/3) sandy loam, reddish brown (5YR 4/3) moist; weak medium subangular blocky structure; loose; many fine roots; common fine tubular pores; slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

Bw2—7 to 12 inches; light reddish brown (5YR 6/4) sandy loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; many fine roots; common fine tubular pores; slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk1—12 to 25 inches; reddish yellow (5YR 6/6) sandy loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine roots; common fine tubular pores; common fine irregularly-shaped calcium carbonate masses and few fillings in pores; violently effervescent, 6 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk2—25 to 54 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; common fine roots; common fine tubular pores; common fine irregularly-shaped calcium carbonate masses and few fillings in pores; violently effervescent, 8 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

2Btkb—54 to 60 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; moderate medium prismatic structure parting to strong medium subangular blocky; very hard, firm, sticky and slightly plastic; few very fine roots; common fine tubular pores; few faint clay films lining pores; many medium irregularly-shaped calcium carbonate masses and coatings on faces of peds; violently effervescent, 49 percent calcium carbonate equivalent; moderately alkaline (pH 8.4).

The thickness of the surface horizon ranges from 0 to 15 inches. Depth to the calcic horizon ranges from 10 to 20 inches. The calcium carbonate equivalent ranges from 5 to 10 percent in the upper 40 inches.

The A horizon has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 or 4 dry and moist.

The Bw and Bk horizons are sandy loam and fine sandy loam (5 to 18 percent clay). They have hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 or 4 dry and moist.

The buried argillic horizon does not occur in all pedons. Textures of the buried argillic horizon range from clay or clay loam to sandy clay loam.

Leanto Series

The Leanto series consists of shallow, well drained, moderately permeable soils overlying sandstone (fig. 10). These soils formed in eolian material and alluvium derived dominantly from sandstone and mudstone. They are on plateaus, mesas, and buttes. Slope ranges from 1 to 60 percent.

These soils are loamy, mixed, mesic Lithic Camborthids.

Typical pedon of Leanto channery loamy sand, in an area of Leanto-Bisoodi complex, 1 to 12 percent slopes, about 10 miles south of Woodruff, about 2,200 feet east and 1,000 feet south of the northwest corner of sec. 5, T. 14 N., R. 22 E.

A—0 to 1 inch; reddish yellow (5YR 6/6) channery loamy sand, reddish brown (5YR 4/4) moist; single grained; loose; common fine roots; common very fine irregular pores; 20 percent channers; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bw—1 to 10 inches; reddish brown (5YR 5/4) channery fine sandy loam, reddish brown (5YR 4/4) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; 15 percent channers; strongly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk—10 to 14 inches; light reddish brown (5YR 6/4) channery loam, reddish brown (5YR 4/4) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; 10 percent calcium carbonate coated channers and 20 percent fragments of calcium carbonate pendants; violently effervescent, 15 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

2R—14 inches; Moenkopie sandstone.

Depth to bedrock ranges from 10 to 20 inches.

The A horizon is loamy sand or sandy loam with 15 to 45 percent sandstone channers, flagstone, or fragments of calcium carbonate pendants. It has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 4 to 6 dry and moist.

The B horizon is sandy loam or loam (12 to 18 percent clay). It has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 4 or 5 dry and moist. The content of rock fragments is less than 15 percent in the upper part of the B horizon and is as high as 25 percent in the lower part of the horizon directly above the bedrock. The content of calcium carbonate ranges from 1 to 25 percent.

Lozinta Series

The Lozinta series consists of very deep, somewhat excessively drained, moderately rapidly permeable soils on cinder cones. These soils formed in material derived from cinders. Slope ranges from 20 to 60 percent.

These soils are ashy-skeletal over fragmental or cindery, mixed, mesic Vitrandic Ustochrepts.

Typical pedon of Lozinta extremely cindery loam, 20 to 60 percent slopes, on Cooley Knoll directly south of White Mountain Lake, about 6 miles northeast of Show Low, about 2,400 feet east and 800 feet south of the northwest corner of sec. 25, T. 11 N., R. 22 E.

A—0 to 2 inches; dark brown (7.5YR 4/4) extremely cindery loam, dark reddish brown (5YR 3/3) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; many very fine and fine irregular pores; 65 percent fine gravel-sized cinders; noneffervescent; neutral (pH 7.0); clear wavy boundary.

Bw1—2 to 11 inches; dark brown (7.5YR 4/4) extremely cindery loam, dark reddish brown (5YR 3/3) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; many very fine and fine irregular pores; 70 percent fine gravel-sized cinders; noneffervescent; neutral (pH 7.0); clear wavy boundary.

Bw2—11 to 21 inches; dark brown (7.5YR 4/4) extremely cindery loam, dark reddish brown (5YR 3/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; many very fine irregular pores; 70 percent fine gravel-sized cinders; noneffervescent; neutral (pH 7.0); clear wavy boundary.

2C1—21 to 23 inches; pinkish gray (5YR 7/2) dry and reddish brown (5YR 5/3) moist; calcium carbonate coated cinders; common fine and medium roots; clear wavy boundary.

2C2—23 to 60 inches; reddish yellow (5YR 6/6) dry and reddish brown (5YR 4/4) moist; cinders; few fine and medium roots.

Depth to cinders is 20 to 30 inches. Depth to maximum accumulation of calcium carbonate is 15 to 25 inches. The content of calcium carbonate ranges from 0 to 15 percent. The content of cinders is 50 to 70 percent in the upper solum, and it increases to 90 percent or more with increasing depth.

The A and Bw horizons contain 50 to 70 percent cinders. They have hue of 5YR or 7.5YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3 dry and moist. The C horizon is usually all cinders that can be loose or welded together.

Manzano Series

The Manzano series consists of very deep, well drained, moderately slowly permeable soils on flood plains. These soils formed in mixed alluvium weathered dominantly from sandstone, limestone, and mudstone. Slope ranges from 0 to 3 percent.

These soils are fine-loamy, mixed, mesic Cumulic Haplustolls.

Typical pedon of Manzano sandy clay loam, 0 to 3 percent slopes, along Cottonwood Wash west of Taylor, 2,600 feet west and 1,300 feet north of the southeast corner of sec. 33, T. 13 N., R. 21 E.

A1—0 to 3 inches; brown (7.5YR 5/2) sandy clay loam, dark brown (7.5YR 3/2) moist; weak fine platy structure; slightly hard, very friable, slightly sticky and

slightly plastic; common fine roots; common very fine irregular pores; moderately alkaline (pH 8.0); clear smooth boundary.

A2—3 to 20 inches; brown (7.5YR 5/2) sandy clay loam, dark brown (7.5YR 3/2) moist; weak to moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine tubular pores; common worm holes and casts; moderately alkaline (pH 8.0); clear smooth boundary.

Bw—20 to 27 inches; light brown (7.5YR 6/4) sandy clay loam, dark brown (7.5YR 4/4) moist; weak to moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine tubular pores; common worm holes and casts; slightly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Bk—27 to 36 inches; light brown (7.5YR 6/4) sandy clay loam, dark reddish brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common very fine and medium tubular pores; common worm holes and casts; few very fine calcium carbonate filaments; slightly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

C—36 to 60 inches; brown (7.5YR 6/4) sandy clay loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure appearing massive in places; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine tubular pores; common worm holes and casts; strongly effervescent; moderately alkaline (pH 8.2).

Calcium carbonate is finely disseminated throughout the profile with few filaments in the lower part. Organic matter content is 1 or 2 percent.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 dry, and chroma of 2 or 3 dry and moist.

The B and C horizons are sandy clay loam or clay loam (20 to 35 percent clay). They have hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4 dry and moist. The content of calcium carbonate ranges from 5 to 15 percent.

Marcou Series

The Marcou series consists of very deep, somewhat excessively drained, moderately permeable sodic soils on stabilized transverse and large coppice dunes. These soils formed in eolian material overlying mixed alluvium. Slope ranges from 1 to 8 percent.

These soils are coarse-loamy, mixed (calcareous), mesic Typic Torriorthents.

Typical pedon of Marcou loamy sand, in an area of Burnswick-Marcou complex, 1 to 5 percent slopes, about 5 miles north of Joseph City, about 500 feet north and 2,300 feet east of the southwest corner of sec. 29, T. 19 N., R. 19 E.

A—0 to 6 inches; light reddish brown (5YR 6/3) loamy sand, reddish brown (5YR 5/3) moist; single grained; loose; many fine, very fine and common medium roots; many very fine irregular pores; very slightly effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

C1—6 to 13 inches; reddish brown (5YR 5/3) coarse sandy loam, reddish brown (5YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many fine, very fine and common medium roots; common fine and many very fine tubular pores; very slightly effervescent; strongly alkaline (pH 8.6); clear smooth boundary.

C2—13 to 35 inches; reddish brown (5YR 5/3) sandy loam, reddish brown (5YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and nonplastic; many fine, very fine and few medium roots; many very fine and common fine tubular pores; slightly effervescent, 6 percent calcium carbonate equivalent; strongly alkaline (pH 8.8); clear smooth boundary.

C3—35 to 47 inches; reddish brown (5YR 5/3) sandy loam, reddish brown (5YR 4/3) moist; massive; slightly hard, friable, slightly sticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; strongly effervescent, 7 percent calcium carbonate equivalent; strongly alkaline (pH 8.8); clear smooth boundary.

2Bkb1—47 to 54 inches; light reddish brown (5YR 6/3) sandy clay loam, reddish brown (5YR 5/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; common fine and very fine tubular and irregular pores; common fine calcium carbonate coatings on faces of peds and lining pores; violently effervescent, 8 percent calcium carbonate equivalent; strongly alkaline (pH 8.8); abrupt smooth boundary.

3Bkb2—54 to 60 inches; light reddish brown (5YR 6/3) loamy coarse sand, reddish brown (5YR 5/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; many fine rounded soft calcium carbonate accumulations; violently effervescent, 18 percent calcium carbonate equivalent; strongly alkaline (pH 8.8).

Sodicity is slight to moderate (SAR ranges from 2 to 30). Salinity ranges from nonsaline to slight (electrical conductivity ranges from 0 to 8 dS/m). Reaction is moderately alkaline or strongly alkaline. The content of calcium carbonate ranges from 1 to 10 percent. Thickness

of the coarse textured eolian deposit and depth to the finer textured alluvial deposit range from 40 to more than 60 inches. The content of rock fragments is less than 5 percent in the upper eolian material but can be as high as 35 percent in the underlying material.

The A horizon has hue of 5YR or 7.5YR, value of 5 to 7 (4 or 5 moist), and chroma of 3 or 4 dry and moist.

The C horizon is sandy loam, fine sandy loam, or coarse sandy loam. It has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 or 4 dry and moist.

The buried Bk horizon may not occur in all pedons.

Medisaprists

Medisaprists consist of very deep, poorly drained, moderately permeable organic soils on flood plains and seep areas along the Little Colorado River. These soils formed in a mixture of alluvium and decomposed plant material. Slope ranges from 0 to 1 percent.

Representative pedon of Medisaprists, in an area of Medisaprists, saline, 0 to 1 percent slopes, Obed Meadow south of Joseph City, 1,600 feet west and 900 feet north of the southeast corner of sec. 33, T. 18 N., R. 19 E.

Oi—0 to 6 inches; very dark gray (10YR 3/1) and black (N/2) sapric material, moist; about 85 percent fiber, 60 percent rubbed; nonsticky; about 100 percent herbaceous fibers; many roots; electrical conductivity is 16 dS/m; thin salt crust on surface when dry; slightly effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.

C—6 to 12 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable, sticky and slightly plastic; many very fine and fine roots; electrical conductivity is 8 dS/m; strongly effervescent; moderately alkaline (pH 8.4); abrupt wavy boundary.

Oa—12 to 50 inches; very dark gray (10YR 3/1) dry and black (N2/) sapric material moist; about 100 percent herbaceous fibers; nonsticky; electrical conductivity is 14 dS/m; noneffervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.

2C—50 to 60 inches; light gray (10YR 7/1) silty clay, light brownish gray (10YR 6/2) moist; massive; slightly hard, friable, sticky and plastic; few decayed herbaceous fibers mixed with soil; noneffervescent; moderately alkaline (pH 8.0).

The seasonal water table is from 0 to 3 feet. The surface has many long narrow cracks and rounded holes from 3 to 30 inches deep and up to 10 inches wide. Salinity ranges from moderate to strong (electrical conductivity ranges from 8 to more than 16 dS/m). The content of calcium carbonate ranges from 0 to 5 percent.

Mellenthin Series

The Mellenthin series consists of shallow and very shallow, well drained, moderately permeable soils on plateaus, mesas, and buttes. These soils formed in alluvium derived from limestone and calcareous sandstone. Slope ranges from 1 to 60 percent.

These soils are loamy-skeletal, mixed, mesic Lithic Ustollic Calciorthids.

Typical pedon of Mellenthin very channery fine sandy loam, in an area of Mellenthin-Rock outcrop complex, 1 to 20 percent slopes, about 18 miles south of Winslow, about 1,900 feet west and 2,500 feet north of the southeast corner of sec. 24, T. 16 N., R. 15 E.

A—0 to 1 inch; reddish brown (5YR 5/4) very channery fine sandy loam, reddish brown (5YR 4/4) moist; moderate thin platy structure; slightly hard, very friable, nonsticky and nonplastic; common fine roots; many fine and very fine vesicular pores; 35 percent channers and pendant fragments; slightly effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bw—1 to 6 inches; light reddish brown (5YR 6/4) very channery loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many fine roots; common fine tubular pores; 35 percent calcium carbonate coated channers and common fine irregular fragments of calcium carbonate pendants; strongly effervescent, 18 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bk—6 to 12 inches; pink (5YR 7/4) very channery loam, light reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many fine and few medium roots; common fine tubular pores; 50 percent calcium carbonate coated channers and common irregular medium fragments of calcium carbonate pendants; violently effervescent, 33 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); very abrupt smooth boundary.

2R1—12 to 20 inches; slightly fractured limestone with loamy material between plates and in fractures; many very fine and fine roots between plates and in fractures; limestone plates are coated with secondary calcium carbonate deposits that are 2 to 10 millimeters thick; abrupt smooth boundary.

2R2—20 inches; limestone.

Depth to bedrock ranges from 8 to 20 inches. The calcium carbonate equivalent ranges from 15 to 40 percent. The content of rock fragments ranges from 35 to 60 percent.

The A horizon is loam or fine sandy loam with 35 to 60 percent limestone channers, flagstone, or fragments of

calcium carbonate pendants. It has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 4 or 5 dry and moist.

The Bw and Bk horizons have 35 to 60 percent limestone channers, flagstone, or fragments of calcium carbonate pendants. They have hue of 5YR or 7.5YR, value of 5 to 7 (4 or 5 moist), and chroma of 4 to 5 dry and moist.

Navajo Series

The Navajo series consists of very deep, well drained to poorly drained, very slowly permeable soils on alluvial fans and flood plains. These soils formed in recent mixed alluvium weathered dominantly from sandstone, mudstone, and basalt. Slope ranges from 0 to 3 percent.

These soils are fine, mixed (calcareous), mesic Vertic Torrifluvents.

Typical pedon of Navajo silty clay, saline-sodic, 1 to 3 percent slopes, about 6 miles north of Winslow, about 1,320 feet east and 50 feet north of the southwest corner of sec. 23, T. 20 N., R. 15 E.

A—0 to 5 inches; reddish brown (5YR 5/3) silty clay, reddish brown (5YR 4/3) moist; weak medium and thick platy structure; hard, firm, very sticky and very plastic; few fine tubular pores; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

C1—5 to 20 inches; reddish brown (2.5YR 4/4) silty clay, dark reddish brown (2.5YR 3/4) moist; weak medium and coarse angular blocky structure and moderate medium subangular blocky; very hard, very firm, very sticky and very plastic; many fine irregular and few fine tubular pores; few pressure faces; strongly effervescent; moderately alkaline (pH 8.0); gradual smooth boundary.

C2—20 to 60 inches; reddish brown (2.5YR 4/4) stratified clay, dark reddish brown (2.5YR 3/4) moist; massive; very hard, very firm, very sticky and very plastic; many fine irregular and few fine tubular pores; few small slickensides and pressure faces; few to common very fine strata of silt, silt loam, and loam; strongly effervescent; common fine calcium carbonate filaments and masses; moderately alkaline (pH 8.0).

Salinity is nonsaline to strong (electrical conductivity ranges from 2 to more than 16 dS/m). Sodicity is none to slight (SAR ranges from 0 to 13). Reaction is moderately alkaline to strongly alkaline.

The Navajo soils are silty clay or clay throughout (40 to 60 percent clay). They have hue of 2.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 or 4 dry and moist. They commonly have thin strata of silt, silt loam, and loam in any or all horizons. The content of calcium carbonate ranges from 1 to 10 percent.

Needle Series

The Needle series consists of very shallow and shallow, excessively drained, rapidly permeable soils on plateaus. These soils formed in eolian material derived from sandstone. Slope ranges from 1 to 10 percent slopes.

These soils are mixed, mesic Lithic Torripsamments.

Typical pedon of Needle fine sand, in an area of Rock outcrop-Needle complex, 1 to 10 percent slopes, about 7 miles southwest of Holbrook, about 2,500 feet south and 500 feet west of the northeast corner of sec. 5, T. 16 N., R. 20 E.

A1—0 to 2 inches; yellowish red (5YR 5/6) fine sand, yellowish red (5YR 4/6) moist; weak thin platy structure in the upper 1/4 inch and single grained below; loose; common fine roots; common very fine irregular pores; noneffervescent; slightly alkaline (pH 7.8); clear smooth boundary.

A2—2 to 7 inches; yellowish red (5YR 5/6) fine sand, yellowish red (5YR 4/6) moist; single grained; loose; common fine roots; common very fine tubular pores; very slightly effervescent; slightly alkaline (pH 7.8); abrupt smooth boundary.

C—7 to 9 inches; red (2.5YR 4/6) loamy fine sand, red (2.5YR 3/6) moist; massive; soft, very friable, nonsticky and nonplastic; common fine roots; common fine tubular pores; very slightly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

2R—9 inches; Coconino sandstone that has few thin coatings of calcium carbonate in fractures.

Depth to bedrock is dominantly 8 to 15 inches, but it ranges from 5 to 20 inches. Reaction is slightly alkaline or moderately alkaline. The content of rock fragments ranges from 0 to 5 percent. These soils are fine sand, loamy sand, and loamy coarse sand. They have hue of 2.5YR or 5YR, value of 4 to 6 (4 or 5 moist), and chroma of 4 to 6 dry and moist.

Nuffel Series

The Nuffel series consists of very deep, well drained, moderately slowly permeable soils formed in mixed alluvium derived dominantly from sandstone, limestone, mudstone, and basalt. These soils are on flood plains and alluvial fans. Slope ranges from 0 to 3 percent.

These soils are fine-silty, mixed (calcareous), mesic Ustic Torrifluvents.

Typical pedon of Nuffel silt loam, 0 to 3 percent slopes, about 7.5 miles west of Snowflake, about 1,700 feet west and 1,800 feet north of the southeast corner of sec. 22, T. 13 N., R. 20 E.

A1—0 to 2 inches; light reddish brown (5YR 6/4) silt loam, dark reddish brown (5YR 3/4) moist; moderate

medium platy structure; slightly hard, friable, slightly sticky and plastic; many very fine and fine vesicular and common very fine tubular and irregular pores; common fine and very fine roots; strongly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

A2—2 to 5 inches; light reddish brown (5YR 6/4) silty clay loam, dark reddish brown (5YR 3/4) moist; moderate thin platy structure; slightly hard, friable, very sticky and plastic; many very fine and fine vesicular and common very fine tubular and irregular pores; common fine and very fine roots; strongly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

C1—5 to 12 inches; reddish brown (5YR 5/4) silty clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; hard, friable, very sticky and plastic; many fine and very fine tubular and irregular pores; few fine roots; strongly effervescent; moderately alkaline (pH 8.3); clear smooth boundary.

C2—12 to 60 inches; reddish brown (5YR 5/4) stratified silty clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; hard, firm, very sticky and plastic; many very fine tubular and irregular pores; few fine roots; strongly effervescent; moderately alkaline (pH 8.2).

These soils have hue of 7.5YR or 5YR, value of 5 or 6 (3 to 5 moist), and chroma of 3 or 4 dry and moist. They are dominantly silty clay loam and silt loam throughout and are stratified with coarser and finer materials. In some pedons horizons of clay or clay loam may occur below a depth of 40 inches.

Padilla Series

The Padilla series consists of very deep, well drained, slowly permeable soils on fan terraces (fig. 11). These soils formed in alluvium derived dominantly from mudstone and sandstone. Slope ranges from 1 to 5 percent.

These soils are fine, mixed, mesic Ustollic Haplargids.

Typical pedon of Padilla sandy clay loam, in an area of Padilla-Cerrillos complex, 1 to 10 percent slopes, about 12 miles northeast of Snowflake, about 700 feet west and 1,700 feet north of the southeast corner of sec. 16, T. 14 N., R. 23 E.

A—0 to 2 inches; reddish brown (5YR 4/4) sandy clay loam, reddish brown (5YR 3/4) moist; weak thin platy structure parting to moderate fine granular; slightly hard, friable, sticky and slightly plastic; many fine roots; many very fine vesicular pores; 5 percent fine gravel; slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

AB—2 to 8 inches; reddish brown (5YR 4/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; many fine roots; common fine tubular pores; few faint clay films lining pores; slightly effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

Bt—8 to 15 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; strong medium angular blocky structure; hard, firm, very sticky and very plastic; many fine roots; common fine tubular pores; common faint clay films on faces of peds; strongly effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

Btk1—15 to 42 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; strong medium prismatic structure parting to strong fine angular blocky; hard, firm, very sticky and very plastic; common fine roots; common fine tubular pores; many faint clay films on faces of peds; strongly effervescent, 12 percent calcium carbonate equivalent; common fine calcium carbonate masses; moderately alkaline (pH 8.4); clear smooth boundary.

Btk2—42 to 53 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; strong medium prismatic structure parting to strong fine subangular blocky; hard, firm, very sticky and very plastic; common fine roots; common fine tubular pores; many faint clay films on faces of peds; 5 percent fine gravel; violently effervescent, 14 percent calcium carbonate equivalent; common fine calcium carbonate masses; moderately alkaline (pH 8.2); clear smooth boundary.

Btk3—53 to 60 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; strong medium prismatic structure parting to strong fine angular blocky; hard, firm, very sticky and very plastic; few fine roots; common fine tubular pores; many faint clay films on faces of peds; 5 percent fine gravel; violently effervescent, 14 percent calcium carbonate equivalent; many fine irregular and rounded accumulations of calcium carbonate; moderately alkaline (pH 8.2).

Organic matter content is more than 1 percent in the upper 8 inches. The content of rock fragments is less than 10 percent. The surface horizons are slightly alkaline or moderately alkaline. The calcium carbonate equivalent is less than 15 percent.

The A horizon has value of 4 or 5 (3 or 4 moist) and chroma of 3 to 6 dry and moist.

The Bt and Btk horizons are clay or clay loam (35 to 55 percent clay). They have hue of 7.5YR or 5YR, value of 3 to 6 (3 to 5 moist), and chroma of 3 to 6 dry and moist.

Pensom Series

The Pensom series consists of deep, excessively drained, rapidly permeable soils on dunes of plateaus.

These soils formed in eolian sediments overlying mixed alluvium derived dominantly from sandstone with a minor influence from mudstone and limestone. Slope ranges from 1 to 5 percent.

These soils are mixed, mesic Ustic Torripsamments.

Typical pedon of Pensom fine sand, in an area of Pensom-Chedeski complex, 1 to 5 percent slopes, about 10 miles west of Snowflake, about 700 feet west and 400 feet south of the northeast corner of sec. 20, T. 13 N., R. 20 E.

A1—0 to 3 inches; yellowish red (5YR 5/6) fine sand, reddish brown (5YR 4/4) moist; weak thin platy structure; loose; many very fine roots; many very fine irregular pores; noneffervescent; slightly alkaline (pH 7.8); clear smooth boundary.

A2—3 to 17 inches; yellowish red (5YR 5/6) fine sand, reddish brown (5YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine irregular pores; noneffervescent; moderately alkaline (pH 8.0); clear smooth boundary.

C1—17 to 27 inches; yellowish red (5YR 5/6) loamy fine sand, reddish brown (5YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many fine irregular pores; slightly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

C2—27 to 41 inches; yellowish red (5YR 5/6) loamy fine sand, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots; common fine irregular pores; slightly effervescent, 3 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

2Bk1—41 to 46 inches; light reddish brown (5YR 6/4) fine sandy loam, reddish brown (5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; many fine and very fine roots; common fine tubular pores; strongly effervescent, 6 percent calcium carbonate equivalent; common calcium carbonate coatings in pores; moderately alkaline (pH 8.4); clear smooth boundary.

2Bk2—46 to 51 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many fine and very fine roots; common fine and very fine tubular pores; 5 percent gravel; violently effervescent, 10 percent calcium carbonate equivalent; common fine calcium carbonate masses, coatings on gravel, and fillings in pores; moderately alkaline (pH 8.4); abrupt smooth boundary.

3R—51 inches; sandstone.

Depth to bedrock ranges from 45 to more than 60 inches. Depth to maximum accumulation of calcium carbonate is 40 inches or more. Reaction is slightly alkaline or moderately alkaline in the surface.

The A horizon has chroma of 3 to 6 dry and moist.

The C horizon is loamy fine sand or loamy sand. It has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 4 to 6 dry and moist.

The 2Bk horizons are fine sandy loam or loam. They have hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 4 to 6 dry and moist. The content of calcium carbonate ranges from 5 to 15 percent. The content of rock fragments ranges from 0 to 10 percent.

Penzance Series

The Penzance series consists of very deep, well drained, slowly permeable soils on fan terraces of plateaus. These soils formed in old mixed alluvium weathered dominantly from sandstone and mudstone. Slope ranges from 0 to 2 percent.

These soils are fine, montmorillonitic, mesic Vertic Haplargids.

Typical pedon of Penzance clay loam, in an area of Penzance-Grieta complex, 0 to 5 percent slopes, about 17 miles northeast of Holbrook, in the center of sec. 2, T. 18 N., R. 23 E.

A—0 to 3 inches; light reddish brown (5YR 6/3) clay loam, reddish brown (5YR 4/3) moist; weak thin platy structure parting to moderate very fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine roots; many very fine vesicular and few very fine and fine tubular pores; slightly effervescent, 9 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Btn1—3 to 9 inches; light reddish brown (5YR 6/3) clay, reddish brown (5YR 4/3) moist; moderate fine subangular blocky structure; hard, firm, sticky and slightly plastic; many fine and very fine roots; few fine and very fine tubular and irregular pores; few faint clay films on faces of peds and lining pores; strongly effervescent, 11 percent calcium carbonate equivalent; slightly sodic (SAR is 5); strongly alkaline (pH 8.6); clear smooth boundary.

Btn2—9 to 17 inches; light reddish brown (5YR 6/3) clay, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; many fine and very fine roots; few fine and very fine tubular and irregular pores; common faint clay films on faces of peds and lining pores; common pressure faces; violently effervescent, 11 percent calcium carbonate equivalent; slightly sodic (SAR is 10); strongly alkaline (pH 8.6); clear smooth boundary.

Btknz—17 to 32 inches; light reddish brown (5YR 6/3) clay,

reddish brown (5YR 4/3) moist; moderate fine angular blocky structure; very hard, firm, very sticky and very plastic; few fine and very fine roots; few fine tubular and irregular pores; few faint clay films on faces of peds and lining pores; many pressure faces; common fine, rounded, soft lime masses; violently effervescent, 11 percent calcium carbonate equivalent; slightly saline (electrical conductivity is 5 dS/m) and slightly sodic (SAR is 13); strongly alkaline (pH 8.6); clear smooth boundary.

Bssknz—32 to 42 inches; light reddish brown (5YR 6/3) clay, reddish brown (5YR 4/3) moist; moderate fine and very fine angular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; few fine tubular and irregular pores; common stress surfaces; few intersecting slickensides; few fine soft accumulations of calcium carbonate; violently effervescent, 10 percent calcium carbonate equivalent; slightly saline (electrical conductivity is 5 dS/m) and slightly sodic (SAR is 10); strongly alkaline (pH 8.6); clear smooth boundary.

Bssknzy—42 to 60 inches; reddish brown (5YR 5/3) clay, reddish brown (5YR 4/3) moist; moderate medium angular blocky structure; very hard, very firm, very sticky and very plastic; common intersecting slickensides; few fine soft lime masses; strongly effervescent, 9 percent calcium carbonate equivalent and 1 percent calcium sulfate; slightly saline (electrical conductivity is 5 dS/m) and slightly sodic (SAR is 12); strongly alkaline (pH 8.6).

Reaction is moderately alkaline or strongly alkaline. Salinity and sodicity are none to slight. These soils crack when dry. The content of calcium carbonate ranges from 0 to 15 percent.

The A horizon has hue of 5YR or 7.5YR and value of 5 or 6 (3 or 4 moist).

The Bt horizons are clay, sandy clay, or clay loam. They have hue of 5YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 or 4 dry or moist.

The Bss horizons are clay or silty clay. They have hue of 5YR or 7.5YR and chroma of 3 to 6 dry or moist. The content of gypsum ranges from 0 to 2 percent.

Poley Series

The Poley series consists of very deep, well drained, slowly permeable soils formed in mixed alluvium derived dominantly from sandstone, mudstone, limestone, and basalt. These soils are on fan terraces on plateaus. Slope ranges from 1 to 5 percent.

These soils are fine, mixed, mesic Ustollic Haplargids.

Typical pedon of Poley fine sandy loam, 1 to 5 percent slopes, about 9 miles west of Taylor, about 1,400 feet east and 500 feet north of the southwest corner of sec. 23, T. 13 N., R. 19 E.

A1—0 to 1 inch; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 4/4) moist; moderate thin platy structure; slightly hard, friable, nonsticky and nonplastic; many fine roots; many fine and very fine vesicular and common very fine tubular pores; 5 percent gravel; noneffervescent; slightly alkaline (pH 7.6); abrupt smooth boundary.

A2—1 to 4 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky and strong fine granular structure; slightly hard, friable, sticky and slightly plastic; many fine roots; common fine tubular pores; noneffervescent; slightly alkaline (pH 7.6); abrupt smooth boundary.

Bt—4 to 13 inches; reddish brown (2.5YR 4/4) clay loam, dark reddish brown (2.5YR 3/4) moist; weak fine prismatic structure parting to strong medium subangular blocky; hard, friable, sticky and plastic; many fine roots; many very fine and common fine tubular pores; many faint clay films on faces of peds and lining pores; noneffervescent; slightly alkaline (pH 7.8); clear smooth boundary.

Btk1—13 to 22 inches; light reddish brown (5YR 6/4) clay, reddish brown (5YR 5/4) moist; strong fine and medium subangular blocky structure; very hard, firm, very sticky and plastic; common fine roots; many very fine and common fine tubular pores; many pressure faces; common faint clay films on faces of peds and lining pores; common fine calcium carbonate nodules and veins; strongly effervescent, 12 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Btk2—22 to 34 inches; light reddish brown (5YR 6/4) clay, reddish brown (5YR 5/4) moist; strong fine and medium subangular blocky structure; very hard, firm, very sticky and plastic; common fine roots; many very fine and common fine tubular pores; many pressure faces; common faint clay films on faces of peds and lining pores; many fine calcium carbonate nodules and veins; violently effervescent, 23 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk—34 to 47 inches; light reddish brown (5YR 6/4) clay, reddish brown (5YR 5/4) moist; strong and medium subangular blocky structure; very hard, firm, sticky and plastic; common very fine and few fine roots; many very fine and common fine tubular pores; many pressure faces; common fine calcium carbonate nodules and veins; violently effervescent, 24 percent calcium carbonate equivalent; strongly alkaline (pH 8.6); clear smooth boundary.

Btk—47 to 60 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and slightly plastic; few very fine roots; many fine tubular pores; common faint clay films line pores and few faint clay films on faces of peds; 5 percent gravel; common fine white calcium carbonate masses; strongly effervescent; strongly alkaline (pH 8.8).

Depth to the calcic horizon ranges from 20 to 30 inches. The content of rock fragments ranges from 0 to 5 percent. Reaction is slightly alkaline to strongly alkaline.

The A horizon has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 4 or 5 dry and moist.

The Bt horizon is clay loam or clay (35 to 45 percent clay). It has hue of 2.5YR or 5YR, value or 4 or 5 (3 or 4 moist), and chroma of 3 or 4 dry and moist. Salinity and sodicity are none to slight.

The Bk horizon is clay or clay loam (35 to 45 percent clay). It has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 4 or 5 dry and moist. Salinity and sodicity are none to slight.

The Btk horizon is sandy clay loam or clay loam. It has hue of 5YR or 7.5YR and value of 5 or 6 (4 or 5 moist). Salinity and sodicity are none to slight.

Purgatory Series

The Purgatory series consists of moderately deep, well drained, moderately slowly permeable soils on plateaus. These soils formed in a mixture of eolian material and residuum weathered from gypsiferous mudstone and sandstone. Slope ranges from 1 to 8 percent.

These soils are fine-loamy, gypsic, mesic Typic Gypsiorthids.

Typical pedon of Purgatory fine sandy loam, 1 to 8 percent slopes, directly southeast of Holbrook on the old Woodruff Road, about 500 feet west and 1,800 feet north of the southeast corner of sec. 14, T. 17 N., R. 21 E.

A—0 to 1 inch; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; moderate thin platy structure; slightly hard, very friable; many very fine roots; many very fine pores; 10 percent gravel on the surface; common fine gypsum crystals; strongly effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.

By1—1 to 20 inches; pink (5YR 8/4) loam, light reddish brown (5YR 6/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many fine tubular pores; many fine and medium gypsum crystals; strongly effervescent; moderately alkaline (pH 8.4); abrupt wavy boundary.

2By2—20 to 27 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; massive; hard, friable, slightly sticky and slightly plastic; many medium to large gypsum crystals; strongly effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

3Cr1—27 to 49 inches; weathered gypsiferous mudstone; many medium and large gypsum crystals; strongly effervescent; clear wavy boundary.

3Cr2—49 to 60 inches; mudstone; few thin seams of soft gypsum.

Depth to weathered mudstone is 20 to 40 inches. Depth to the gypsic horizon is 1 to 8 inches. The gypsic horizon contains 30 to 55 percent gypsum, which occurs as amorphous gypsum in thin to moderately thick layers of crystals.

The A horizon has hue of 5YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 4 or 5 dry and moist. The content of rock fragments is 5 to 25 percent.

The By horizon is loam or clay loam. It has hue of 5YR or 7.5YR, value of 5 to 8 (3 to 7 moist), and chroma of 0 to 6 dry and moist.

The Cr horizon is weathered gypsiferous mudstone or weathered sandstone with horizontal bedding of crystalline gypsum.

Radnik Series

The Radnik series consists of very deep, well drained, moderately permeable soils on flood plains and alluvial fans. These soils formed in highly stratified, recent mixed alluvium weathered dominantly from sandstone and mudstone. Slope ranges from 0 to 3 percent.

These soils are coarse-loamy, mixed (calcareous), mesic Ustic Torrifluvents.

Typical pedon of Radnik silt loam, 0 to 3 percent slopes, about 25 miles southwest of Holbrook, about 300 feet east and 2,600 feet north of the southwest corner of sec. 33, T. 16 N., R. 17 E.

A—0 to 4 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine vesicular and tubular pores; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

C—4 to 45 inches; light yellowish brown and brown (10YR 6/4 and 5/3) stratified silt loam and loamy fine sand, dark yellowish brown and dark brown (10YR 4/4 and 3/3) moist; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

2Btkb—45 to 60 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard,

friable, sticky and slightly plastic; few very fine roots; common very fine tubular pores; few faint clay films lining pores and on faces of peds; slightly effervescent; few fine soft calcium carbonate masses; moderately alkaline (pH 8.0).

Reaction is slightly alkaline or moderately alkaline. The content of rock fragments is less than 15 percent. Disseminated calcium carbonate ranges from 0 to 10 percent.

The A horizon has hue of 10YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 to 6 dry and moist.

The C horizon is stratified silt loam and loamy fine sand with thin strata of coarser and finer materials. It has hue of 7.5YR or 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 to 6 dry and moist.

The buried Btk horizon does not occur in some pedons.

Shalet Series

The Shalet series consists of very shallow and shallow, well drained, slowly permeable sodic soils on plateaus. These soils formed in mixed alluvium derived dominantly from mudstone and sandstone. Slope ranges from 0 to 3 percent.

These soils are loamy, mixed (calcareous), mesic, shallow Typic Torriorthents.

Typical pedon of Shalet silty clay loam, 0 to 3 percent slopes, about 3 miles southeast of Holbrook, 1,500 feet east and 300 feet north of the southwest corner of sec. 28, T. 17 N., R. 21 E.

A1—0 to 1 inch; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; strong medium platy structure; slightly hard, friable, very sticky and plastic; many very fine and fine vesicular and common medium pores; violently effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.

A2—1 to 3 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; strong medium platy structure; hard, friable, very sticky and plastic; many very fine vesicular pores; violently effervescent; strongly alkaline; abrupt wavy boundary.

A3—3 to 4 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 3/4) moist; strong thin platy structure; few fine irregular pores; violently effervescent; strongly alkaline (pH 8.6); clear smooth boundary.

2Cr—4 to 7 inches; weathered mudstone; strongly effervescent; abrupt smooth boundary.

2R—7 to 60 inches; interbedded mudstone and sandstone.

Depth to mudstone ranges from 4 to 15 inches. Depth to sandstone ranges from 25 to 45 inches. Sodicity is slight (SAR ranges from 4 to 13), and salinity is slight to strong (electrical conductivity ranges from 4 to more than 16 dS/m). Reaction is moderately alkaline or strongly alkaline. The content of rock fragments is less than 10 percent.

The Shalet soils are silty clay loam or clay loam. They have hue of 2.5YR or 5YR, value of 5 or 6 (3 or 4 moist), and chroma of 4 or 5 dry and moist.

Sheppard Series

The Sheppard series consists of very deep, somewhat excessively drained, rapidly permeable soils in dunes on plateaus and adjacent to intermittent major drainageways. These soils formed in sandy eolian material weathered from mixed sources. Slope ranges from 1 to 12 percent.

These soils are mixed, mesic Typic Torripsamments.

Typical pedon of Sheppard loamy fine sand, in an area of Sheppard-Grieta complex, 1 to 12 percent slopes, approximately 13 miles northeast of Holbrook, about 1,700 feet south and 50 feet west of the northeast corner of sec. 28, T. 19 N., R. 22 E.

C1—0 to 6 inches; reddish brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) moist; single grained; loose; many very fine roots; many very fine irregular pores; slightly effervescent; moderately alkaline (pH 8.2); gradual wavy boundary.

C2—6 to 23 inches; reddish brown (5YR 5/4) loamy fine sand, reddish brown (5YR 4/4) moist; massive; soft, very friable; common very fine roots; few fine tubular pores; slightly effervescent; moderately alkaline (pH 8.4); gradual wavy boundary.

C3—23 to 60 inches; yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) moist; massive; soft, very friable; common very fine roots; few fine tubular pores; common very fine to moderately thick (1 millimeter to 2 centimeters) strata of fine and coarse sand; slightly effervescent; moderately alkaline (pH 8.4).

These soils are sand, fine sand, and loamy fine sand (2 to 5 percent clay and 70 to 98 percent sand). They have hue of 5YR or 7.5YR, value of 4 to 6 (4 or 5 moist), and chroma of 4 to 6 dry and moist. Some pedons have a buried argillic horizon of sandy loam or sandy clay loam below a depth of 50 inches.

Sheza Series

The Sheza series consists of very deep, well drained, moderately slowly permeable soils on fan terraces. These soils formed in mixed alluvium derived dominantly from sandstone, limestone, quartzite, and basalt. Slope ranges from 2 to 20 percent.

These soils are fine-loamy over sandy or sandy-skeletal, mixed, mesic Ustollic Haplargids.

Typical pedon of Sheza gravelly sandy loam, 2 to 20 percent slopes, just south of Woodruff, about 1,700 feet south and 500 feet west of the northeast corner of sec. 17, T. 15 N., R. 22 E.

A—0 to 4 inches; reddish brown (5YR 5/4) gravelly sandy loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; many fine roots; many fine irregular pores; 30 percent gravel; moderately alkaline (pH 8.0); clear smooth boundary.

Bt—4 to 15 inches; reddish brown (5YR 5/4) gravelly clay loam, reddish brown (5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many very fine tubular pores; few faint clay films on faces of peds and lining pores; 20 percent gravel; moderately alkaline (pH 8.2); clear smooth boundary.

Bk1—15 to 19 inches; pink (5YR 7/4) very gravelly loam, reddish brown (5YR 5/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; 55 percent gravel; common medium calcium carbonate accumulations; violently effervescent; moderately alkaline (pH 8.4); abrupt wavy boundary.

Bk2—19 to 28 inches; pinkish white (5YR 8/2) extremely gravelly loam, light reddish brown (5YR 6/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; 60 percent gravel and 10 percent cobbles with many calcium carbonate pendants on undersides; violently effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.

2Bk—28 to 38 inches; reddish brown (5YR 5/4) extremely gravelly loamy coarse sand, reddish brown (5YR 4/4) moist; massive; loose, nonsticky and nonplastic; many fine roots; 75 percent gravel and 10 percent cobbles with many calcium carbonate pendants on undersides; slightly effervescent; moderately alkaline (pH 8.2); gradual wavy boundary.

2C—38 to 60 inches; reddish brown (5YR 5/4) stratified extremely gravelly loamy coarse sand, reddish brown (5YR 4/4) moist; massive; loose; many fine roots; 75 percent gravel and 10 percent cobbles; slightly effervescent; moderately alkaline (pH 8.2).

Depth to the calcic horizon is 10 to 20 inches. Depth to stratified sand and gravel is 25 to 38 inches. Reaction is slightly alkaline or moderately alkaline in the upper part.

The A horizon contains 15 to 35 percent rock fragments and less than 18 percent clay. It has value of 4 to 6 (3 to 5 moist) and chroma of 2 to 6 dry and moist.

The Bt and Btk horizons are clay loam or gravelly clay loam that have 15 to 35 percent rock fragments and 27 to 35 percent clay. They have hue of 2.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 6 dry and moist. The content of calcium carbonate ranges from 0 to 5 percent.

The lower Bk and C horizons are stratified sand and gravel averaging 35 to 85 percent rock fragments. They have hue of 5YR or 7.5YR, value of 6 to 8 (4 to 6 moist), and chroma of 2 to 4 dry and moist. The content of calcium carbonate ranges from 1 to 40 percent.

Springerville Series

The Springerville series consists of very deep, well drained, very slowly permeable soils on fan terraces. These soils formed in mixed alluvium weathered from clayey mudstone. Slope ranges from 0 to 3 percent.

These soils are fine, montmorillonitic, mesic Aridic Haplusterts.

Typical pedon of Springerville clay, 0 to 3 percent slopes, 1.5 miles west of Taylor and directly east of Cottonwood Wash, about 1,600 feet east and 300 feet south of the northwest corner of sec. 3, T. 12 N., R. 21 E.

A—0 to 5 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; moderate thin platy structure in the upper ½ inch and moderate fine granular below; slightly hard, friable, very sticky and plastic; many fine and very fine roots; many very fine and fine irregular pores; 10 percent gravel on the surface; slightly effervescent; slightly alkaline (pH 7.5); clear smooth boundary.

Bss1—5 to 35 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (10YR 3/3) moist; moderate medium angular blocky structure; very hard, very firm, very sticky and very plastic; common fine and very fine roots; common fine and very fine tubular pores; many pressure faces and common slickensides; common wedges tilted 10 to 30 degrees from horizontal; few 1-inch-wide cracks extend to the lower boundary of the horizon; strongly effervescent; slightly alkaline (pH 7.7); clear wavy boundary.

Bss2—35 to 60 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; massive; very hard, firm, very sticky and very plastic; common fine and very fine common roots; fine and very fine tubular pores; common pressure faces; few slickensides; few wedges tilted 10 to 30 degrees from horizontal; few cracks extend to a depth of 40 inches; 10 percent gravel; strongly effervescent; slightly alkaline (pH 7.5).

These soils are a taxadjunct to the Springerville series. They have an ustic aridic soil moisture regime instead of the aridic ustic moisture regime that is recognized for the official series. These soils are classified as fine, montmorillonitic, mesic Typic Haplotorrerts.

These soils crack widely and deeply as they dry. Highly

weathered, clayey mudstone may occur at depths of more than 30 inches. The content of rock fragments is less than 15 percent.

These soils are clay or silty clay (40 to 60 percent clay). They have hue of 7.5YR or 10YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3 dry and moist. The content of calcium carbonate ranges from 0 to 10 percent.

Springerville Family

The Springerville family consists of very deep, well drained, very slowly permeable soils on mesas and plateaus. These soils formed in alluvium and colluvium derived dominantly from basalt and pyroclastics. Slope ranges from 1 to 8 percent.

These soils are fine, montmorillonitic, mesic Aridic Haplusterts.

Typical pedon of Springerville family silty clay, 1 to 8 percent slopes, at Cowlake Area about 6 miles east-southeast of White Mountain Lake, about 1,700 feet south and 2,200 feet east of the northwest corner of sec. 22, T. 11 N., R. 23 E.

A—0 to 1 inch; reddish brown (5YR 4/3) silty clay, dark reddish brown (5YR 3/4) moist; moderate fine granular structure; slightly hard, friable, very sticky and very plastic; common fine roots; many fine irregular pores; noneffervescent; slightly alkaline (pH 7.4); abrupt smooth boundary.

Bss1—1 to 9 inches; reddish brown (5YR 4/4) silty clay, dark reddish brown (5YR 3/4) moist; moderate medium angular blocky structure; hard, friable, very sticky and very plastic; common fine roots; few very fine tubular pores; common small slickensides tilted 20 to 45 degrees from horizontal; noneffervescent; slightly alkaline (pH 7.4); gradual wavy boundary.

Bss2—9 to 22 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; moderate medium angular blocky structure; very hard, firm, very sticky and very plastic; few very fine and fine roots; few very fine tubular pores; many small slickensides tilted 20 to 45 degrees from horizontal; noneffervescent; slightly alkaline (pH 7.6); gradual wavy boundary.

Css—22 to 60 inches; reddish brown (5YR 4/4) clay, dark reddish brown (5YR 3/4) moist; massive; very hard, very firm, very sticky and very plastic; few very fine tubular pores; common to many small slickensides tilted 20 to 45 degrees from horizontal; noneffervescent; slightly alkaline (pH 7.6).

These soils crack widely and deeply upon drying. A few areas show some gilgai relief. Gravel and cobbles may occur on the surface of some pedons.

These soils are silty clay and clay (40 to 60 percent clay). They have hue of 5YR or 10YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 to 4 dry and moist. The content of calcium carbonate ranges from 0 to 5 percent.

Thunderbird Series

The Thunderbird series consists of moderately deep, well drained, very slowly permeable soils on hills and mesas. These soils formed in alluvium derived dominantly from basalt and pyroclastics. Slope ranges from 1 to 12 percent.

These soils are fine, montmorillonitic, mesic Aridic Argiustolls.

Typical pedon of Thunderbird cobbly silty clay loam, 1 to 12 percent slopes, about 1 mile south of Cooley Knoll east of Show Low, about 1,200 feet east and 1,800 feet south of the northwest corner of sec. 31, T. 11 N., R. 23 E.

A—0 to 2 inches; brown (7.5YR 4/2) cobbly silty clay loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; slightly hard, friable, sticky and plastic; many fine roots; many very fine irregular pores; 20 percent gravel and 10 percent basalt cobbles; noneffervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Bt1—2 to 7 inches; dark brown (7.5YR 3/2) clay, dark brown (7.5YR 3/3) moist; moderate fine subangular blocky structure; hard, firm, sticky and very plastic; many fine and very fine roots; many fine and very fine tubular pores; common pressure faces; common faint clay films lining pores; 5 percent basalt gravel; noneffervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Bt2—7 to 18 inches; dark brown (7.5YR 3/2) clay, dark brown (7.5YR 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and very plastic; many fine and medium roots; common fine and very fine tubular pores; common pressure faces; common faint clay films on faces of peds and lining pores; 5 percent basalt gravel; slightly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Bt3—18 to 27 inches; reddish brown (5YR 4/3) cobbly clay, dark reddish brown (5YR 3/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and very plastic; many fine and few medium roots; common very fine and fine tubular pores; common pressure faces; common faint clay films on faces of peds and lining pores; 15 percent basalt cobbles and 5 percent gravel; slightly effervescent; moderately alkaline (pH 8.4); clear wavy boundary.

Bk—27 to 31 inches; pink (5YR 7/3) very cobbly clay loam, reddish yellow (5YR 6/6) moist; massive; hard, firm, slightly sticky and slightly plastic; common fine and

very fine roots; many fine and very fine tubular pores; 40 percent basalt cobbles and 20 percent gravel; many large and medium, irregularly-shaped calcium carbonate masses; strongly effervescent; moderately alkaline (pH 8.4); abrupt irregular boundary.
2R—31 inches; calcium carbonate coated basalt.

Depth to bedrock ranges from 20 to 40 inches. Depth to maximum calcium carbonate accumulation is 20 to 30 inches. The content of calcium carbonate ranges from 0 to 15 percent. Reaction is slightly alkaline or moderately alkaline. The content of rock fragments averages less than 25 percent but can be as high as 60 percent in any one horizon.

The A horizon has 5 to 25 percent cobbles and 5 to 25 percent gravel. It has hue of 7.5YR or 10YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3 dry and moist.

The Bt horizon has hue of 5YR or 7.5YR, value of 3 or 4 dry and moist, and chroma of 2 or 3 dry and moist.

The Bk horizon has hue of 5YR or 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 3 to 6 dry and moist.

Torriorthents

Torriorthents are very shallow to very deep, excessively drained or well drained, rapidly permeable to very slowly permeable soils on hills, buttes, mesas, and escarpments. These soils are sandy to clayey and nongravelly to very cobbly. Parent material includes eolian material, alluvium, and colluvium. Slope ranges from 1 to 80 percent.

Representative pedon of Torriorthents, in an area of Calciorthids-Torriorthents-Rock outcrop complex, 15 to 80 percent slopes, on Woodruff Butte, about 3,500 feet north and 2,250 feet east of the southwest corner of sec. 8, T. 16 N., R. 22 E.

A1—0 to 2 inches; dark brown (7.5YR 4/4) very cobbly silty clay loam, dark brown (7.5YR 3/4) moist; weak fine granular structure; slightly hard, friable, sticky and plastic; common fine and very fine roots; many fine irregular pores; 30 percent cobbles and 20 percent gravel; strongly effervescent; moderately alkaline (pH 8.4); clear smooth boundary.
A2—2 to 8 inches; dark brown (7.5YR 4/4) very gravelly clay loam, dark brown (7.5YR 3/4) moist; weak fine subangular blocky structure; hard, friable, sticky and plastic; many fine and very fine roots; common fine tubular and irregular pores; 35 percent gravel and 10 percent cobbles; strongly effervescent; moderately alkaline (pH 8.4); clear smooth boundary.
C—8 to 32 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; massive; hard, firm, sticky and plastic; common fine and very fine and few medium roots; common fine and very fine tubular pores; 10 percent gravel and 2 percent cobbles; violently effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.
2Cr—32 inches; mudstone.

Torriorthents are included in four map units that differ greatly because of their parent material but are all near or on escarpments.

Depth to mudstone, sandstone, or basalt ranges from 4 to 60 or more inches. The content of rock fragments ranges from 0 to 75 percent. Textures range from sand to clay.

Tours Series

The Tours series consists of very deep, well drained, moderately slowly permeable soils on flood plains and alluvial fans. These soils formed in mixed alluvium. Slope ranges from 0 to 3 percent.

These soils are fine-silty, mixed (calcareous), mesic Typic Torrifluvents.

Typical pedon of Tours silty clay loam, saline-sodic, 0 to 1 percent slopes, about 3 miles east of Winslow, directly north of Interstate 40, about 2,200 feet east and 200 feet north of the southwest corner of sec. 27, T. 19 N., R. 16 E.

A—0 to 6 inches; light reddish brown (5YR 6/4) silty clay loam, reddish brown (5YR 5/4) moist; moderate thin and medium platy structure; hard, friable, very sticky and plastic; many very fine vesicular pores; common fine and very fine roots; violently effervescent, 15 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.
C1—6 to 19 inches; reddish brown (5YR 5/4) stratified silty clay loam, reddish brown (5YR 4/4) moist; massive; hard, friable, very sticky and plastic; common fine tubular pores; common fine roots; strongly effervescent, 9 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); abrupt smooth boundary.
C2—19 to 47 inches; light reddish brown and reddish brown (5YR 5/4 and 6/4) stratified silty clay loam and silt loam, reddish brown (5YR 5/4 and 4/4) moist; massive; hard, friable, very sticky and plastic; common fine tubular pores; common fine roots; few fine salt crystals; violently effervescent, 19 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); abrupt smooth boundary.
C3—47 to 55 inches; pink and pinkish gray (5YR 7/3 and 6/2) stratified silt loam and very fine sandy loam; reddish brown and dark reddish brown (5YR 5/3 and 4/2) moist; massive; slightly hard, friable, nonsticky and nonplastic; common fine and very fine tubular pores; common fine and few medium roots; few fine salt crystals; violently effervescent, 19 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

C4—55 to 60 inches; pink (5YR 7/4) stratified very fine sandy loam, light reddish brown (5YR 6/4) moist; massive; soft, very friable, nonsticky and nonplastic; common fine tubular pores; common fine roots; few fine salt crystals; violently effervescent, 14 percent calcium carbonate equivalent; moderately alkaline (pH 8.4).

Salt crystals are not present in all pedons. Sodicity is none to moderate (SAR ranges from 0 to 30), and salinity is nonsaline to strong (electrical conductivity ranges from 2 to more than 16 dS/m). Reaction is moderately alkaline or strongly alkaline. Calcium carbonate is disseminated throughout. The content of calcium carbonate ranges from 5 to 20 percent.

Tours soils are stratified silty clay loam or clay loam with thin strata of coarser and finer materials. They have hue of 2.5YR or 5YR, value of 4 to 7 (4 to 6 moist), and chroma of 2 to 6 dry and moist.

Trail Series

The Trail series consists of very deep, somewhat excessively drained, moderately rapidly permeable soils on flood plains. These soils formed in recent, stratified, mixed alluvium. Slope ranges from 0 to 3 percent.

These soils are sandy, mixed, mesic Typic Torrifluvents.

Typical pedon of Trail loamy sand, 0 to 3 percent slopes, on the north side of the Little Colorado River, west of the bridge for Arizona Highway 77 on the south side of Holbrook, about 2,100 feet north and 500 feet west of the southeast corner of sec. 1, T. 17 N., R. 20 E.

A—0 to 3 inches; light brown (7.5YR 6/4) loamy sand, brown (7.5YR 5/4) moist; single grained; loose, nonsticky and nonplastic; many very fine roots; many fine irregular pores; noneffervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.

C1—3 to 20 inches; light brown (7.5YR 6/4) stratified loamy sand, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; many fine irregular pores; slightly effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.

C2—20 to 26 inches; light brown (7.5YR 6/4) stratified fine sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common fine roots; common fine tubular pores; few very thin strata of silt loam, loam, and clay loam; slightly effervescent; moderately alkaline (pH 8.4); abrupt wavy boundary.

C3—26 to 43 inches; light reddish brown (5YR 6/4) stratified loamy sand, reddish brown (5YR 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common fine roots; common fine irregular pores; few very thin strata of silt loam, loam, and clay loam; slightly effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.

C4—43 to 60 inches; light brown (7.5YR 6/4) stratified loamy sand, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; common fine irregular pores; few very thin strata of very fine sandy loam, fine sandy loam, and silt loam; slightly effervescent; moderately alkaline (pH 8.4).

The Trail soils contain less than 15 percent rock fragments. Salinity is slight to none (electrical conductivity is less than 8 dS/m). Sodicity also is slight to none (SAR is less than 13). The Trail soils are stratified loamy sand, loamy fine sand, or fine sand throughout with thin strata of finer materials. They have hue of 5YR or 7.5YR, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4 dry and moist.

Typic Calciorthids

Typic Calciorthids are very deep, well drained, moderately permeable or moderately rapidly permeable soils on mesa escarpments. These soils formed in alluvium derived from mixed sources. Slope ranges from 20 to 60 percent.

Representative pedon of Typic Calciorthids, in an area of Torriorthents-Typic Calciorthids association, 20 to 60 percent slopes, about 8 miles north of Holbrook, about 1,300 feet north and 20 feet west of the southeast corner of sec. 21, T. 21 N., R. 20 E.

A—0 to 3 inches; reddish brown (5YR 5/4) gravelly sandy loam, reddish brown (5YR 4/4) moist; weak thin platy and weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine roots; many very fine and fine vesicular pores; 30 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bw—3 to 13 inches; reddish brown (5YR 5/4) coarse sandy loam, reddish brown (5YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; many very fine and fine tubular pores; 10 percent gravel; slightly effervescent, 13 percent calcium carbonate equivalent; moderately alkaline (pH 8.0); clear smooth boundary.

Bk1—13 to 32 inches; yellowish red (5YR 5/6) gravelly sandy loam, yellowish red (5YR 4/6) moist; massive; hard, friable, slightly sticky and nonplastic; common very fine and fine roots; common very fine and fine tubular pores; 20 percent calcium carbonate coated gravel; weakly cemented; violently effervescent, 38 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk2—32 to 40 inches; yellowish red (5YR 5/6) gravelly

sandy clay loam, yellowish red (5YR 4/6) moist; massive; hard, friable, sticky and slightly plastic; few very fine and fine roots; common very fine and fine tubular pores; 30 percent calcium carbonate coated gravel; common calcium carbonate masses and fillings in pores; violently effervescent, 20 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk3—40 to 56 inches; yellowish red (5YR 5/6) gravelly sandy loam, yellowish red (5YR 4/6) moist; massive; hard, friable, slightly sticky and nonplastic; few very fine and fine roots; common very fine and fine tubular pores; 25 percent calcium carbonate coated gravel; common calcium carbonate masses and fillings in pores; violently effervescent, 26 percent calcium carbonate equivalent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk4—56 to 60 inches; reddish yellow (5YR 6/6) gravelly sandy clay loam, yellowish red (5YR 5/6) moist; weak subangular blocky structure; hard, friable, sticky and slightly plastic; very few very fine roots; common very fine and fine tubular and irregular pores; 30 percent gravel with common calcium carbonate coatings; few calcium carbonate masses and fillings in pores; violently effervescent, 18 percent calcium carbonate equivalent; moderately alkaline (pH 8.4).

Typic Calciorthids vary greatly in texture and the content of rock fragments.

Depth to a calcic horizon ranges from 5 to 30 inches. The content of rock fragments ranges from 5 to 35 percent. Surface textures are loamy sand, sandy loam, and fine sandy loam. Subsurface textures are loam, sandy loam, sandy clay loam, coarse sandy loam, and loamy coarse sand.

Typic Torrifluvents

Typic Torrifluvents are deep or very deep, poorly drained to well drained, slowly to rapidly permeable soils. They formed in mixed alluvium on flood plains and in stream drainageways. Slope ranges from 0 to 5 percent.

Representative pedon of Typic Torrifluvents, in an area of Riverwash-Typic Torrifluvents complex, 0 to 5 percent slopes, along the Little Colorado River near Winslow, about 2,400 feet south and 2,200 feet west of the northeast corner of sec. 17, T. 19 N., R. 16 E.

C1—0 to 9 inches; light reddish brown (5YR 6/3) sand, reddish brown (5YR 5/3) moist; single grained; loose; many fine and very fine roots; many fine and very fine irregular pores; 5 percent fine gravel; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

C2—9 to 60 inches; light reddish brown (5YR 6/3) stratified loamy sand, reddish brown (5YR 5/3) moist; massive; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular pores; common thin to moderately thick strata of silt loam, sand, and fine gravel; 10 percent fine gravel; slightly effervescent; moderately alkaline (pH 8.0).

Typic Torrifluvents vary in depth, texture, and rock fragment content.

Depth to bedrock ranges from 40 to 60 inches or more. Salinity ranges from none to moderate.

Soil textures are generally sand, loamy sand, sandy loam, or loam. Along the Little Colorado River, the content of rock fragments ranges from 5 to 15 percent. Along intermittent drainageways, the content of rock fragments ranges from 5 to 50 percent.

Ubank Series

The Ubank series consists of very deep, well drained, moderately permeable soils on fan terraces of plateaus. These soils formed in mixed alluvium derived from sandstone, mudstone, limestone, and basalt. Slope ranges from 1 to 8 percent.

These soils are coarse-loamy, carbonatic, mesic Ustollic Calciorthids.

Typical pedon of Ubank fine sandy loam, in an area of Cerrillos-Ubank complex, 1 to 8 percent slopes, about 2.5 miles south of Hay Hollow, about 700 feet east and 1,000 feet north of the southwest corner of sec. 9, T. 14 N., R. 23 E.

A—0 to 2 inches; reddish brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak thin platy structure; slightly hard, very friable, nonsticky and nonplastic; many very fine roots; many very fine vesicular and irregular pores; 10 percent gravel; strongly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bw—2 to 10 inches; reddish brown (5YR 5/4) sandy loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; many very fine roots; common very fine and fine tubular and irregular pores; 10 percent gravel; strongly effervescent; moderately alkaline (pH 8.4); clear wavy boundary.

Bk1—10 to 14 inches; pink (5YR 7/3) loam, reddish yellow (5YR 6/6) moist; massive; hard, friable, sticky and slightly plastic; common fine and very fine roots; many very fine and common fine tubular pores; violently effervescent, 30 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt wavy boundary.

2Bk2—14 to 44 inches; pink (5YR 8/3) loam, pink (5YR 7/3) moist; massive; hard, firm, slightly sticky and slightly plastic; common very fine and few fine roots; common fine tubular pores; common medium accumulations of calcium carbonate; violently effervescent, 50 percent calcium carbonate equivalent; moderately alkaline (pH 8.4); abrupt smooth boundary.

3Btkb—44 to 60 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; strong medium subangular blocky structure; hard, firm, sticky and plastic; few fine and very fine roots; common fine and very fine tubular and irregular pores; common faint clay films on faces of peds and lining pores; common fine and medium round soft calcium carbonate masses and few fillings in pores; strongly effervescent, 33 percent calcium carbonate equivalent; moderately alkaline (pH 8.4).

The content of calcium carbonate averages 40 to 55 percent. The content of rock fragments averages 5 to 15 percent but can be as high as 35 percent in any one horizon.

The A horizon has value of 4 to 6 (3 to 5 moist) and chroma of 3 or 4 dry and moist.

The Bw horizon is sandy loam or loam. It has value of 4 or 5 (3 to 5 moist) and chroma of 3 or 4 dry and moist.

The Bk horizon is loam, sandy loam, or sandy clay loam. It has hue of 5YR or 7.5YR, value of 4 to 8 dry and moist, and chroma of 2 to 6 dry and moist.

Not all pedons are underlain by buried argillic horizons.

Ustic Torrifluvents

Ustic Torrifluvents are deep to very deep, poorly drained to well drained, slowly permeable to rapidly permeable soils. These soils formed in mixed alluvium on flood plains and in stream channels. Slope ranges from 0 to 5 percent.

Representative pedon of Ustic Torrifluvents, in an area of Riverwash-Ustic Torrifluvents complex, 0 to 5 percent slopes, along the Cottonwood Wash near Taylor, about 1,500 feet south and 1,100 feet west of the northeast corner of sec. 5, T. 12 N., R. 21 E.

C1—0 to 10 inches; brown (7.5YR 5/3) gravelly sandy loam, dark brown (7.5YR 4/3) moist; single grained; loose, nonsticky and nonplastic; many fine and very fine roots; many fine and very fine irregular pores; 20 percent gravel and 5 percent cobbles; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

C2—10 to 60 inches; brown (7.5YR 5/3) stratified gravelly sandy loam, dark brown (7.5YR 4/3) moist; massive; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; many fine and very fine tubular and irregular pores; common thin strata of finer and coarser materials; 25 percent gravel and 5 percent cobbles; slightly effervescent; moderately alkaline (pH 8.2).

Ustic Torrifluvents vary in depth, texture, and content of rock fragments.

Depth to bedrock ranges from 40 to 60 inches or more. Soil textures range from sand to loam with 5 to 50 percent rock fragments.

Ustollic Haplargids

Ustollic Haplargids are deep or very deep, well drained soils on hills and fan terraces. Permeability is moderately slow or slow. These soils formed in mixed alluvium and colluvium derived dominantly from sandstone, mudstone, limestone, and basalt. Slope ranges from 1 to 30 percent.

Representative pedon of Ustollic Haplargids, in an area of Ustollic Haplargids association, 1 to 30 percent slopes, about 11 miles west of Snowflake, about 100 feet south and 1,800 feet west of the northeast corner of sec. 11, T. 13 N., R. 19 E.

A1—0 to 1 inch; light reddish brown (5YR 6/4) gravelly sandy loam, reddish brown (5YR 4/3) moist; weak medium platy structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine vesicular pores; 15 percent gravel; noneffervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

A2—1 to 3 inches; light reddish brown (5YR 6/4) gravelly sandy loam, reddish brown (5YR 4/3) moist; weak fine granular and weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; common fine and very fine tubular and irregular pores; 15 percent gravel; noneffervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bt—3 to 13 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; common fine and very fine tubular and irregular pores; 5 percent gravel; noneffervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Btk—13 to 25 inches; reddish brown (5YR 5/4) gravelly sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine and very fine roots; common fine and very fine tubular and irregular pores; 15 percent gravel; noneffervescent matrix with common fine calcium carbonate masses and veins; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk1—25 to 42 inches; reddish yellow (5YR 6/6) stratified very gravelly loamy sand, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; many fine and very fine irregular pores; 25 percent gravel; common fine calcium carbonate veins; strongly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk2—42 to 60 inches; reddish yellow (5YR 6/6) gravelly sandy loam, yellowish red (5YR 4/6) moist; massive; slightly hard, friable, nonsticky and nonplastic; no roots; common fine and very fine irregular pores; 25 percent gravel; common fine calcium carbonate veins; strongly effervescent; moderately alkaline (pH 8.2).

Ustollic Haplargids vary widely in texture and rock fragment content.

Depth to bedrock ranges from 40 to 60 inches or more. Bedrock varies from soft mudstone to hard sandstone or limestone. The content of rock fragments ranges from 5 to 60 percent. The surface horizons are loam, sandy loam, and fine sandy loam. The upper horizons of the subsoil range from loam to clay, and the lower horizons range from sandy loam to loamy sand.

Formation of the Soils

Soil is a complex, natural, three-dimensional body at the earth's surface that supports plants and other life forms. It consists of inorganic and organic material and has characteristics and qualities that are determined by physical and chemical processes. These processes result from the interaction of five factors: climate, living organisms, time, topography, and parent material. The influence of each factor varies from one location to another, but the interaction of all the factors determines the kind of soil that forms (Thompson 1957).

Soil is often seen as a thermodynamic system existing in equilibrium with certain external, soil forming factors. Changes in these factors cause the soil to move towards a new equilibrium (Wilding et al 1983). The soil in its current state is inching its way towards that equilibrium.

During the past million years or so, the soils in the survey area have undergone dynamic alterations. Faulting, folding, and uplift have altered elevation and topography. Erupting volcanoes have added fresh material, and streams have eroded surfaces and transported sediment to low-lying areas. Winds have transported and deposited sediments, and the climate and the types of living organisms have changed. These events have greatly influenced the soil properties.

In this section the five factors related to soil formation are discussed. The major processes affecting the soils in the survey area are also described.

Climate

Climate affects soil formation through its influence on animal and plant life and physical and chemical weathering. Climate also contributes to landform expression and to the development of geomorphic surfaces and local topography.

As temperature and moisture increase, so do physical, chemical, and biological processes in the soil because temperature and moisture control the rate and degree of mineral decomposition and alteration. The leaching of clay, humus, soluble salts, and minerals from the upper part of the solum and their accumulation in layers deeper in the soil profile are also influenced by climate. Nitrogen fixation, carbon transformation, and other microbial activity are strongly affected by soil temperature and moisture (Thompson 1957).

Changes in climate complicate the study of soil formation but can strongly influence the kind of soil formed. Climatic changes have been verified through geologic evidence of stream erosion and deposition and glacial activity. Theories for climatic changes are many and complex. Most agree that changes in temperature and precipitation effected the advance and retreat of the ice sheets, which in turn effected moisture and mineral deposition in nonglaciated areas (Flint 1971). Since the last ice age about 10,000 years ago, temperatures have warmed slightly and available moisture has decreased greatly. Heavy rainfall was contemporaneous with glacial climates, and snow lines were lower than at present (Gilluly et al 1968).

These changes are evidenced in the soils of this survey. The reddish brown, loamy to clayey, alluvial materials that top the large mesas (the Ives and Marcou soils) were deposited by water on a very broad scale during the Pleistocene. In the dryer Holocene environment that followed, these materials were reworked by wind and water, leaving areas of dune sand, gravel pavements, and a gently rolling landscape in which the surfaces of the alluvial deposits merge with the bedrock controlled surfaces on the Chinle, Moenkopie, and Coconino Formations.

Soils exhibiting these characteristics include the Sheppard, Grieta, Penzance, Kinan, Cerrillos, and Padilla soils. The Sheppard and Kinan soils formed almost entirely in eolian deposits. The Grieta and Cerrillos soils are only affected near the surface and upper subsurface layers. The Penzance and Padilla soils are deflated soils in which only the old clay subsoil remains; the surface layers have blown away.

The argillic horizons of the Grieta, Penzance, Cerrillos, and Padilla soils probably formed during a time when the climate was more moist than it is now. The climate was moist enough to remove carbonates and to translocate clays to form argillic horizons. These soils now have moderate to strong argillic horizons with an abundance of carbonates throughout the profile. Research describes a similar pattern of soil development in New Mexico and attributes the carbonates to an airborne origin (Gile et al 1979).

The stratified sand and gravel underlying these developed soils are evidence of another climatic change.

This evidence indicates an abundance of faster moving water. Erosion of the reddish brown loamy sediments from the upper part of these deposits exposes the underlying coarser sediments. The more recent erosional phase of present day has left these coarse sediments as hills along Silver Creek, Chevelon Canyon, and the Little Colorado River. These hills are of economic importance to the area as the main source of sand and gravel materials for construction. Soils associated with these sand and gravel deposits are the Sheza soils and areas mapped as Gypsiorthids-Torriorthents.

Effects of changes in climate can be seen most vividly in our present day soils by driving from the northern part of the survey area to the southern edge. In the north, beginning at Holbrook where the average annual precipitation is 8.6 inches, the soils are dry, moderate to strongly alkaline, saline, and eroding. Vegetative production is low, and wildlife is limited to animals and birds suited to the desert.

Driving south, precipitation increases as the elevation increases. Vegetative production and the varieties of wildlife also increase. The content of organic matter in the soils increases, and carbonates have been leached out of the surface horizons.

Farther south, in the Snowflake-Taylor area, precipitation increases to 12.25 inches annually and the average annual air temperature is about 3 degrees cooler. The soils have a darker surface horizon due to the organic matter content, and the subsoils are a brighter red. Carbonates have been leached from the surface horizons and have been partially leached from the subsurface horizons. Generally, the soils are slightly alkaline.

As the southern boundary is approached just south of White Mountain Lake, the annual precipitation has increased to 16 inches and the average annual air temperature has dropped about 2 degrees more. The soils are dark brown from the surface to a depth of as much as 60 inches in some areas due to the high content of organic matter. They have well defined, strong structured argillic horizons. They are neutral to slightly alkaline. Carbonates have been leached out of the upper part of the profile and are seen only as highly segregated soft masses in the lower part. Wildlife consists of forest animals that inhabit a cool, somewhat moist climate. The forested woodlands and open grasslands produce a wide variety of plants. Soil erosion is minimal in undisturbed areas.

Living Organisms

Living organisms play an extremely important role in soil formation and in the cycling of carbon and nitrogen. These three processes are closely related. Carbon fixed by plants is decomposed by soil microbes. The nitrogen cycle is interrelated with the carbon cycle, and the rate of nitrogen cycling is closely related to productivity. Accumulation of organic matter in soils is a balance between productivity, biomass accumulation, and decomposition rate. Organic matter accumulation and decomposition products have a profound influence on soil formation (Wilding et al 1983).

Among all living organisms, plants have the most significant overall influence on soil formation. Plants of all sizes intercept precipitation, reduce soil erosion, trap sediment, and help aerate soils. Decaying plant remains, especially fibrous grass roots, are the major source of organic matter.

Animals influence soil formation by contributing organic matter and synthesizing it. They also mix soil horizons by burrowing into the soil. Burrowing animals, such as prairie dogs, skunks, gophers, and ground squirrels, influence soil mainly through mechanical turning and mixing. Insects, nematodes, earthworms, and millipedes synthesize organic matter. They are dependent on the soil for plants, animal remains, and moisture.

The soils in the northern and central parts of this survey area are generally dry for long periods of time. They are well drained to excessively drained, so they do not pond water for long periods. Plants cover only a small portion of the soil surface. Because of their sparseness, they add little organic matter to the soil, give scant protection from wind and water erosion, and provide little shade. Therefore, the soils of this dry area have a very low content of organic matter.

The soils in the southern part of the survey area, on the other hand, are moist for longer periods of time. The content of organic matter in the surface horizons is 1 or 2 percent. Microbial activity is high in these soils during the warm, moist season of the year and low during the cold winter months.

Time

Soils acquire their properties over periods of time measured in hundreds and thousands of years. The rate of soil formation is a product of all the component individual factors taking place in the soil over time. Soil age is difficult to determine but is relative to soil development and age of the geomorphic surface (Wilding et al 1983).

A young soil, in a relative sense, is one in which its profile closely resembles its parent material. The soils of dunes, floodplains, and alluvial fans go through alternating sedimentation and erosional cycles so fast that soil forming processes have not had time to alter the parent material. Soils in this survey area that fall in this category are the Arches, Ives, Jocity, Manzano, Navajo, Needle, Sheppard, Nuffel, Radnik, Tours, and Trail soils and the active dune areas mapped as Dune land.

Older soils include those that have been in place long

enough to begin altering the parent material. These soils occur on somewhat stable to stable geomorphic surfaces and include the Arntz, Bagley, Burnswick, Claysprings, Marcou, and Purgatory soils.

The old and very old soils are those that have well defined, moderate to strong structured argillic, calcic, cambic, or both calcic and cambic horizons. They occur on very stable geomorphic surfaces and have undergone horizontal transformation in the soil profile. Soils occurring in this group include Bisoodi, Cerrillos, Deama, Barx, Grieta, Epikom, Leanto, Sheza, Padilla, Penzance, Springerville, Poley, Thunderbird, Mellenthin, and Lozinta soils.

Topography and Parent Material

Since soils form a three-dimensional continuum on the landscape, any study of soil formation and distribution requires an understanding of the evolution of the landscape. Geomorphology is the interpretative description of landscapes, including an explanation of the history of those landscapes. Through the use of geomorphic terms, the relationships of parent material, topography, and soils can be better understood.

The entire survey area is within the Colorado Plateau Province (Peirce 1967). This broad undulating plateau is broken only by canyons, buttes, and mesas and by a few small volcanic remnants in the northern part and basalt flows and cinder cones in the southern part.

The Colorado Plateau Province was once completely covered with water. The present day geologic formations were laid down in that sea environment. The regional uplift that began the withdrawal of the seas from most of Arizona and the erosion that followed did not occur until the late Cretaceous Period (about 65 to 70 million years ago) (Wilson et al 1969).

Theories suggest that parts of southern Arizona probably were mountainous and higher in elevation than most of northern Arizona, which was a wide plain. In general, geologic evidence seems to indicate that streams flowed from the ancestral Mogollon Highlands, located in what is now southern Arizona and southeastern California, northward across this plain. Through regional uplift and subsidence accompanied by large scale faulting, the Colorado River system began developing and in late Tertiary and early Quaternary time (the last 20 million years) volcanic activity began to form the White Mountains and the San Francisco Peaks (Wilson et al 1969).

Theoretical reconstruction of this survey area indicates that during the late Tertiary and the Quaternary times, contemporaneous with the canyon cutting, erosion removed from the Colorado Plateau layers of rock and sediments ranging from 1,000 to 6,000 feet in depth. This erosional period has continued through the present day (Wilson et al 1969). Wind and water continue to carve a picturesque landscape in this plateau province.

The geological formations exposed by this vast removal of rock and sediments include (listed from youngest to oldest): Quaternary Alluvium, Quaternary Basalt, early Quaternary and late Tertiary Rim Gravels, Tertiary Volcanic Dikes and Plugs, Triassic Chinle Formation, Triassic Shinarump Conglomerate, Triassic Moenkopie Formation, Permian Kaibab Limestone, and Permian Coconino Sandstone (Wilson et al 1969). The oldest formation is believed to be 230 to 280 million years old. These geological formations are the predominate contributors of soil parent materials in the area. Each parent material exhibits its own definable characteristic in the soils that it forms.

The Chinle Formation dominates the area north of the Little Colorado River. It is famous for its beautiful colors as exhibited in the Painted Desert (fig. 12). The multicolored mudstone is high in alkaline salts, and soils formed in sediments derived from it are alkaline and saline. The Burnswick, Claysprings, and Marcou soils exhibit these characteristics. The Burnswick and Claysprings soils are on fan terraces below the badland areas of the Chinle Formation. The Marcou soils occur as coppice and transverse dunes on these fan terraces.

Other soils influenced by the Chinle Formation are on alluvial fans, playas, and floodplains of the Little Colorado River and its tributaries. These soils include saline phases of the Ives, Jocity, Navajo, Tours, and Trail soils.

The Moenkopie Formation extends over most of the area and influences soils from the Little Colorado River south to the southern boundary of the survey area. Most soils formed in the Moenkopie Formation or in the pedisediments overlying it are shallow to moderately deep and may contain gypsum. The Epikom, Leanto, Kech, and Atarque soils are all shallow soils overlying the sandstone of the Moenkopie Formation. They occur on the tops of buttes and mesas and as an undulating plateau between the scattered buttes and mesas. The Arntz and Purgatory soils are influenced by gypsum. They occur on terraces and foot slopes below buttes and mesas.

The Coconino Formation is exposed along margins of the buttes and mesas and on canyon walls throughout the central part of the survey area. The high content of sand is a major influence on the soils forming on and near any exposure of Coconino Sandstone. The soils associated with the Coconino Sandstone are the Needle and Arches soils. These soils are shallow or very shallow over bedrock and are formed in windblown sands. Other soils that are influenced by the sands of the Coconino Sandstone are the Pensom and Chedeski soils and active dune areas. These soils are all in the dune and interdune area of the broad undulating plateau.

The Kaibab Limestone is exposed dominantly in the

Figure 12.—Badland in an area of Badland-Torriorthents association, 1 to 30 percent slopes, in the Painted Desert of the Petrified Forest National Park.

southwest corner of the survey area, extending from south of Winslow to south of Taylor. A portion of this area is characterized by the karst topography known locally as The Sinks. Soils that occur on the undulating plateau dominated by limestone are the Mellenthin and Deama soils. These soils contain high amounts of lime and are shallow over bedrock.

The Quaternary Basalt and cinder cones occur in the extreme southeast corner of the survey area. The basalt flows form rolling hills and terraces on which the Deama family, Springerville, and Thunderbird soils occur. These soils are shallow to deep over bedrock. They have dark surfaces and clay subsoils. The clay subsoils are remarkably free of basalt cobbles, but basalt cobbles are common on the surfaces of these soils and deep in their profiles. The cinder cones act as an outfielder's glove and collect windblown sediments to form the loamy Lozinta soils.

The Rim Gravels occur in a small area at the southern end of the survey area, east of Snowflake. The rolling hills are somewhat dissected by gully erosion. Identifiable soils are many and are complex in their pattern of occurrence. Most are Ustollic Haplargids, so this area was called by that name rather than by series names.

The Quaternary Alluvium can be divided into two ages—Holocene (the past 10,000 years) and Pleistocene (10,000 to 2 million years ago). Holocene alluvium includes sediment being deposited by water today. It is highly stratified coarse grained to fine grained materials and has undergone little or no alteration since deposition. These materials occur on flood plains, playas, and alluvial fans. Soils included in this group are the Bagley, Ives, Jocity, Manzano, Navajo, Nuffel, Radnik, Tours, and Trail soils.

Pleistocene alluvium is parent material deposited by water more than 10,000 years ago. The soils formed in these deposits are remnants of the ice ages. Today these

soils are in high dry terrace positions. The Ives and Marcou soils and other soils occur throughout the survey area. Soils on these terraces appear to have developed under a more moist climate, as evidenced by their development of different horizons. Soils identified on these terraces include the Cerrillos, Chedeski, Barx, Poley, Sheza, Ubank, Grieta, Padilla, and Penzance soils.

Tertiary Volcanic Dikes and Plugs dot the northern parts of this survey area. Woodruff Butte, Mitten Peaks, Hennessy Buttes, Twin Buttes, Flying Butte, and Carrizo Butte are the only remnants of an old volcanic field that must have been very active. All that remains are basalt monuments that are crumbling down around themselves and covering the mudstone and sandstone with basalt cobble. These areas are a complex of a variety of soils that vary in depth, texture, rock fragment content, and development. The soils are not mapped at the soil series level because of their complexity. Instead, they are mapped as Calciorthids-Torriorthents-Rock outcrop complex, 15 to 80 percent slopes.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3.5
Low	3.5 to 5
Moderate	5 to 7.5
High	7.5 to 10
Very high	more than 10

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Back slopes in profile are commonly steep, are linear, and may or may not include cliff segments.

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on a contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Blowout. A shallow depression from which all or most of the soil material has been removed by the wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Brush management. Use of mechanical, chemical, or

biological methods to make conditions favorable for reseeding or to eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte. An isolated small mountain or hill with steep or precipitous sides and a top variously flat, rounded, or pointed that may be a residual mass isolated by erosion or an exposed volcanic neck.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Canyon. A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax plant community. The plant community on a given site that will be established if present environmental conditions continue to prevail and the site is properly managed.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conglomerate. A coarse grained, clastic rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:
Loose.—Noncoherent when dry or moist; does not hold together in a mass.
Friable.—When moist, crushes easily under gentle

pressure between thumb and forefinger and can be pressed together into a lump.
Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
Plastic.—Readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.
Sticky.—Adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.
Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coppice dune. A small dune of fine grained soil material stabilized around shrubs or small trees.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Desert pavement. On a desert surface, a layer of gravel or larger fragments that was emplaced by upward movement of the underlying sediment or remains after finer particles have been removed by running water or the wind.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface

during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Draw. A small stream valley that generally is more open and has broader bottom land than a ravine or gulch.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.
Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.
Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material is 35 to 60 percent flagstones, and extremely flaggy soil material is more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hard rock. Rock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually

expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mesa. A broad, nearly flat topped and commonly isolated upland mass characterized by summit widths that are more than the heights of bounding erosional scarps.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides and a surface of considerably bare rock. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Playa. The generally dry and nearly level lake plain that occupies the lowest parts of closed depressional areas, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Potential plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Burning an area under conditions of weather and soil moisture and at the time of day that

will result in the intensity of heat and spread required to accomplish specific forest management, wildlife, grazing, or fire hazard reduction purposes.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200 to 300 draw bar horsepower rating.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more, for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs the growth of plants. A saline soil does not contain excess exchangeable sodium.

Salty water (in tables). Water that is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

SAR. Sodium absorption ratio. See sodicity.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil generally is silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey the following slope classes are recognized:

Nearly level	0 to 1 percent
Gently sloping or undulating	1 to 5 percent
Strongly sloping or rolling	5 to 15 percent
Moderately steep or hilly	15 to 25 percent
Steep	25 to 55 percent
Very steep	more than 55 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodic (alkali) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $Ca^+ + Mg^{++}$. The degrees of sodicity and their respective ratios are:

Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates, in millimeters, recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that

weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. All subdivisions of these horizons are included.

Talus. Rock fragments of any size or shape, commonly coarse and angular, derived from and lying at the base of a cliff or very steep, rock slope. The accumulated mass of such loose, broken rock formed chiefly by falling, rolling, or sliding.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1901-93 at Winslow and Snowflake, Arizona, and 1903-93 at Holbrook, Arizona)

Month	Temperature						Precipitation			
				2 years in 10 will have--				2 years in 10 will have--		
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more
	°F	°F	°F	°F	°F	Units	In	In	In	
WINSLOW:										
January----	45.6	19.4	32.5	68	-3	24	0.48	0.14	0.85	1
February---	53.8	24.8	39.3	73	6	69	0.48	0.18	0.78	1
March------	61.2	29.9	45.5	79	13	194	0.51	0.21	0.85	1
April------	70.3	37.1	53.7	87	21	406	0.39	0.12	0.67	1
May--------	79.6	44.6	62.1	94	28	661	0.32	0.07	0.60	1
June-------	90.3	53.4	71.9	102	37	923	0.31	0.07	0.70	0
July-------	93.3	62.1	77.7	103	50	1,128	1.38	0.53	2.10	3
August-----	90.4	60.6	75.5	100	49	1,047	1.52	0.73	2.20	4
September--	84.5	52.7	68.6	96	37	806	0.92	0.26	1.52	2
October----	72.9	40.1	56.5	88	21	487	0.70	0.20	1.35	1
November---	58.2	27.8	43.0	76	9	140	0.49	0.16	0.90	1
December---	46.7	20.7	33.7	68	-0	29	0.66	0.17	1.12	1
Yearly:										
Average---	70.6	39.4	55.0	---	---	---	---	---	---	---
Extreme---	109.0	-18.0	---	105	-7	---	---	---	---	---
Total-----	---	---	---	---	---	5,914	8.14	4.92	10.41	17
HOLBROOK:										
January----	47.6	18.0	32.8	68	-5	21	0.55	0.18	0.95	1
February---	55.3	23.4	39.3	75	3	65	0.57	0.17	0.94	1
March------	62.6	28.3	45.4	80	12	79	0.57	0.19	0.99	2
April------	71.5	35.2	53.3	87	19	376	0.44	0.16	0.85	1
May--------	80.4	42.1	61.3	95	26	605	0.30	0.10	0.67	0
June-------	90.8	50.8	70.8	102	35	871	0.33	0.09	0.80	0
July-------	94.1	59.8	76.9	104	46	1,082	1.44	0.48	2.42	3
August-----	91.4	58.5	74.9	101	44	1,013	1.53	0.64	2.29	4
September--	85.4	50.4	67.9	97	34	808	1.03	0.31	1.71	2
October----	74.2	37.7	56.0	89	21	461	0.75	0.20	1.48	1
November---	60.4	25.9	43.2	78	7	133	0.57	0.22	1.17	1
December---	48.6	19.6	34.1	68	-0	26	0.58	0.21	1.03	1
Yearly:										
Average---	71.8	37.5	54.7	---	---	---	---	---	---	---
Extreme---	109.0	-20.0	---	104	-9	---	---	---	---	---
Total-----	---	---	---	---	---	5,640	8.65	5.42	11.12	17

See footnote at end of table.

TABLE 1.--TEMPERATURE AND PRECIPITATION--Continued

Month	Temperature						Precipitation			
				2 years in 10 will have--				2 years in 10 will have--		
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more
	°F	°F	°F	°F	°F	Units	In	In	In	
SNOWFLAKE:										
January----	47.4	16.6	32.0	68	-8	14	0.73	0.23	1.20	2
February---	54.1	20.9	37.5	72	-1	41	0.69	0.23	1.12	2
March------	59.9	25.3	42.6	77	8	120	0.82	0.33	1.40	3
April------	68.6	31.3	49.9	84	15	285	0.55	0.16	0.98	2
May--------	77.0	37.9	57.5	91	23	487	0.53	0.17	1.13	1
June-------	87.4	46.1	66.7	99	29	743	0.47	0.16	0.96	1
July-------	89.9	55.3	72.6	100	41	937	2.15	0.91	3.19	5
August-----	87.3	54.3	70.8	97	41	906	2.59	1.38	3.65	6
September--	82.3	45.7	64.0	93	30	655	1.41	0.36	2.34	3
October----	72.2	34.2	53.2	87	18	384	1.04	0.30	1.91	2
November---	59.2	23.4	41.3	78	4	101	0.69	0.25	1.36	1
December---	49.0	17.5	33.3	68	-6	20	0.80	0.27	1.38	2
Yearly:										
Average---	69.5	34.0	51.8	---	---	---	---	---	---	---
Extreme---	104.0	-30.0	---	101	-13	---	---	---	---	---
Total-----	---	---	---	---	---	4,694	12.48	8.13	15.24	30

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1901-93 at Winslow and Snowflake, Arizona, and 1903-93 at Holbrook, Arizona)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
WINSLOW*:			
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 21	May 5	May 22
2 years in 10 later than--	Apr. 13	Apr. 29	May 15
5 years in 10 later than--	Mar. 30	Apr. 17	May 2
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 22	Oct. 13	Oct. 3
2 years in 10 earlier than--	Oct. 27	Oct. 18	Oct. 8
5 years in 10 earlier than--	Nov. 5	Oct. 26	Oct. 19
HOLBROOK**:			
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 29	May 13	May 28
2 years in 10 later than--	Apr. 21	May 6	May 21
5 years in 10 later than--	Apr. 7	Apr. 22	May 6
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 15	Oct. 8	Sept. 26
2 years in 10 earlier than--	Oct. 21	Oct. 13	Oct. 2
5 years in 10 earlier than--	Nov. 1	Oct. 25	Oct. 13

TABLE 2.--FREEZE DATES IN SPRING AND FALL--Continued

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
SNOWFLAKE***:			
Last freezing temperature in spring:			
1 year in 10 later than--	May 14	May 29	Jun. 12
2 years in 10 later than--	May 6	May 22	Jun. 5
5 years in 10 later than--	Apr. 22	May 9	May 23
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 9	Sept. 28	Sept. 16
2 years in 10 earlier than--	Oct. 14	Oct. 3	Sept. 22
5 years in 10 earlier than--	Oct. 24	Oct. 14	Oct. 3

* The period 1901-93 has 5 days in spring and 6 days in fall of missing data.

** The period 1903-93 has 16 days in spring and 11 days in fall of missing data.

*** The period 1901-93 has 12 days in spring and 10 days in fall of missing data.

TABLE 3.--GROWING SEASON

(Absence of an entry indicates that data were not available or were not estimated)

Probability	Daily minimum temperature		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
Recorded in the period 1901-93 at Winslow*			
9 years in 10	182	164	143
8 years in 10	191	172	152
5 years in 10	209	187	169
2 years in 10	226	203	186
1 year in 10	235	211	195
Recorded in the period 1903-93 at Holbrook**			
9 years in 10	169	150	130
8 years in 10	178	159	139
5 years in 10	194	177	158
2 years in 10	211	196	177
1 year in 10			
Recorded in the period 1901-93 at Snowflake***			
9 years in 10	146	123	100
8 years in 10	155	133	110
5 years in 10	171	150	129
2 years in 10	188	168	149
1 year in 10	196	178	159

* Six years during the period 1901-93 have 25 days or more of missing data.

** Twenty-one years during the period 1903-93 have 25 days or more of missing data.

*** Seventeen years during the period 1901-93 have 25 days or more of missing data.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Arntz fine sandy loam, 1 to 8 percent slopes	36,645	2.4
2	Atarque fine sandy loam, 1 to 12 pernent slopes	1,345	0.1
3	Badland-Torriorthents association, 1 to 30 percent slopes	66,000	4.4
4	Bagley clay loam, 0 to 3 percent slopes	640	*
5	Barx fine sandy loam, 0 to 3 percent slopes	2,375	0.2
6	Barx fine sandy loam, 3 to 10 percent slopes	28,605	1.9
7	Bosoodi fine sandy loam, 1 to 8 percent slopes	20,460	1.4
8	Burnswick-Marcou complex, 1 to 5 percent slopes	36,430	2.4
9	Burnswick sandy clay loam, 1 to 5 percent slopes	61,525	4.1
10	Calciorthids-Torriorthents-Rock outcrop complex, 15 to 80 percent slopes	3,425	0.2
11	Cerrillos sandy loam, 1 to 10 percent slopes	13,350	0.9
12	Cerrillos-Ubank complex, 1 to 8 percent slopes	39,365	2.6
13	Clayspringss clay, 1 to 10 percent slopes	38,985	2.6
14	Deama family very gravelly loam, 1 to 8 percent slopes	3,750	0.3
15	Deama-Rock outcrop complex, 1 to 20 percent slopes	18,400	1.2
16	Dune land	460	*
17	Epikom channery sandy loam, 1 to 12 percent slopes	135,315	9.0
18	Epikom-Rock outcrop complex, 1 to 20 percent slopes	37,290	2.5
19	Escavada family sandy loam, 0 to 3 percent slopes	390	*
20	Grieta sandy loam, 1 to 3 percent slopes	6,925	0.5
21	Grieta sandy loam, 3 to 10 percent slopes	61,740	4.1
22	Gypsiorthids-Torriorthents association, 5 to 60 percent slopes	15,205	1.0
23	Ives fine sandy loam, wet, 0 to 1 percent slopes	2,900	0.2
24	Ives sandy loam, saline-sodic, 1 to 3 percent slopes	4,195	0.3
25	Ives very fine sandy loam, saline-sodic, 0 to 1 percent slopes	5,950	0.4
26	Jocity sandy clay loam, 1 to 3 percent slopes	550	*
27	Jocity sandy clay loam, saline-sodic, 0 to 1 percent slopes	1,980	0.1
28	Jocity sandy clay loam, saline-sodic, 1 to 3 percent slopes	18,515	1.2
29	Jocity silty clay, saline-sodic, 0 to 1 percent slopes	390	*
30	Kech fine sandy loam, 1 to 12 percent slopes	43,100	2.9
31	Kech-Rock outcrop complex, 1 to 20 percent slopes	45,130	3.0
32	Kinan loamy sand, 1 to 5 percent slopes	17,075	1.1
33	Leanto-Bisoodi complex, 1 to 12 percent slopes	89,870	6.0
34	Leanto-Bisoodi-Rock outcrop complex, 1 to 20 percent slopes	19,840	1.3
35	Lozinta extremely cindery loam, 20 to 60 percent slopes	360	*
36	Manzano sandy clay loam, 0 to 3 percent slopes	1,550	0.1
37	Marcou loamy sand, 1 to 8 percent slopes	23,170	1.5
38	Medisaprists, saline, 0 to 1 percent slopes	345	*
39	Mellenthin-Rock outcrop complex, 1 to 20 percent slopes	128,890	8.6
40	Navajo silty clay, saline-sodic, 0 to 1 percent slopes	7,330	0.5
41	Navajo silty clay, saline-sodic, 1 to 3 percent slopes	12,000	0.8
42	Navajo silty clay, wet, 0 to 1 percent slopes	1,070	0.1
43	Nuffel silt loam, 0 to 3 percent slopes	19,690	1.3
44	Padilla-Cerrillos complex, 1 to 10 percent slopes	18,205	1.2
45	Pensom-Chedeski complex, 1 to 5 percent slopes	33,395	2.2
46	Penzance-Grieta complex, 0 to 5 percent slopes	12,690	0.8
47	Poley fine sandy loam, 1 to 5 percent slopes	7,985	0.5
48	Purgatory fine sandy loam, 1 to 8 percent slopes	62,085	4.1
49	Radnik silt loam, 0 to 3 percent slopes	1,105	0.1
50	Riverwash-Typic Torrifluvents complex, 0 to 5 percent slopes	17,200	1.1
51	Riverwash-Ustic Torrifluvents complex, 0 to 5 percent slopes	820	0.1
52	Rock outcrop-Arches complex, 2 to 30 percent slopes	24,150	1.6
53	Rock outcrop-Deama complex, 20 to 60 percent slopes	4,690	0.3
54	Rock outcrop-Epikom complex, 20 to 60 percent slopes	10,680	0.7
55	Rock outcrop-Kech complex, 20 to 60 percent slopes	12,215	0.8
56	Rock outcrop-Leanto complex, 20 to 60 percent slopes	2,455	0.2
57	Rock outcrop-Mellenthin complex, 20 to 60 percent slopes	9,470	0.6
58	Rock outcrop-Needle complex, 1 to 10 percent slopes	29,495	2.0
59	Shalet silty clay loam, 0 to 3 percent slopes	3,170	0.2
60	Sheppard-Grieta complex, 1 to 12 percent slopes	46,825	3.1
61	Sheppard loamy sand, 1 to 12 percent slopes	11,150	0.7
62	Sheza gravelly sandy loam, 2 to 20 percent slopes	12,220	0.8
63	Springerville clay, 0 to 3 percent slopes	1,210	0.1

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
64	Springerville family silty clay, 1 to 8 percent slopes	1,275	0.1
65	Thunderbird cobbly silty clay loam, 1 to 12 percent slopes	41,425	2.8
66	Torriorthents-Typic Calciorthids association, 20 to 60 percent slopes	17,895	1.2
67	Tours clay loam, 1 to 3 percent slopes	5,890	0.4
68	Tours silty clay loam, saline-sodic, 0 to 1 percent slopes	8,525	0.6
69	Tours silty clay loam, saline-sodic, 1 to 3 percent slopes	10,435	0.7
70	Trail loamy sand, 0 to 3 percent slopes	9,225	0.6
71	Ustollic Haplargids association, 1 to 30 percent slopes	12,800	0.9
72	Water	3,240	0.2
73	Miscellaneous water	210	*
74	Borrow pits	200	*
75	Dam	40	*
	Total	1,504,900	100.0

* Less than 0.1 percent.

TABLE 5.--RANGELAND PRODUCTIVITY

(Only the soils that support rangeland vegetation that is suitable for grazing are listed)

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
1 Arntz	Gypsum Upland, 9-13" p.z.	750	550	300
3*: Badland.				
Torriorthents	Shale Upland, 5-9" p.z.	400	300	200
4 Bagley	Clayey Bottom, 9-13" p.z.	1,300	900	700
5, 6 Barx	Loamy Upland, 9-13" p.z.	900	600	400
7 Bisoodi	Shallow Loamy, 9-13" p.z.	700	500	300
8*: Burnswick	Clay Loam Terrace, (sodic), 5-9" p.z.	800	500	350
Marcou	Sandy Upland, (sodic), 5-9" p.z.	700	500	350
10*: Calciorthids	Breaks, 5-9" p.z.	500	350	150
Torriorthents	Breaks, 5-9" p.z.	500	300	100
11 Cerrillos	Sandy Loam Upland, 9-13" p.z.	1,150	800	350
12*: Cerrillos	Sandy Loam Upland, 9-13" p.z.	1,150	800	350
Ubank	Loamy Upland, 9-13" p.z.	750	600	400
13 Claysprings	Shale Upland, 5-9" p.z.	600	475	350
17 Epikom	Sandstone Upland, 5-9" p.z.	650	500	300
18*: Epikom	Sandstone Upland, 5-9" p.z.	650	500	300
Rock outcrop.				
19* Escavada family	Loamy Upland, 9-13" p.z.	700	500	300
20, 21 Grieta	Sandy Loam Upland, 5-9" p.z.	700	500	350
22*: Gypsiorthids	Breaks, 5-9" p.z.	450	300	100
Torriorthents	Breaks, 5-9" p.z.	500	350	200

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
23---------- Ives	Saline Subirrigated, 5-9" p.z.----------	2,700	2,000	1,500
24, 25---------- Ives	Saline Bottom, 5-9" p.z.----------	1,000	850	600
26---------- Jocity	Loamy Bottom, 5-9" p.z.----------	2,000	1,500	1,000
27, 28---------- Jocity	Saline Bottom, 5-9" p.z.----------	1,600	1,100	700
29---------- Jocity	Saline Bottom, 5-9" p.z.----------	2,000	1,500	1,000
30---------- Kech	Sandstone Upland, 9-13" p.z.----------	700	500	300
31*:				
Kech----------	Sandstone Upland, 9-13" p.z.----------	700	500	300
Rock outcrop.				
32---------- Kinan	Sandy Upland, 5-9" p.z.----------	700	500	300
33*:				
Leanto----------	Sandstone Upland, 9-13" p.z.----------	700	500	300
Bisoodi----------	Shallow Loamy, 9-13" p.z.----------	700	500	300
34*:				
Leanto----------	Sandstone Upland, 9-13" p.z.----------	700	500	300
Bisoodi----------	Shallow Loamy, 9-13" p.z.----------	700	500	300
Rock outcrop.				
36---------- Manzano	Loamy Bottom, 9-13" p.z.----------	2,000	1,750	1,200
37---------- Marcou	Sandy Upland (sodic), 5-9" p.z.--------	700	500	350
38---------- Medisaprists	Saline Subirrigated, 5-9" p.z.----------	3,500	2,500	1,500
39*:				
Mellenthin----------	Shallow Loamy, 9-13" p.z.----------	800	650	500
Rock outcrop.				
40, 41---------- Navajo	Saline Bottom, 5-9" p.z.----------	1,300	900	600
42---------- Navajo	Saline Subirrigated, 5-9" p.z.----------	1,900	1,500	1,200
43---------- Nuffel	Loamy Bottom, 9-13" p.z.----------	4,000	3,000	2,000

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
44*:				
Padilla	Clay Loam Upland, 9-13" p.z.	1,000	650	300
Cerrillos	Sandy Loam Upland, 9-13" p.z.	1,150	800	350
45*:				
Pensom	Sandy Upland, 9-13" p.z.	700	525	350
Chedeski	Sandstone Upland, 9-13" p.z.	600	450	250
46*:				
Penzance	Clay Loam Upland, 5-9" p.z.	800	500	250
Grieta	Sandy Loam Upland, 5-9" p.z.	700	500	350
47---- Poley	Loamy Upland, 9-13" p.z.	1,000	800	600
48---- Purgatory	Gypsum Upland, 5-9" p.z.	600	400	200
49---- Radnik	Loamy Bottom, 9-13" p.z.	4,000	3,000	2,000
50*: Riverwash.				
Typic Torrifluvents	Loamy Bottom, 5-9" p.z.	2,000	1,600	1,100
51*: Riverwash.				
Ustic Torrifluvents	Loamy Bottom, 9-13" p.z.	2,200	1,700	1,100
52*: Rock outcrop.				
Arches	Sandstone Upland, 9-13" p.z.	600	450	300
54*: Rock outcrop.				
Epikom	Sandstone Upland, 5-9" p.z.	650	500	300
55*: Rock outcrop.				
Kech	Sandstone Upland, 9-13" p.z.	700	500	300
56*: Rock outcrop.				
Leanto	Sandstone Upland, 9-13" p.z.	700	500	300
57*: Rock outcrop.				
Mellenthin	Shallow Loamy, 9-13" p.z.	800	650	500

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		Lb/acre	Lb/acre	Lb/acre
58*: Rock outcrop.				
Needle	Sandstone Upland, 5-9" p.z.	450	350	250
59---------- Shalet	Shale Upland, 5-9" p.z.	400	300	200
60*:				
Sheppard	Sandy Upland, 5-9" p.z.	700	500	300
Grieta	Sandy Loam Upland, 5-9" p.z.	700	500	350
61---------- Sheppard	Sandy Upland, 5-9" p.z.	700	500	300
62---------- Sheza	Loamy Bottom, 9-13" p.z.	800	650	500
63---------- Springerville	Clayey Upland, 9-13" p.z.	1,000	650	350
64*---------- Springerville family	Clay Upland, 14-18" p.z.	1,150	900	850
66*:				
Torriorthents	Breaks, 5-9" p.z.	500	300	100
Calciorthids	Breaks, 5-9" p.z.	500	350	150
67---------- Tours	Clayey Bottom, 5-9" p.z.	3,000	2,500	1,500
68, 69---------- Tours	Saline Bottom, 5-9" p.z.	1,600	1,100	700
70---------- Trail	Sandy Bottom, 5-9" p.z.	1,100	900	800
71*:				
Ustollic Haplargids	Loamy Upland, 9-13" p.z.	800	600	400
Ustollic Haplargids	Loamy Upland, 9-13" p.z.	800	600	400
Ustollic Haplargids	Loamy Upland, 9-13" p.z.	800	600	400

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of --				
	<8	8-15	16-25	26-35	>35
4---- Bagley	Fourwing saltbush	American plum, Nanking cherry.	Common chokecherry, Russian-olive.	---	Austrian pine, blue spruce, golden willow, green ash, Scotch pine, silver maple.
5, 6---- Barx	Fourwing saltbush	American plum,	---	---	Black locust, honeylocust, Austrian pine, eastern redcedar.
7---- Bisoodi	---	Juniper----------	Pinyon----------	---	---
8*:					
Burnswick--------	---	---	Russian-olive-----	---	Cottonwood.
Marcou----------	---	---	Russian-olive-----	---	---
9---- Burnswick	---	---	Russian-olive-----	---	Cottonwood.
11---- Cerrillos	Skunkbush sumac, fourwing saltbush.	Tatarian honeysuckle, big saltbush, lilac, Nanking cherry.	Siberian peashrub, Russian-olive.	Rocky Mountain juniper.	Siberian elm, pinyon, silver maple.
12*:					
Cerrillos--------	Skunkbush sumac, fourwing saltbush.	Tatarian honeysuckle, big saltbush, lilac, Nanking cherry.	Siberian peashrub, Russian-olive.	Rocky Mountain juniper.	Siberian elm, pinyon, silver maple.
Ubank----------	Skunkbush sumac, fourwing saltbush.	Tatarian honeysuckle, big saltbush, lilac, Nanking cherry.	Siberian peashrub, Russian-olive.	Rocky Mountain juniper.	Siberian elm, pinyon, silver maple.
23---- Ives	---	---	Russian-olive	---	---
25---- Ives	---	---	Russian-olive	---	---
26, 27, 28, 29---- Jocity	Fourwing saltbush	American plum, cotoneaster, serviceberry, golden currant.	Common chokecherry, redbud.	---	Arizona cypress, Austrian pine, black locust.
32---- Kinan	Fourwing saltbush	American plum, cotoneaster, golden currant.	Common chokecherry, redbud.	---	Arizona cypress, Austrian pine, black locust.
33*: Leanto.					

See footnote at end of table.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of --				
	<8	8-15	16-25	26-35	>35
33*: Bisoodi	---	Juniper	Pinyon	---	---
34*: Leanto.					
Bisoodi	---	Juniper	Pinyon	---	---
Rock outcrop.					
36--- Manzano	Fourwing saltbush	American plum, lilac, Nanking cherry.	Common chokecherry, Russian-olive, Siberian peashrub.	Rocky Mountain juniper.	Silver maple, Goodding willow, green ash, Siberian elm.
37--- Marcou	---	---	Russian-olive	---	---
40--- Navajo	---	---	Russian-olive	---	---
43--- Nuffel	Fourwing saltbush	American plum, Nanking cherry.	Common chokecherry, Russian-olive.	---	Austrian pine, blue spruce, golden willow, green ash, Scotch pine, silver maple.
44*: Padilla	Fourwing saltbush	American plum, lilac.	---	---	Black locust, honeylocust, Austrian pine, eastern redcedar.
Cerrillos.					
45*: Pensom	Fourwing saltbush	Lilac, serviceberry.	---	---	Austrian pine, pinyon, eastern redcedar, honeylocust, black locust.
Chedeski	Fourwing saltbush	Lilac, serviceberry.	---	---	Arizona cypress, pinyon, Austrian pine, honeylocust, black locust, eastern redcedar.
47--- Poley	Fourwing saltbush	American plum, lilac.	---	---	Black locust, honeylocust, Austrian pine, eastern redcedar.
49--- Radnik	Skunkbush sumac, fourwing saltbush.	Lilac	Eastern redcedar, Russian-olive.	Siberian elm	---

See footnote at end of table.

TABLE 6.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of --				
	<8	8-15	16-25	26-35	>35
62---------- Sheza	Fourwing saltbush	American plum, lilac.	---	---	Black locust, honeylocust, Austrian pine, eastern redcedar.
68---------- Tours	---	---	Russian-olive-----	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1 Arntz	Slight	Slight	Moderate: slope, small stones, depth to rock.	Slight.
2 Atarque	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
3*: Badland	Severe: slope, depth to rock, excess salt.	Severe: slope, excess salt, depth to rock.	Severe: slope, depth to rock, excess salt.	Moderate: slope.
Torriorthents	Severe: depth to rock, excess salt.	Severe: excess salt, depth to rock.	Severe: slope, depth to rock, excess salt.	Slight.
4 Bagley	Severe: flooding.	Slight	Moderate: flooding.	Slight.
5 Barx	Slight	Slight	Slight	Severe: erodes easily.
6 Barx	Slight	Slight	Severe: slope.	Severe: erodes easily.
7 Bisoodi	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
8*: Burnswick	Slight	Slight	Moderate: slope, small stones.	Slight.
Marcou	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
9 Burnswick	Slight	Slight	Moderate: slope, small stones.	Slight.
10*: Calciorthids	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Torriorthents	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
11--- Cerrillos	Slight	Slight	Moderate: slope, small stones.	Slight.
12*: Cerrillos	Slight	Slight	Moderate: slope, small stones.	Slight.
Ubank	Slight	Slight	Moderate: slope, small stones.	Slight.
13--- Claysprings	Severe: depth to rock, excess salt.	Severe: excess salt, depth to rock.	Severe: depth to rock, excess salt.	Moderate: too clayey.
14*--- Deama family	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Slight.
15*: Deama	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones.	Slight.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
16*--- Dune land	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy, slope.
17--- Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
18*: Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
19*--- Escavada family	Severe: flooding.	Slight	Moderate: small stones.	Slight.
20--- Grieta	Slight	Slight	moderate: slope.	Slight.
21--- Grieta	Slight	Slight	Severe: slope.	Slight.
22*: Gypsiorthids	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
22*: Torriorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
23--- Ives	Severe: flooding, ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding.
24--- Ives	Severe: flooding, excess salt.	Severe: excess salt.	Severe: excess salt.	Slight.
25--- Ives	Severe: flooding, excess salt.	Severe: excess salt.	Severe: excess salt.	Moderate: dusty.
26, 27, 28--- Jocity	Severe: flooding, excess salt.	Severe: excess salt.	Severe: excess salt.	Slight.
29--- Jocity	Severe: flooding, excess salt.	Severe: excess salt.	Severe: excess salt.	Moderate: too clayey.
30--- Kech	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
31*: Kech---	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
Rock outcrop---	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
32--- Kinan	Slight---	Slight---	Moderate: slope.	Slight.
33*: Leanto---	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
Bisoodi---	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
34*: Leanto---	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
34*:				
Bisoodi	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
35--- Lozinta	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.
36--- Manzano	Severe: flooding.	Slight	Moderate: flooding.	Slight.
37--- Marcou	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
38--- Medisaprists	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.
39*:				
Mellenthin	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: small stones.
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
40, 41--- Navajo	Severe: flooding, excess salt.	Severe: excess salt.	Severe: excess salt.	Moderate: too clayey.
42--- Navajo	Severe: flooding, ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding, excess salt.	Severe: ponding.
43--- Nuffel	Severe: flooding.	Moderate: dusty.	Moderate: flooding, dusty.	Moderate: dusty.
44*:				
Padilla	Slight	Slight	Moderate: slope, small stones.	Slight.
Cerrillos	Slight	Slight	Moderate: slope, small stones.	Slight.
45*:				
Pensom	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
45*:				
Chedeski	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
46*:				
Penzance	Slight	Slight	Moderate: small stones.	Slight.
Grieta	Slight	Slight	Moderate: slope.	Slight.
47 Poley	Slight	Slight	Moderate: slope.	Slight.
48 Purgatory	Moderate: excess salt.	Moderate: excess salt.	Moderate: slope, excess salt.	Severe: erodes easily.
49 Radnik	Severe: flooding.	Moderate: dusty.	Moderate: flooding, dusty.	Moderate: dusty.
50*:				
Riverwash	Severe: flooding, wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: wetness, flooding, depth to rock.	Severe: wetness.
Typic Torrifluvents	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.
51*:				
Riverwash	Severe: flooding, wetness, depth to rock.	Severe: wetness, depth to rock.	Severe: wetness, flooding, depth to rock.	Severe: wetness.
Ustic Torrifluvents	Severe: flooding, wetness.	Moderate: flooding, wetness.	Severe: wetness, flooding.	Moderate: wetness, flooding.
52*:				
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Arches	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: too sandy, slope.
53*:				
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
53*:				
Deama	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: large stones, slope, small stones.	Severe: slope.
54*:				
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Epikom	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.
55*:				
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Kech	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.
56*:				
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Leanto	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.
57*:				
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Mellenthin	Severe: slope, large stones, depth to rock.	Severe: slope, large stones, depth to rock.	Severe: large stones, slope, small stones.	Severe: slope.
58*:				
Rock outcrop	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
Needle	Severe: too sandy, depth to rock.	Severe: too sandy, depth to rock.	Severe: too sandy, depth to rock.	Severe: too sandy.
59 Shalet	Severe: depth to rock, excess sodium, excess salt.	Severe: excess sodium, excess salt, depth to rock.	Severe: depth to rock, excess sodium, excess salt.	Slight.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
60*:				
Sheppard	Moderate: too sandy.	Moderate: too sandy.	Severe: slope.	Moderate: too sandy.
Grieta	Slight	Slight	Severe: slope.	Slight.
61. Sheppard				
62 Sheza	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight.
63 Springerville	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Severe: too clayey, percs slowly.	Moderate: too clayey.
64* Springerville family	Moderate: percs slowly, too clayey.	Moderate: too clayey, percs slowly.	Moderate: slope, too clayey, percs slowly.	Moderate: too clayey.
65 Thunderbird	Moderate: large stones, small stones.	Moderate: large stones, small stones.	Severe: large stones, slope, small stones.	Slight.
66*:				
Torriorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Calciorthids	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
67 Tours	Severe: flooding.	Slight	Moderate: slope, flooding.	Slight.
68, 69 Tours	Severe: flooding, excess sodium, excess salt.	Severe: excess sodium, excess salt.	Severe: excess sodium, excess salt.	Slight.
70 Trail	Severe: flooding.	Slight	Moderate: flooding.	Slight.
71*:				
Ustollic Haplargids	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Ustollic Haplargids	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Ustollic Haplargids	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1---------- Arntz	Moderate: depth to rock.	Slight---------	Moderate: depth to rock.	Moderate: slope.	Slight---------	Moderate: depth to rock.
2---------- Atarque	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
3*: Badland----------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: excess salt, slope, depth to rock.
Torriorthents----	Severe: depth to rock.		Severe: depth to rock.	Severe: slope.		Severe: excess salt, depth to rock.
4---------- Bagley	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
5---------- Barx	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.	Slight.
6---------- Barx	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Slight.
7---------- Bisoodi	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
8*: Burnswick--------	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: droughty.
Marcou----------	Slight---------	Slight---------	Slight---------	Slight---------	Slight---------	Severe: excess sodium.
9---------- Burnswick	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: droughty.
10*: Calciorthids-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
Torriorthents----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
11---------- Cerrillos	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
12*: Cerrillos--------	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
Ubank----------	Slight---------	Slight---------	Slight---------	Moderate: slope.	Slight---------	Slight.
13---------- Claysprings	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: thin layer, too clayey.
14*---------- Deama family	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, droughty, depth to rock.
15*: Deama----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.
Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
16*---------- Dune land	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
17---------- Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
18*: Epikom----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
19*---------- Escavada family	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
20---------- Grieta	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.	Slight.
21---------- Grieta	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Slight.
22*: Gypsiorthids-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
22*: Torriorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
23---------- Ives	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.	Severe: excess salt, ponding, droughty.
24, 25---------- Ives	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: excess salt, droughty.
26, 27, 28-------- Jocity	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: excess salt, droughty.
29---------- Jocity	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: excess salt, droughty, too clayey.
30---------- Kech	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
31*: Kech----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
32---------- Kinan	Slight---------	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
33 Leanto----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Bisoodi----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
34*: Leanto----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Bisoodi----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: thin layer.
Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
35---------- Lozinta	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: small stones, droughty, slope.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
36---- Manzano	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
37---- Marcou	Slight---	Slight---	Slight---	Moderate: slope.	Slight---	Severe: excess sodium.
38---- Medisaprists	Severe: wetness.	Severe: subsides, flooding, wetness.	Severe: subsides, flooding, wetness.	Severe: subsides, flooding, wetness.	Severe: subsides, wetness, flooding.	Severe: wetness, flooding.
39*: Mellenthin-------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.
Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
40, 41---- Navajo	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: shrink-swell, low strength, flooding.	Severe: excess salt, droughty, too clayey.
42---- Navajo	Severe: ponding.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: flooding, ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: excess salt, ponding, droughty.
43---- Nuffel	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
44*: Padilla----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
Cerrillos--------	Slight---	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Slight.
45*: Pensom----------	Severe: cutbanks cave.	Slight---	Moderate: depth to rock.	Slight---	Slight---	Moderate: droughty.
Chedeski---------	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.
46*: Penzance---------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
Grieta----------	Slight---	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.	Slight.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
47---------- Poley	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Slight.
48---------- Purgatory	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.	Moderate: thin layer.
49---------- Radnik	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
50*: Riverwash--------	Severe: depth to rock, wetness.	Severe: flooding, wetness, depth to rock.	Severe: flooding, wetness, depth to rock.	Severe: flooding, wetness, depth to rock.	Severe: depth to rock, wetness, flooding.	Severe: wetness, flooding, depth to rock.
Typic Torrifluvents---	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.
51*: Riverwash--------	Severe: depth to rock, wetness.	Severe: flooding, wetness, depth to rock.	Severe: flooding, wetness, depth to rock.	Severe: flooding, wetness, depth to rock.	Severe: depth to rock, wetness, flooding.	Severe: wetness, flooding, depth to rock.
Ustic Torrifluvents---	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.
52*: Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Arches----------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
53*: Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Deama----------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
54*: Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Epikom----------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.

See footnote at end of table

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
55*:						
Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Kech----------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe depth to rock, slope.	Severe: slope, depth to rock.
56*:						
Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Leanto----------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
57*:						
Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Mellenthin-------	Severe: depth to rock, large stones, slope.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope, depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: large stones, slope, depth to rock.
58*:						
Rock outcrop-----	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
Needle----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
59---------- Shalet	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: excess salt, excess sodium, depth to rock.
60*:						
Sheppard---------	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
Grieta----------	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Slight.
61---------- Sheppard	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
62---------- Sheza	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, droughty, slope.
63---------- Springerville	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
64*---------- Springerville family	Severe: cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: too clayey.
65---------- Thunderbird	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Moderate: small stones, large stones.
66*:						
Torriorthents----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Calciorthids-----	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
67---------- Tours	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
68, 69---------- Tours	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Severe: excess salt, excess sodium.
70---------- Trail	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: droughty, flooding.
71*:						
Ustollic Haplargids------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ustollic Haplargids------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Ustollic Haplargids------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1---------- Arntz	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: depth to rock.
2---------- Atarque	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
3*:					
Badland----------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, slope.
Torriorthents------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
4---------- Bagley	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
5---------- Barx	Moderate: percs slowly.	Moderate: seepage.	Slight----------	Slight----------	Fair: small stones.
6---------- Barx	Moderate: percs slowly.	Moderate: seepage, slope.	Slight----------	Slight----------	Fair: small stones.
7---------- Bisoodi	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: depth to rock.
8*:					
Burnswick----------	Severe: percs slowly.	Severe: seepage.	Slight----------	Slight----------	Good.
Marcou----------	Moderate: percs slowly.	Severe: seepage.	Slight----------	Slight----------	Fair: thin layer.
9---------- Burnswick	Severe: percs slowly.	Severe: seepage.	Slight----------	Slight----------	Good.
10*:					
Calciorthids-------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
Torriorthents------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
Rock outcrop-------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, slope.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
11---------- Cerrillos	Severe: percs slowly.	Moderate: slope.	Slight----------	Slight----------	Good.
12*: Cerrillos----------	Severe: percs slowly.	Moderate: slope.	Slight----------	Slight----------	Good.
Ubank----------	Severe: percs slowly.	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
13---------- Claysprings	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, hard to pack.
14*---------- Deama family	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
15*: Deama----------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, small stones.
Rock outcrop-------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
16*---------- Dune land	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
17---------- Epikom	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: depth to rock.
18*: Epikom----------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
Rock outcrop-------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
19*---------- Escavada family	Moderate: flooding.	Severe: seepage.	Moderate: flooding, too sandy.	Moderate: flooding.	Fair: too sandy.
20, 21---------- Grieta	Moderate: percs slowly.	Severe: seepage.	Slight----------	Slight----------	Good.
22*: Gypsiorthids-------	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope.
Torriorthents------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
23---------- Ives	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding, excess salt.	Severe: flooding, ponding.	Poor: ponding.
24, 25---------- Ives	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, excess salt.	Severe: flooding.	Good.
26, 27, 28, 29------ Jocity	Severe: flooding, percs slowly.	Severe: seepage, flooding.	Severe: flooding, excess salt.	Severe: flooding.	Good.
30---------- Kech	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: depth to rock.
31*: Kech----------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
Rock outcrop-------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
32---------- Kinan	Severe: percs slowly.	Severe: seepage.	Slight----------	Slight----------	Good.
33*: Leanto----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: depth to rock.
Bisoodi----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: depth to rock.
34*: Leanto----------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
Bisoodi----------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
Rock outcrop-------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
35---------- Lozinta	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
36---------- Manzano	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
37---------- Marcou	Moderate: percs slowly.	Severe: seepage.	Slight----------	Slight----------	Fair: thin layer.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
38--Medisaprists	Severe: subsides, flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
39*:					
Mellenthin	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock, small stones.
Rock outcrop	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
40, 41--Navajo	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, excess salt.	Severe: flooding.	Poor: hard to pack.
42--Navajo	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, excess salt.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
43--Nuffel	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
44*:					
Padilla	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Poor: hard to pack.
Cerrillos	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Good.
45*:					
Pensom	Severe: poor filter.	Severe: seepage.	Severe: depth to rock.	Slight	Poor: thin layer.
Chedeski	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: depth to rock.
46*:					
Penzance	Severe: percs slowly.	Slight	Slight	Slight	Poor: hard to pack.
Grieta	Moderate: percs slowly.	Severe: seepage.	Slight	Slight	Good.
47--Poley	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Poor: hard to pack.
48--Purgatory	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: depth to rock.
49--Radnik	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too sandy.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
50*:					
Riverwash	Severe: flooding, depth to rock, wetness.	Severe: depth to rock, flooding, wetness.	Severe: flooding, depth to rock, wetness.	Severe: flooding, depth to rock, wetness.	Poor: depth to rock, wetness.
Typic Torrifluvents	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, depth to rock, wetness.	Severe: flooding, wetness.	Poor: wetness.
51*:					
Riverwash	Severe: flooding, depth to rock, wetness.	Severe: depth to rock, flooding, wetness.	Severe: flooding, depth to rock, wetness.	Severe: flooding, depth to rock, wetness.	Poor: depth to rock, wetness.
Ustic Torrifluvents	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, depth to rock, wetness.	Severe: flooding, wetness.	Poor: wetness.
52*:					
Rock outcrop	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, slope.
Arches	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope, too sandy.	Severe: slope.	Poor: depth to rock, too sandy, slope.
53*:					
Rock outcrop	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, slope.
Deama	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: depth to rock, small stones, slope.
54*:					
Rock outcrop	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, slope.
Epikom	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
55*:					
Rock outcrop	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, slope.
Kech	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
56*:					
Rock outcrop	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, slope.
Leanto	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
57*:					
Rock outcrop	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, slope.
Mellenthin	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: slope.	Poor: depth to rock, large stones, slope.
58*:					
Rock outcrop	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock.
Needle	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too sandy.	Slight	Poor: depth to rock, too sandy.
59--- Shalet	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: depth to rock.
60*:					
Sheppard	Severe: poor filter.	Severe: seepage.	Moderate: too sandy.	Slight	Fair: too sandy.
Grieta	Moderate: percs slowly.	Severe: seepage.	Slight	Slight	Good.
61--- Sheppard	Severe: poor filter.	Severe: seepage.	Moderate: too sandy.	Slight	Fair: too sandy.
62--- Sheza	Severe: poor filter.	Severe: seepage, slope.	Moderate: slope.	Moderate: slope.	Poor: seepage, small stones.
63--- Springerville	Severe: percs slowly.	Slight	Slight	Slight	Poor: hard to pack.
64--- Springerville family	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Poor: hard to pack.
65--- Thunderbird	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: depth to rock, hard to pack, small stones.
66*:					
Torriorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 9.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
66*: Calciorthids	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
67--- Tours	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, depth to rock.	Severe: flooding.	Good.
68, 69--- Tours	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, excess salt.	Severe: flooding.	Good.
70--- Trail	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, too sandy.	Severe: flooding.	Poor: seepage, too sandy.
71*: Ustollic Haplargids	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope.
Ustollic Haplargids	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope.
Ustollic Haplargids	Severe: slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--CONSTRUCTION MATERIALS

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1---------- Arntz	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, small stones.
2---------- Atarque	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
3*:				
Badland----------	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Torriorthents---------	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
4---------- Bagley	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
5, 6---------- Barx	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
7---------- Bisoodi	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
8*:				
Burnswick----------	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, excess salt.
Marcou----------	Good----------	Probable----------	Improbable: too sandy.	Poor: excess sodium.
9---------- Burnswick	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, excess salt.
10*:				
Calciorthids----------	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Torriorthents---------	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.
Rock outcrop----------	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
11---------- Cerrillos	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
12*:				
Cerrillos----------	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
12*:				
Ubank	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
13 Claysprings	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey.
14*: Deama family	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
15*:				
Deama	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Rock outcrop	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
16*: Dune land	Poor: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
17 Epikom	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
18*:				
Epikom	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Rock outcrop	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
19* Escavada family	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones.
20, 21 Grieta	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
22*:				
Gypsiorthids	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Torriorthents	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
23 Ives	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
24, 25---------- Ives	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
26, 27, 28, 29--------- Jocity	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
30---------- Kech	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
31*: Kech----------	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Rock outcrop----------	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
32---------- Kinan	Good----------	Improbable: excess fines.	Improbable: excess fines.	Good.
33*: Leanto----------	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Bisoodi----------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
34*: Leanto----------	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Bisoodi----------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Rock outcrop----------	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
35---------- Lozinta	Poor: slope.	Improbable: small stones.	Probable----------	Poor: small stones, area reclaim, slope.
36---------- Manzano	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
37---------- Marcou	Good----------	Probable----------	Improbable: too sandy.	Fair: excess salt.
38---------- Medisaprists	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
39*:				
Mellenthin	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Rock outcrop	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
40, 41 Navajo	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt.
42 Navajo	Poor: shrink-swell, low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, excess salt, wetness.
43 Nuffel	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
44*:				
Padilla	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Cerrillos	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
45*:				
Pensom	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
Chedeski	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
46*:				
Penzance	Poor: shrink-swell, low strength.	Improbable: excess fines	Improbable: excess fines.	Poor: too clayey.
Grieta	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
47 Poley	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
48 Purgatory	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
49 Radnik	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
50*:				
Riverwash	Poor: depth to rock, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, wetness.
Typic Torrifluvents	Fair: depth to rock, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
51*:				
Riverwash	Poor: depth to rock, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, wetness.
Ustic Torrifluvents	Fair: depth to rock, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
52*:				
Rock outcrop	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
Arches	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too sandy, slope.
53*:				
Rock outcrop	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
Deama	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
54*:				
Rock outcrop	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
Epikom	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
55*:				
Rock outcrop	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
Kech	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
56*:				
Rock outcrop	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
Leanto	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
57*:				
Rock outcrop	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
Mellenthin	Poor: depth to rock, large stones, slope.	Improbable: excess fines, large stones.	Improbable: excess fines, large stones.	Poor: depth to rock, large stones, slope.
58*:				
Rock outcrop	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, area reclaim, slope.
Needle	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too sandy.
59--- Shalet	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, excess salt, excess sodium.
60*:				
Sheppard	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
Grieta	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
61--- Sheppard	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
62--- Sheza	Good	Probable	Probable	Poor: small stones, area reclaim.
63--- Springerville	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
64*--- Springerville family	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 10.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
65---------- Thunderbird	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones.
66*:				
Torriorthents---------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Calciorthids----------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
67---------- Tours	Good----------	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
68, 69---------- Tours	Good----------	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, excess sodium.
70---------- Trail	Good----------	Probable----------	Improbable: too sandy.	Poor: too sandy.
71*:				
Ustollic Haplargids---	Fair: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Ustollic Haplargids---	Fair: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Ustollic Haplargids---	Fair: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
1---------- Arntz	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing, depth to rock.	Depth to rock, soil blowing.
2---------- Atarque	Severe: depth to rock.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing, depth to rock.	Depth to rock, soil blowing.
3*: Badland----------	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, depth to rock, excess salt.	Slope, depth to rock.
Torriorthents----	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, depth to rock, excess salt.	Slope, depth to rock.
4---------- Bagley	Moderate: seepage.	Moderate: thin layer.	Severe: no water.	Deep to water	Flooding-------	Erodes easily.
5---------- Barx	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Soil blowing---	Erodes easily.
6---------- Barx	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Erodes easily.
7---------- Bisoodi	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Deep to water	Depth to rock	Depth to rock, soil blowing.
8*: Burnswick--------	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, excess salt.	Favorable.
Marcou----------	Severe: seepage.	Severe: piping, excess sodium.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	
9---------- Burnswick	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, excess salt.	Favorable.
10*: Calciorthids-----	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, depth to rock.	Slope, depth to rock.
Torriorthents----	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, depth to rock.	Slope, depth to rock.
Rock outcrop-----	Severe: depth to rock, slope.	Slight---------	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
11---------- Cerrillos	Moderate: slope.	Slight---------	Severe: no water.	Deep to water	Slope, soil blowing.	Soil blowing.
12*: Cerrillos--------	Moderate: slope.	Slight---------	Severe: no water.	Deep to water	Slope, soil blowing.	Soil blowing.
Ubank----------	Moderate: seepage, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing.	Soil blowing.
13---------- Claysprings	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Deep to water	Slow intake, percs slowly, depth to rock.	Depth to rock, percs slowly.
14*---------- Deama family	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, droughty, depth to rock.	Depth to rock.
15*: Deama----------	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, droughty, depth to rock.	Slope, depth to rock.
Rock outcrop-----	Severe: depth to rock, slope.	Slight---------	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.
16---------- Dune land	Severe: seepage, slope.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.
17---------- Epikom	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, soil blowing, depth to rock.	Depth to rock, soil blowing.
18*: Epikom----------	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, soil blowing, depth to rock.	Slope, depth to rock, soil blowing.
Rock outcrop-----	Severe: depth to rock, slope.	Slight---------	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.
19*---------- Escavada family	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Soil blowing---	Too sandy, soil blowing.
20---------- Grieta	Severe: seepage.	Moderate: thin layer.	Severe: no water.	Deep to water	Soil blowing---	Soil blowing.
21---------- Grieta	Severe: seepage.	Moderate: thin layer.	Severe: no water.	Deep to water	Slope, soil blowing.	Soil blowing.
22*: Gypsiorthids-----	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
22*:						
Torriorthents	Severe: slope.	Slight	Severe: no water.	Deep to water	Slope	Slope.
23---- Ives	Moderate: seepage.	Severe: piping, ponding, excess salt.	Severe: salty water.	Ponding, flooding.	Ponding, droughty.	Ponding, soil blowing.
24---- Ives	Severe: seepage.	Severe: piping, excess salt.	Severe: no water.	Deep to water	Droughty, soil blowing.	Soil blowing.
25---- Ives	Severe: seepage.	Severe: piping, excess salt.	Severe: no water.	Deep to water	Droughty, soil blowing, erodes easily.	Erodes easily, soil blowing.
26, 27, 28---- Jocity	Severe: seepage.	Severe: excess salt.	Severe: no water.	Deep to water	Droughty	Favorable.
29---- Jocity	Severe: seepage.	Severe: excess salt.	Severe: no water.	Deep to water	Droughty, slow intake.	Favorable.
30---- Kech	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, soil blowing, depth to rock.	Depth to rock, soil blowing.
31*:						
Kech	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.
Rock outcrop	Severe: depth to rock. slope.	Slight	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.
32---- Kinan	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, fast intake, soil blowing.	Soil blowing.
33*:						
Leanto	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Depth to rock, soil blowing.
Bisoodi	Severe: depth to rock.	Severe: thin layer.	Severe: no water.	Deep to water		Depth to rock, soil blowing.
34*:						
Leanto	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, droughty.	Slope, depth to rock, soil blowing.
Bisoodi	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water		Slope, depth to rock, soil blowing.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
34*:						
Rock outcrop-----	Severe: depth to rock, slope.	Slight---------	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.
35---------- Lozinta	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope,
36---------- Manzano	Slight---------	Slight---------	Severe: no water.	Deep to water	Flooding-------	Favorable.
37---------- Marcou	Severe: seepage.	Severe: piping, excess sodium.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	
38---------- Medisaprists	Slight---------	Severe: wetness.	Slight---------	Flooding, subsides.	Wetness, flooding.	Wetness.
39*:						
Mellenthin-------	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, droughty, depth to rock.	Slope, depth to rock.
Rock outcrop-----	Severe: depth to rock, slope.	Slight---------	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.
40, 41---------- Navajo	Slight---------	Severe: excess salt.	Severe: no water.	Deep to water	Droughty, slow intake, percs slowly.	Percs slowly.
42---------- Navajo	Slight---------	Severe: ponding, excess salt.	Severe: slow refill, salty water.	Ponding, percs slowly, flooding.	Ponding, droughty, slow intake.	Ponding, percs slowly.
43---------- Nuffel	Slight---------	Severe: piping.	Severe: no water.	Deep to water	Erodes easily, flooding.	Erodes easily.
44*:						
Padilla----------	Moderate: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, percs slowly.	Percs slowly.
Cerrillos--------	Moderate: slope.	Slight---------	Severe: no water.	Deep to water	Slope, soil blowing.	Soil blowing.
45*:						
Pensom----------	Severe: seepage.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.
Chedeski---------	Severe: depth to rock.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing, depth to rock.	Depth to rock, soil blowing.
46*:						
Penzance---------	Slight---------	Moderate: hard to pack.	Severe: no water.	Deep to water	Percs slowly, excess salt.	Percs slowly.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
46*:						
Grieta	Severe: seepage.	Moderate: thin layer.	Severe: no water.	Deep to water	Slope, soil blowing.	Soil blowing.
47--- Poley	Moderate: slope.	Moderate: hard to pack.	Severe: no water.	Deep to water	Slope, soil blowing, percs slowly.	Soil blowing, percs slowly.
48--- Purgatory	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, soil blowing, depth to rock.	Depth to rock, erodes easily, soil blowing.
49--- Radnik	Moderate: seepage.	Severe: piping.	Severe: no water.	Deep to water	Erodes easily, flooding.	Erodes easily.
50*:						
Riverwash	Severe: depth to rock.	Severe: thin layer, wetness.	Severe: depth to rock.	Depth to rock, flooding.	Wetness, depth to rock, flooding.	Depth to rock, wetness.
Typic Torriorthents	Moderate: depth to rock.	Severe: wetness.	Moderate: depth to rock.	Flooding	Wetness, flooding.	Wetness.
51*:						
Riverwash	Severe: depth to rock.	Severe: thin layer, wetness.	Severe: depth to rock.	Depth to rock, flooding.	Wetness, depth to rock, flooding.	Depth to rock, wetness.
Ustic Torrifluvents	Moderate: depth to rock.	Severe: wetness.	Moderate: depth to rock.	Flooding	Wetness, flooding.	Wetness.
52*:						
Rock outcrop	Severe: depth to rock, slope.	Slight	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.
Arches	Severe: depth to rock, slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Slope, depth to rock, too sandy.
53*:						
Rock outcrop	Severe: depth to rock, slope.	Slight	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.
Deama	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, droughty, depth to rock.	Slope, depth to rock.
54*:						
Rock outcrop	Severe: depth to rock, slope.	Slight	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.
Epikom	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, soil blowing, depth to rock.	Slope, depth to rock, soil blowing.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
55*:						
Rock outcrop-----	Severe: depth to rock, slope.	Slight---------	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.
Kech----------	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, soil blowing, depth to rock.	Slope, depth to rock, soil blowing.
56*:						
Rock outcrop-----	Severe: depth to rock, slope.	Slight---------	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.
Leanto----------	Severe: depth to rock, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, droughty.	Slope, depth to rock, soil blowing.
57*:						
Rock outcrop-----	Severe: depth to rock, slope.	Slight---------	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.
Mellenthin-------	Severe: depth to rock, slope.	Severe: large stones.	Severe: no water.	Deep to water	Slope, large stones, droughty.	Slope, large stones, depth to rock.
58*:						
Rock outcrop-----	Severe: depth to rock, slope.	Slight---------	Severe: no water.	Deep to water	Slope, depth to rock, rooting depth.	Slope, depth to rock.
Needle----------	Severe: depth to rock.	Severe: piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Depth to rock, too sandy.
59---------- Shalet	Severe: depth to rock.	Severe: excess sodium.	Severe: no water.	Deep to water	Droughty, depth to rock, excess sodium.	Depth to rock.
60*:						
Sheppard---------	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.
Grieta----------	Severe: seepage.	Moderate: thin layer.	Severe: no water.	Deep to water	Slope, soil blowing.	Soil blowing.
61---------- Sheppard	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Slope, droughty, fast intake.	Too sandy, soil blowing.
62---------- Sheza	Severe: seepage, slope.	Severe: seepage.	Severe: no water.	Deep to water	Slope, droughty.	Slope.
63---------- Springerville	Slight---------	Severe: hard to pack.	Severe: no water.	Deep to water	Slow intake, percs slowly.	Percs slowly.

See footnote at end of table.

TABLE 11.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--			Features affecting--		
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions
64*---------- Springerville family	Moderate: slope.	Severe: hard to pack.	Severe: no water.	Deep to water	Slope, slow intake, percs slowly.	Erodes easily, percs slowly.
65---------- Thunderbird	Moderate: depth to rock, slope.	Severe: hard to pack.	Severe: no water.	Deep to water	Slope, percs slowly, depth to rock.	Large stones, depth to rock.
66*:						
Torriorthents----	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope.
Calciorthids-----	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope.
67---------- Tours	Slight---------	Moderate: thin layer, piping.	Severe: no water.	Deep to water	Flooding-------	Erodes easily.
68, 69---------- Tours	Moderate: seepage.	Severe: excess sodium, excess salt.	Severe: no water.	Deep to water	Droughty, erodes easily, flooding.	Erodes easily.
70---------- Trail	Severe: seepage.	Severe: seepage, piping.	Severe: no water.	Deep to water	Droughty, fast intake.	Too sandy.
71*:						
Ustollic Haplargids------	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope.
Ustollic Haplargids------	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope.
Ustollic Haplargids------	Severe: slope.	Slight---------	Severe: no water.	Deep to water	Slope----------	Slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
1---------- Arntz	0-6	Fine sandy loam.	SM, SC-SM	A-4	0	0	90-100	85-95	60-80	35-45	15-25	NP-5
	6-12	Clay loam-----	CL	A-6	0	0	90-100	85-95	75-95	60-75	30-40	10-20
	12-32	Loam----------	CL-ML, CL, SC-SM, SC	A-4	0	0	90-100	85-95	70-85	50-65	20-30	5-10
	32-42	Clay loam-----	CL	A-4, A-6	0	0	90-100	85-95	75-95	60-75	30-40	10-20
	42-60	Weathered bedrock, gypsiferous material.	---	---	---	---	---	---	---	---	---	---
2---------- Atarque	0-1	Fine sandy loam.	SM, SC-SM	A-2, A-4	0	0	85-95	85-95	60-80	30-45	15-25	NP-5
	1-6	Loam----------	ML, CL-ML, SM, SC-SM	A-4	0	0	85-95	85-95	70-90	45-65	20-30	NP-10
	6-14	Loam----------	CL, CL-ML, SC, SC-SM	A-4	0	0	85-95	85-95	70-90	45-65	25-30	5-10
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
3*:												
Badland------	0-1	Variable------	---	---	---	---	---	---	---	---	---	---
	1-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
Torriorthents	0-10	Variable------	---	---	---	---	---	---	---	---	---	---
	10-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
4---------- Bagley	0-9	Clay loam-----	ML, CL	A-6, A-7	0	0	100	100	90-100	70-80	35-45	10-20
	9-39	Clay loam-----	CL	A-7	0	0	100	100	90-100	70-80	40-45	15-20
	39-60	Loam----------	CL-ML, ML, CL	A-4	0	0	100	100	85-95	60-75	25-35	5-10
5---------- Barx	0-10	Fine sandy loam.	SM, SC-SM, CL-ML, ML	A-4	0	0	100	100	70-95	40-65	20-30	0-10
	10-18	Fine sandy loam, clay loam, loam.	SC-SM, SC, CL-ML, CL	A-4, A-6	0	0	100	100	70-100	45-75	20-35	5-15
	18-28	Sandy clay loam, loam, clay loam.	SC-SM, SC, CL, CL-ML	A-4, A-6	0	0-10	80-100	75-100	60-100	35-75	20-40	5-20
	28-60	Sandy loam, sandy clay loam, loam.	SC-SM, CL, CL-ML, SC	A-4, A-6	0	0-10	80-100	75-100	45-95	30-70	20-35	5-15
6---------- Barx	0-3	Fine sandy loam.	SM, SC-SM, CL-ML, ML	A-4	0	0	100	100	70-95	40-65	20-30	0-10
	3-18	Fine sandy loam, clay loam, loam.	SC-SM, SC, CL-ML, CL	A-4, A-6	0	0	100	100	70-100	45-75	20-35	5-15
	18-42	Sandy clay loam, loam, clay loam.	SC-SM, SC, CL, CL-ML	A-4, A-6	0	0-10	80-100	75-100	60-100	35-75	20-40	5-20
	42-60	Sandy loam, sandy clay loam, loam.	SC-SM, CL, CL-ML, SC	A-2, A-4, A-6	0	0-10	80-100	75-100	45-95	30-70	20-35	5-15

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
7---------- Bisoodi	0-1	Fine sandy loam.	SM, SC-SM, SC	A-2, A-4	0	0-5	95-100	90-100	60-80	30-45	15-25	0-10
	1-14	Loam, sandy loam, gravelly loam.	SM, SC-SM, SC	A-2, A-4	0	0-5	80-95	70-90	50-70	30-50	15-25	0-10
	14-18	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
8*: Burnswick----	0-3	Sandy clay loam.	SC-SM, SC	A-2, A-4, A-6	0	0	95-100	85-100	70-90	30-50	25-40	5-20
	3-16	Sandy clay loam, clay loam.	SC-SM, CL-ML, SC, CL	A-4, A-6	0	0	95-100	85-100	70-95	40-75	25-40	5-20
	16-41	Sandy clay loam, clay loam.	SC-SM, CL-ML, SC, CL	A-4, A-6	0	0	95-100	85-100	70-95	40-75	25-40	5-20
	41-53	Sandy loam, fine sandy loam.	SM, SC-SM	A-2, A-4	0	0	95-100	85-100	50-70	25-40	15-25	0-5
	53-60	Sandy clay loam, clay loam, gravelly sandy clay loam.	SC-SM, CL-ML, SC, CL	A-4, A-6	0	0	95-100	85-100	70-95	40-75	25-40	5-20
Marcou-------	0-6	Loamy sand----	SM	A-2	0	0	100	100	50-75	15-20	0-14	0-0
	6-47	Sandy loam----	SM, SC-SM	A-4	0	0	100	100	70-85	40-50	15-20	0-5
	47-54	Sandy clay loam.	SC-SM, SC	A-4, A-2, A-6	0	0	95-100	90-100	70-85	30-50	25-35	5-15
	54-60	Loamy coarse sand.	SP-SM, SM	A-1	0	0	95-100	90-100	35-50	10-15	0-14	0-0
9---------- Burnswick	0-3	Sandy clay loam.	SC-SM, SC	A-2, A-4, A-6	0	0	95-100	85-100	70-90	30-50	25-40	5-20
	3-16	Sandy clay loam, clay loam.	SC-SM, CL-ML, SC, CL	A-4, A-6	0	0	95-100	85-100	70-95	40-75	25-40	5-20
	16-41	Sandy clay loam, clay loam.	SC-SM, CL-ML, SC, CL	A-4, A-6	0	0	95-100	85-100	70-95	40-75	25-40	5-20
	41-53	Sandy loam, fine sandy loam.	SM, SC-SM	A-2, A-4	0	0	95-100	85-100	50-70	25-40	15-25	0-5
	53-60	Sandy clay loam, clay loam, gravelly sandy clay loam.	SC-SM, CL-ML, SC, CL	A-4, A-6	0	0	95-100	85-100	70-95	40-75	25-40	5-20
10*: Calciorthids-	0-27	Variable------	---	---	---	---	---	---	---	---	---	---
	27	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
10*:												
Torriorthents	0-32	Variable------	---	---	---	---	---	---	---	---	---	---
	32	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
Rock outcrop-	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
11----------	0-2	Sandy loam----	SM, SC-SM	A-1, A-2	0	0	85-95	80-95	45-65	20-35	15-20	0-5
Cerrillos	2-15	Sandy clay loam.	SC	A-2, A-6	0	0	85-95	80-95	60-85	25-50	30-40	10-20
	15-34	Clay loam-----	CL	A-6	0	0	85-95	80-95	70-90	55-70	30-40	10-20
	34-60	Sandy clay loam.	SC	A-2, A-6	0	0	85-95	80-95	60-85	25-50	20-40	10-20
12*:												
Cerrillos----	0-2	Sandy loam----	SM, SC-SM	A-1, A-2	0	0	85-95	80-95	45-65	20-35	15-20	0-5
	2-15	Sandy clay loam.	SC	A-2, A-6	0	0	85-95	80-95	60-85	25-50	30-40	10-20
	15-34	Clay loam-----	CL	A-6	0	0	85-95	80-95	70-90	55-70	30-40	10-20
	34-60	Sandy clay loam.	SC	A-2, A-6	0	0	85-95	80-95	60-85	25-50	20-40	10-20
Ubank--------	0-2	Fine sandy loam.	SM, SC-SM	A-2, A-4	0	0	85-100	75-95	50-80	30-45	15-25	0-5
	2-10	Loam, sandy loam, fine sandy loam.	SM, ML, CL-ML, SC-SM	A-2, A-4	0	0	85-100	75-95	50-80	25-65	15-25	0-5
	10-44	Loam, sandy loam, fine sandy loam.	SM, ML, CL-ML, SC-SM	A-2, A-4	0	0	85-100	75-95	50-80	25-65	15-25	0-5
	44-60	Sandy clay loam.	SC-SM, SC	A-2, A-4, A-6	0	0	85-100	75-95	60-85	25-50	25-35	5-15
13----------	0-3	Clay----------	CH, CL	A-7	0	0	100	100	90-100	75-90	45-55	20-30
Claysprings	3-18	Clay----------	CH, CL	A-7	0	0	100	100	90-100	75-95	45-60	20-35
	18	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
14*----------	0-6	Very gravelly loam.	GM-GC, GC	A-1, A-2	0	0-10	40-55	35-50	30-45	20-30	15-25	5-10
Deama family	6-17	Very gravelly loam, extremely gravelly loam.	GM-GC, GC	A-1, A-2	0	0-10	30-55	25-50	20-45	15-30	15-25	5-10
	17-27	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
15*:												
Deama--------	0-1	Very channery loam.	GM-GC, GC	A-1, A-2	0	0	40-55	35-50	20-50	20-35	20-30	5-10
	1-4	Channery loam	GM-GC, GC SC-SM, SC	A-2, A-4	0	0	65-80	60-75	50-70	30-50	20-30	5-10
	4-13	Very channery loam.	GM-GC, GC GP-GC	A-1, A-2	0	0	20-30	15-25	15-25	10-20	20-30	5-10
	13-20	Extremely channery loam.	GM-GC, GC GP-GC	A-1, A-2	0	0	20-30	15-25	15-25	10-20	20-30	5-10
	20-30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
15*:												
Rock outcrop-	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
16*----------	0-60	Fine sand-----	SP, SP-SM, SM	A-3, A-2	0	0	100	100	60-80	0-25	---	NP
Dune land												
17----------	0-1	Channery sandy loam.	SM, SC-SM	A-1	0-5	0-5	60-80	55-75	30-50	15-25	10-20	NP-5
Epikom	1-10	Loam----------	CL, CL-ML	A-4	0-5	0-5	85-95	85-95	70-90	50-65	20-30	5-10
	10-14	Very flaggy loam.	SC-SM, SC, GM-GC, GC	A-2, A-4	1-10	30-50	55-75	50-70	40-65	25-45	20-30	5-10
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
18*:												
Epikom-------	0-3	Channery sandy loam.	SM, SC-SM	A-1	0-5	0-5	60-80	55-75	30-50	15-25	10-20	NP-5
	3-14	Channery loam, channery sandy loam.	SC, SC-SM, GC, GM-GC	A-1, A-2, A-4	0-5	0-5	60-80	55-75	40-70	20-50	20-30	5-10
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Rock outcrop-	1-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
19*----------	0-10	Sandy loam----	SM, SC-SM	A-2	0	0	85-95	80-95	50-65	20-35	15-20	NP-5
Escavada family	10-60	Stratified loamy sand to sandy loam.	SM, SC-SM	A-1, A-2	0	0	85-95	80-95	40-65	15-30	<20	NP-5
20, 21--------	0-3	Sandy loam----	SM	A-2	0	0	95-100	90-95	55-65	25-35	20-30	0-5
Grieta	3-20	Sandy clay loam.	SC	A-2, A-6	0	0	95-100	90-95	70-85	30-50	25-35	10-15
	20-44	Sandy clay loam.	SC	A-2, A-6	0	0	95-100	90-95	70-85	30-50	25-35	10-15
	44-60	Sandy loam----	SM	A-2	0	0	95-100	90-95	55-65	25-35	20-30	0-5
22*:												
Gypsiorthids-	0-60	Variable------	---	---	---	---	---	---	---	---	---	---
Torriorthents	0-60	Variable------	---	---	---	---	---	---	---	---	---	---
23----------	0-4	Fine sandy loam.	SM, SC-SM	A-4	0	0	100	95-100	60-85	35-50	20-25	NP-5
Ives	4-60	Stratified sandy loam to fine sandy loam.	SM, SC-SM	A-4	0	0	100	100	70-80	35-50	15-25	NP-5
24----------	0-4	Sandy loam----	SM, SC-SM	A-2, A-4	0	0	95-100	90-100	55-70	25-40	5-15	NP-5
Ives	4-49	Sandy loam----	SM, SC-SM	A-2, A-4	0	0	95-100	90-100	55-70	25-40	5-15	NP-5
	49-62	Loamy sand----	SM	A-1, A-2	0	0	95-100	90-100	45-75	15-25	---	NP
25----------	0-13	Very fine sandy loam.	ML, CL-ML	A-4	0	0	95-100	90-100	75-95	50-65	5-15	NP-5
Ives	13-55	Sandy loam----	SM, SC-SM	A-2, A-4	0	0	95-100	90-100	55-70	25-40	5-15	NP-5
	55-62	Loamy sand----	SM	A-1, A-2	0	0	95-100	90-100	45-75	15-25	---	NP

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 10 inches	Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
26, 27, 28---- Jocity	0-9	Sandy clay loam.	SC-SM, SC	A-4, A-6	0	0	90-100	90-100	70-90	35-50	25-35	5-15
	9-41	Sandy clay loam.	SC-SM, SC	A-4, A-6	0	0	90-100	90-100	70-90	35-50	25-35	5-15
	41-60	Fine sandy loam, sandy loam.	SM, SC-SM	A-4	0	0	90-100	90-100	60-85	35-45	15-20	NP-5
29---------- Jocity	0-9	Silty clay----	CL, CH	A-7	0	0	90-100	90-100	85-100	80-95	40-55	20-30
	9-41	Sandy clay loam.	SC-SM, SC	A-4, A-6	0	0	90-100	90-100	70-90	35-50	25-35	5-15
	41-60	Fine sandy loam, sandy loam.	SM, SC-SM	A-4	0	0	90-100	90-100	60-85	35-45	15-20	NP-5
30---------- Kech	0-2	Fine sandy loam.	SM, SC-SM	A-4	0	0	95-100	90-95	65-80	35-50	20-25	NP-5
	2-5	Loam----------	CL-ML, CL	A-4	0	0	95-100	90-95	75-90	50-65	20-30	5-10
	5-11	Channery loam	SC-SM, SC	A-2, A-4	0	0	75-85	50-75	45-70	30-50	20-30	5-10
	11-15	Channery clay loam.	SC	A-6	0	0	75-85	50-75	45-75	35-50	30-40	10-20
	15-25	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
31*:												
Kech---------	0-2	Channery sandy loam.	SM, SC-SM	A-1, A-2	0	0	75-85	50-75	35-50	15-30	20-25	0-5
	2-12	Channery loam	SC-SM, SC	A-2, A-4	0	0	75-85	50-75	45-70	30-50	20-30	5-10
	12-22	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Rock outcrop-	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
32---------- Kinan	0-1	Loamy sand----	SM	A-2	0	0	100	100	50-75	15-20	10-15	NP
	1-54	Sandy loam, fine sandy loam.	SM, SC-SM	A-2, A-4	0	0	100	100	65-80	30-45	15-20	NP-5
	54-60	Sandy clay loam.	SC, SC-SM, GC, GM-GC	A-4	0	0	95-100	95-100	75-90	35-50	25-35	5-10
33*:												
Leanto-------	0-1	Channery loamy sand.	SM	A-1, A-3	0-5	0-5	60-80	55-75	25-55	5-15	10-15	NP
	1-10	Channery fine sandy loam, channery loam.	SC, SC-SM GC, GM-GC	A-1, A-2, A-4	0-5	0-5	60-80	55-75	40-65	25-45	15-30	5-10
	10-14	Channery loam	SC, SC-SM GC, GM-GC	A-2, A-4	0-5	0-5	60-80	55-75	45-70	30-50	20-30	5-10
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 10 inches	Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
33*:												
Bisoodi------	0-1	Channery fine sandy loam.	SM, SC-SM, SC	A-2, A-1	0	0-5	75-85	65-75	40-50	20-30	15-25	NP-10
	1-14	Loam, sandy loam, gravelly loam.	SM, SC-SM, SC	A-2, A-4	0	0-5	80-95	70-90	50-70	30-50	15-25	NP-10
	14-18	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
	18-28	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
34*:												
Leanto-------	0-1	Channery sandy loam.	SM, SC-SM	A-1	0-5	0-5	60-80	55-75	30-50	15-25	10-20	NP-5
	1-10	Channery fine sandy loam, channery loam.	SC, SC-SM,	A-1, A-2	0-5	0-5	60-80	55-75	40-65	25-45	15-30	5-10
	10-14	Channery loam	SC, SC-SM, GC, GM-GC	A-2, A-4	0-5	0-5	60-80	55-75	45-70	30-50	20-30	5-10
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Bisoodi------	0-1	Channery fine sandy loam.	SM, SC-SM, SC	A-1, A-2	0	0-5	75-85	65-75	40-50	20-30	15-25	0-10
	1-14	Loam, sandy loam, gravelly loam.	SM, SC-SM, SC	A-2, A-4	0	0-5	80-95	70-90	50-70	30-50	15-25	0-10
	14-18	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Rock outcrop-	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
35---------- Lozinta	0-2	Extremely gravelly loam.	GM, GM-GC, GC, GP-GM	A-2, A-1	0	0	20-30	15-25	15-25	10-20	20-30	2-10
	2-21	Extremely gravelly loam.	GM, GM-GC, GC, GP-GM	A-2, A-1	0	0	20-30	15-25	15-25	10-20	20-30	2-10
	21-60	Cinders-------	GP	A-1	0	0	5-10	0-5	0-5	0-5	---	NP
36---------- Manzano	0-3	Sandy clay loam.	SC-SM, SC	A-2, A-4, A-6	0	0	95-100	90-100	70-85	30-50	25-35	5-15
	3-27	Sandy clay loam.	SC-SM, SC	A-2, A-4, A-6	0	0	95-100	90-100	70-85	30-50	25-35	5-15
	27-36	Sandy clay loam.	SC-SM, SC	A-2, A-4, A-6	0	0	95-100	90-100	70-85	30-50	25-35	5-15
	36-60	Sandy clay loam.	SC-SM, SC	A-2, A-4, A-6	0	0	95-100	90-100	70-85	30-50	25-35	5-15

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments	Frag-ments	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	> 10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
37---------- Marcou	0-6	Loamy sand----	SM	A-2	0	0	100	100	50-75	15-20	---	NP
	6-47	Sandy loam----	SM, SC-SM	A-4	0	0	100	100	70-85	40-50	15-20	NP-5
	47-54	Sandy clay loam.	SC-SM, SC	A-4, A-2, A-6	0	0	95-100	90-100	70-85	30-50	25-35	5-15
	54-60	Loamy coarse sand.	SP-SM, SM	A-1	0	0	95-100	90-100	35-50	10-15	---	NP
38---------- Medisaprists	0-60	Variable------	---	---	---	---	---	---	---	---	---	---
39*:												
Mellenthin---	0-1	Very channery fine sandy loam.	GM, GM-GC,	A-1	0-5	0-5	35-55	30-50	20-40	10-20	15-25	NP-5
	1-6	Very channery loam.	GM-GC, GC	A-1, A-2,	0-5	35-55	30-50	25-40	15-40	20-30	5-10	5-10
	6-12	Very channery loam.	GM-GC, GC	A-1, A-2	0-5	35-55	30-50	25-40	15-40	20-30	5-10	5-10
	12-20	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
	20-30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Rock outcrop-	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
40, 41-------- Navajo	0-5	Silty clay----	CH	A-7	0	0	100	100	90-100	80-95	50-55	25-30
	5-60	Stratified silty clay to clay.	CH	A-7	0	0	100	100	90-100	80-90	45-60	20-35
42---------- Navajo	0-5	Silty clay----	CH	A-7	0	0	100	100	90-100	80-95	50-55	25-30
	5-60	Stratified silty clay to clay.	CH	A-7	0	0	100	100	90-100	80-90	55-60	30-35
43---------- Nuffel	0-2	Silt loam-----	CL-ML, CL	A-4	0	0	100	100	90-100	70-90	15-25	5-10
	2-60	Stratified silty clay loam to silt loam.	CL-ML, CL	A-4, A-6	0	0	100	100	95-100	80-90	25-40	5-15
44*:												
Padilla------	0-8	Sandy clay loam.	SM, SC	A-2, A-4, A-6	0	0	90-100	85-100	70-90	30-50	30-40	5-15
	8-60	Clay, clay loam.	CL, CH	A-7	0	0	90-100	85-100	75-100	55-85	40-55	15-30
Cerrillos----	0-2	Sandy loam----	SM, SC-SM	A-1, A-2	0	0	85-95	80-95	45-65	20-35	15-20	0-5
	2-15	Sandy clay loam.	SC	A-2, A-6	0	0	85-95	80-95	60-85	25-50	30-40	10-20
	15-34	Clay loam-----	CL	A-6	0	0	85-95	80-95	70-90	55-70	30-40	10-20
	34-60	Sandy clay loam.	SC	A-2, A-6	0	0	85-95	80-95	60-85	25-50	20-40	10-20

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 10 inches	Fragments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
45*:												
Pensom-------	0-17	Fine sand-----	SM	A-2	0	0	100	100	65-80	20-35	---	NP
	17-41	Loamy fine sand, loamy sand.	SM, SC-SM	A-4	0	0	100	100	90-95	35-45	0-15	NP-5
	41-51	Loam, fine sand, loamy sand.	SM, SC-SM, ML, CL-ML	A-4	0	0	90-95	85-95	65-85	40-55	15-20	NP-5
	51	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Chedeski-----	0-1	Sandy loam----	SM, SC-SM	A-2, A-4	0	0	100	100	50-70	30-40	15-20	NP-5
	1-13	Sandy clay loam, sandy loam.	SC-SM, SC, CL-ML, CL	A-4	0	0	95-100	85-100	65-85	35-60	20-30	5-10
	13-16	Sandy clay loam, loam.	SC-SM, SC, CL-ML, CL	A-4	0	0	95-100	85-100	65-85	35-60	20-30	5-10
	16-26	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
	26-36	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
46*:												
Penzance-----	0-3	Clay loam-----	CL	A-6	0	0	100	80-100	75-100	60-80	30-40	10-15
	3-60	Clay, sandy clay, clay loam.	CL, CH	A-7, A-6	0	0	100	80-100	75-100	55-90	35-55	15-30
Grieta-------	0-3	Sandy loam----	SM	A-2	0	0	95-100	90-95	55-65	25-35	20-30	NP-5
	3-20	Sandy clay loam.	SC	A-2, A-6	0	0	95-100	90-95	70-85	30-50	25-35	10-15
	20-44	Sandy clay loam.	SC	A-2, A-6	0	0	95-100	90-95	70-85	30-50	25-35	10-15
	44-60	Sandy loam----	SM	A-2	0	0	95-100	90-95	55-65	25-35	20-30	NP-5
47----------Poley	0-1	Fine sandy loam.	SM, SC-SM	A-4	0	0	95-100	95-100	65-85	35-45	15-20	NP-5
	1-4	Loam----------	CL-ML, CL	A-4	0	0	95-100	95-100	80-95	55-65	20-30	5-10
	4-13	Clay loam-----	CL	A-4, A-6	0	0	95-100	95-100	85-100	65-75	30-40	10-20
	13-22	Clay, clay loam.	CL, CH	A-6, A-7	0	0	95-100	95-100	85-100	70-85	30-60	15-40
	22-47	Clay, clay loam.	CL, CH	A-6, A-7	0	0	95-100	95-100	85-100	70-85	30-60	15-40
	47-60	Sandy clay loam.	SC-SM, SC	A-4, A-6	0	0	95-100	95-100	75-90	35-50	25-35	5-10
48----------Purgatory	0-1	Fine sandy loam.	SM, ML	A-4	0	0	95-100	90-95	65-85	35-50	15-20	NP-5
	1-20	Sandy loam, fine sandy loam, loam.	SM, ML, SC-SM, CL-ML	A-2, A-4	0	0	95-100	85-100	55-85	30-60	15-20	NP-5
	20-27	Clay loam-----	ML	A-6, A-7	0	0	100	80-90	70-80	55-70	35-45	10-15
	27-60	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 10 inches	Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
49----------	0-4	Silt loam-----	CL-ML, CL	A-4	0	0	95-100	95-100	85-100	65-85	20-30	5-10
Radnik	4-45	Stratified silt loam to loamy fine sand.	CL-ML, CL	A-4	0	0	95-100	95-100	80-90	50-70	20-30	5-10
	45-60	Sandy clay loam.	SC-SM, SC	A-2, A-4, A-6	0	0	95-100	95-100	75-90	30-45	25-35	5-15
50*:												
Riverwash----	0-60	Variable------	---	---	---	---	---	---	---	---	---	---
Typic Torrifluvent	0-60	Variable------	---	---	---	---	---	---	---	---	---	---
51*:												
Riverwash----	0-60	Variable------	---	---	---	---	---	---	---	---	---	---
Ustic Torrifluvent	0-60	Variable------	---	---	---	---	---	---	---	---	---	---
52*:												
Rock outcrop-	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Arches-------	0-13	Loamy fine sand.	SM	A-4	0	0	100	100	85-95	35-45	---	NP
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
53*:												
Rock outcrop-	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Deama--------	0-3	Very flaggy loam.	GM-GC, GC, SC-SM, SC	A-2, A-4	0-10	30-50	55-75	50-70	40-65	25-45	20-30	5-10
	3-12	Very channery loam.	GM-GC, GC, GP-GC	A-1, A-2	0	0	20-30	15-25	15-25	10-20	20-30	5-10
	12-19	Extremely channery loam.	GM-GC, GC, GP-GC	A-1, A-2	0	0	20-30	15-25	15-25	10-20	20-30	5-10
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
54*:												
Rock outcrop-	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Epikom-------	0-3	Channery sandy loam.	SM, SC-SM	A-1	0-5	0-5	60-80	55-75	30-50	15-25	10-20	NP-5
	3-14	Channery loam, channery sandy loam.	SC, SC-SM, GC, GM-GC	A-1, A-2, A-4	0-5	0-5	60-80	55-75	40-70	20-50	20-30	5-10
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
55*:												
Rock outcrop-	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 10 inches	Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
55*:												
Kech---------	0-2	Channery sandy loam.	SM, SC-SM	A-1, A-2	0	0	75-85	50-75	35-50	15-30	20-25	NP-5
	2-12	Channery loam	SC-SM, SC	A-2, A-4	0	0	75-85	50-75	45-70	30-50	20-30	5-10
	12-16	Channery clay loam.	SC	A-6	0	0	75-85	50-75	45-75	35-50	30-40	10-20
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
56*:												
Rock outcrop-	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Leanto-------	0-1	Channery sandy loam.	SM, SC-SM	A-1	0-5	0-5	60-80	55-75	30-50	15-25	10-20	NP-5
	1-10	Channery fine sandy loam, channery loam.	SC, SC-SM, GC, GM-GC	A-1, A-2, A-4	0-5	0-5	60-80	55-75	40-65	25-45	20-30	5-10
	10-14	Channery loam	SC, SC-SM, GC, GM-GC	A-2, A-4	0-5	0-5	60-80	55-75	45-70	30-50	20-30	5-10
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
57*:												
Rock outcrop-	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Mellenthin---	0-5	Very flaggy loam.	SC-SM, SC, GM-GC, GC	A-1, A-2, A-4	0-10	30-50	55-75	50-70	40-65	25-45	20-30	5-10
	5-11	Very flaggy loam.	SC-SM, SC, GM-GC, GC	A-1, A-2, A-4	0-10	30-50	55-75	50-70	40-65	25-45	20-30	5-10
	11-14	Extremely flaggy loam.	SC-SM, SC, GM-GC, GC	A-1, A-2, A-4	0-10	60-80	55-75	50-70	40-65	25-45	20-30	5-10
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
58*:												
Rock outcrop-	0-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Needle-------	0-7	Fine sand-----	SM	A-2	0	0	95-100	95-100	60-80	20-35	---	NP
	7-9	Fine sand, loamy fine sand.	SM	A-2	0	0	95-100	95-100	60-80	20-35	0-20	NP
	9	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
59---------- Shalet	0-1	Silty clay loam.	CL	A-4, A-5 A-6	0	0	95-100	95-100	90-100	75-95	30-45	10-20
	1-4	Clay loam-----	CL	A-4, A-6	0	0	95-100	95-100	85-100	65-80	30-40	10-20
	4-7	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
	7-60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
60*:												
Sheppard-----	0-60	Loamy fine sand.	SM	A-2	0	0	100	100	65-80	25-35	---	NP

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 10 inches	Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
60*:												
Grieta-------	0-3	Sandy loam----	SM	A-2	0	0	95-100	90-95	55-65	25-35	20-30	NP-5
	3-21	Sandy clay loam.	SC	A-2, A-6	0	0	95-100	90-95	70-85	30-50	25-35	10-15
	21-60	Sandy loam----	SM	A-2	0	0	95-100	90-95	55-65	25-35	20-30	NP-5
61---------- Sheppard	0-60	Loamy sand----	SM, SP-SM	A-2	0	0	100	100	65-80	10-20	---	NP
62---------- Sheza	0-4	Gravelly sandy loam.	SM	A-2, A-1	---	0-5	55-80	50-75	30-50	15-30	15-20	NP-5
	4-15	Gravelly clay loam, clay loam.	SC, GC, CL	A-6	0	0-5	60-90	55-85	50-85	40-65	25-35	10-20
	15-28	Very gravelly loam, extremely gravelly loam.	GM-GC, GC, GP-GC	A-1, A-2	0	5-20	30-60	20-50	15-40	10-35	15-25	5-10
	28-60	Extremely gravelly loamy coarse sand.	GP, GP-GM	A-1	0	5-20	30-45	20-40	10-30	0-10	---	NP
63---------- Springerville	0-5	Clay----------	CL, CH	A-7	0	0	100	95-100	90-100	80-95	45-65	25-45
	5-60	Clay, silty clay.	CL, CH	A-7	0	0	100	95-100	90-100	85-95	45-60	25-45
64*---------- Springerville	0-9	Silty clay----	CL, CH	A-7	0	0	95-100	95-100	90-100	80-95	45-65	25-45
	9-60	Clay----------	CL, CH	A-7	0	0	95-100	95-100	90-100	80-95	45-65	25-45
65---------- Thunderbird	0-2	Cobbly silty clay loam.	CL	A-4, A-6	0-5	20-25	75-85	70-80	65-80	65-80	30-40	10-20
	2-18	Clay----------	CL, CH	A-7	0	0-5	90-100	85-95	75-95	65-85	45-60	25-40
	18-27	Cobbly clay---	CL, CH	A-7	0-5	20-25	75-85	70-85	65-85	50-60	45-60	25-40
	27-31	Very cobbly clay loam.	GC	A-4, A-6	0-5	30-45	55-75	50-70	45-70	35-50	30-40	10-20
	31	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
66*:												
Torriorthents	0-60	Variable------	---	---	---	---	---	---	---	---	---	---
Calciorthids-	0-60	Variable------	---	---	---	---	---	---	---	---	---	---
67---------- Tours	0-6	Clay loam-----	CL	A-6	0	0	100	100	90-100	70-90	30-40	10-15
	6-36	Stratified silty clay loam to silt loam.	CL	A-6	0	0	100	100	95-100	75-95	30-40	10-15
	36-60	Stratified silt loam to loamy fine sand.	SM, SC-SM, ML, CL-ML	A-4	0	0	100	100	90-100	40-85	<20	NP-5

See footnote at end of table.

TABLE 12.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 10 inches	Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
68, 69-------- Tours	0-6	Silty clay loam.	CL, ML	A-6, A-7	0	0	100	100	95-100	85-95	35-45	10-20
	6-47	Stratified silty clay loam to silt loam.	CL	A-6, A-7	0	0	100	100	95-100	80-95	30-45	10-20
	47-60	Stratified silt loam to very fine sandy loam.	ML, CL-ML SM, SC-SM	A-4	0	0	100	100	85-95	50-85	<30	NP-7
70---------- Trail	0-3	Loamy sand----	SM	A-2	0	0	100	100	50-75	15-25	---	NP
	3-60	Stratified sand to silt loam.	SM, SP-SM	A-2	0	0	100	100	60-75	10-30	---	NP
71*: Ustollic Haplargids--	0-60	Variable------	---	---	---	---	---	---	---	---	---	---
Ustollic Haplargids--	0-60	Variable------	---	---	---	---	---	---	---	---	---	---
Ustollic Haplargids--	0-60	Variable------	---	---	---	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
1----------	0-6	5-18	1.50-1.60	2.0-6.0	0.12-0.15	7.4-8.4	0-4	Low-------	0.24	3	3	<1
Arntz	6-12	27-35	1.20-1.30	0.2-0.6	0.18-0.20	7.4-8.4	0-4	Moderate	0.28			
	12-32	18-27	1.35-1.45	0.6-2.0	0.14-0.17	7.4-8.4	0-4	Low-------	0.32			
	32-42	27-35	1.15-1.25	0.2-0.6	0.17-0.20	7.4-8.4	0-4	Moderate	0.28			
	42-60	---	---	---	---	---	---	----------	----			
2----------	0-1	5-20	1.40-1.55	2.0-6.0	0.12-0.15	7.4-7.8	0-2	Low-------	0.24	1	3	.5-1
Atarque	1-6	10-27	1.40-1.50	0.6-2.0	0.14-0.18	7.4-7.8	0-2	Low-------	0.32			
	6-14	10-27	1.40-1.50	0.6-2.0	0.14-0.18	7.4-7.8	0-2	Low-------	0.32			
	14	---	---	---	---	---	---	----------	----			
3*:												
Badland---------	0-1	---	---	---	---	---	2-16	----------	----	---	---	---
	1-60	---	---	---	---	---	2-16	High------	----			
Torriorthents---	0-10	---	---	---	---	---	4-16	----------	----	2	---	---
	10-60	---	---	---	---	---	---	High------	----			
4----------	0-9	30-40	1.15-1.25	0.2-0.6	0.19-0.21	7.4-8.4	0-2	Moderate	0.24	5	4L	2-4
Bagley	9-39	35-40	1.20-1.30	0.2-0.6	0.19-0.21	7.9-8.4	0-2	Moderate	0.24			
	39-60	20-27	1.20-1.30	0.6-2.0	0.16-0.18	7.9-8.4	0-2	Low-------	0.37			2-4
5----------	0-10	10-20	1.25-1.35	2.0-6.0	0.12-0.16	7.4-8.4	<2	Low-------	0.43	5	3	1-3
Barx	10-18	16-30	1.20-1.30	0.6-2.0	0.12-0.18	7.4-8.4	<2	Moderate	0.32			
	18-28	22-35	1.25-1.40	0.6-2.0	0.16-0.19	7.4-9.0	<2	Moderate	0.24			
	28-60	16-30	1.25-1.40	0.6-2.0	0.11-0.18	7.9-9.0	<2	Moderate	0.28			
6----------	0-3	10-20	1.25-1.35	2.0-6.0	0.12-0.16	7.4-8.4	<2	Low-------	0.43	5	3	1-3
Barx	3-18	16-30	1.20-1.30	0.6-2.0	0.12-0.18	7.4-8.4	<2	Moderate	0.32			
	18-42	22-35	1.25-1.40	0.6-2.0	0.16-0.19	7.4-9.0	<2	Moderate	0.24			
	42-60	16-30	1.25-1.40	0.6-2.0	0.11-0.18	7.9-9.0	<2	Moderate	0.28			
7----------	0-1	10-20	1.35-1.50	2.0-6.0	0.11-0.14	7.4-8.4	0-2	Low-------	0.20	1	3	1-2
Bisoodi	1-14	5-18	1.25-1.50	0.6-2.0	0.10-0.14	7.9-8.4	0-2	Low-------	0.24			
	14-18	---	---	---	---	---	---	----------	----			
	18	---	---	---	---	---	---	----------	----			
8*:												
Burnswick-------	0-3	20-35	1.25-1.35	0.2-0.6	0.03-0.08	7.9-9.0	0-4	Moderate	0.24	5	4L	<1
	3-16	20-35	1.35-1.50	0.2-0.6	0.03-0.08	7.9-9.0	0-8	Moderate	0.28			
	16-41	20-35	1.35-1.50	0.2-0.6	0.03-0.08	8.5-9.0	0-8	Moderate	0.28			
	41-53	5-20	1.10-1.30	2.0-6.0	0.02-0.07	8.5-9.0	0-8	Low-------	0.20			
	53-60	20-35	1.25-1.35	0.2-0.6	0.03-0.08	8.5-9.0	0-8	Moderate	0.28			
Marcou----------	0-6	3-5	1.45-1.60	2.0-6.0	0.05-0.08	7.9-8.4	0-8	Low-------	0.15	5	2	<1
	6-47	10-15	1.35-1.50	0.6-2.0	0.09-0.11	8.5-9.0	2-8	Low-------	0.20			
	47-54	20-35	1.20-1.30	0.6-2.0	0.09-0.14	8.5-9.0	2-8	Low-------	0.28			
	54-60	1-10	1.50-1.60	6.0-20	0.02-0.04	8.5-9.0	2-8	Low-------	0.15			
9----------	0-3	20-35	1.25-1.35	0.2-0.6	0.03-0.08	7.9-9.0	0-4	Moderate	0.24	5	4L	<1
Burnswick	3-16	20-35	1.35-1.50	0.2-0.6	0.03-0.08	7.9-9.0	0-8	Moderate	0.28			
	16-41	20-35	1.35-1.50	0.2-0.6	0.03-0.08	8.5-9.0	0-8	Moderate	0.28			
	41-53	5-20	1.10-1.30	2.0-6.0	0.02-0.07	8.5-9.0	0-8	Low-------	0.20			
	53-60	20-35	1.25-1.35	0.2-0.6	0.03-0.08	8.5-9.0	0-8	Moderate	0.28			

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
10*:												
Calciorthids----	0-27	---	---	---	---	---	---	Low-------	----	2	---	---
	27	---	---	---	---	---	---	----------	----			
Torriorthents---	0-32	---	---	---	---	---	---	----------	----	2	---	---
	32-42	---	---	---	---	---	---	----------	----			
Rock outcrop----	0-60	---	1.50-1.80	---	---	---	---	----------	----	---	8	---
11----------	0-2	5-20	1.40-1.55	2.0-6.0	0.10-0.13	7.9-8.4	0-0	Low-------	0.20	2	3	.5-1
Cerrillos	2-15	25-35	1.20-1.30	0.2-0.6	0.12-0.16	7.9-8.4	0-0	Moderate	0.28			
	15-34	27-35	1.20-1.30	0.2-0.6	0.17-0.20	7.9-9.0	0-4	Moderate	0.28			
	34-60	25-35	1.20-1.30	0.2-0.6	0.11-0.15	7.9-9.0	0-4	Moderate	0.28			
12*:												
Cerrillos-------	0-2	5-20	1.40-1.55	2.0-6.0	0.10-0.13	7.9-8.4	0-0	Low-------	0.20	2	3	.5-1
	2-15	25-35	1.20-1.30	0.2-0.6	0.12-0.16	7.9-8.4	0-0	Moderate	0.28			
	15-34	27-35	1.20-1.30	0.2-0.6	0.17-0.20	7.9-9.0	0-4	Moderate	0.28			
	34-60	25-35	1.20-1.30	0.2-0.6	0.11-0.15	7.9-9.0	0-4	Moderate	0.28			
Ubank-----------	0-2	5-18	1.35-1.50	2.0-6.0	0.10-0.15	7.4-8.4	0-2	Low-------	0.24	5	3	1-2
	2-10	10-18	1.25-1.50	0.6-2.0	0.11-0.16	7.9-8.4	0-4	Low-------	0.24			
	10-44	10-18	1.25-1.50	0.6-2.0	0.11-0.16	7.9-8.4	0-4	Low-------	0.24			
	44-60	20-30	1.25-1.40	0.2-0.6	0.12-0.16	7.9-8.4	0-4	Moderate	0.32			
13----------	0-3	40-50	1.15-1.30	<0.06	0.14-0.16	7.4-9.0	0-16	High------	0.28	2	4	.5-1
Claysprings	3-18	40-55	1.15-1.30	<0.06	0.14-0.16	7.4-9.0	0-16	High------	0.28			
	18	---	---	---	---	---	---	----------	----			
14*----------	0-6	10-27	1.35-1.45	0.6-2.0	0.05-0.12	7.9-8.4	0-2	Low-------	0.10	1	8	1-2
Deama family	6-17	10-27	1.35-1.45	0.6-2.0	0.03-0.12	7.9-8.4	0-2	Low-------	0.10			
	17	---	---	---	---	---	---	----------	----			
15*:												
Deama-----------	0-1	18-27	1.35-1.45	0.6-2.0	0.07-0.12	7.4-8.4	0-2	Low-------	0.10	1	8	1-2
	1-4	18-27	1.35-1.45	0.6-2.0	0.11-0.14	7.4-8.4	0-2	Low-------	0.10			
	4-13	18-27	1.35-1.45	0.6-2.0	0.07-0.12	7.4-8.4	0-2	Low-------	0.10			
	13-20	18-27	1.30-1.40	0.6-2.0	0.04-0.05	7.4-8.4	0-2	Low-------	0.10			
	20	---	---	---	---	---	---	----------	----			---
Rock outcrop----	0-60	---	1.50-1.80	---	---	---	---	----------	----	---	8	---
16*----------	0-60	0-1	1.50-1.60	6.0-20	0.04-0.05	7.4-8.4	0-0	Low-------	0.15	5	1	<.1
Dune land												
17----------	0-1	5-18	1.45-1.65	2.0-6.0	0.07-0.11	7.9-8.4	0-2	Low-------	0.17	1	3	<.5
Epikom	1-10	15-18	1.40-1.50	0.6-2.0	0.14-0.18	7.9-8.4	0-2	Low-------	0.32			
	10-14	12-18	1.35-1.45	0.6-2.0	0.07-0.12	7.9-8.4	0-2	Low-------	0.10			
	14	---	---	---	---	---	---	----------	----			
18*:												
Epikom----------	0-3	5-18	1.45-1.65	2.0-6.0	0.07-0.11	7.9-8.4	0-2	Low-------	0.17	1	3	<.5
	3-14	12-18	1.35-1.45	0.6-2.0	0.10-0.15	7.9-8.4	0-2	Low-------	0.24			
	14	---	---	---	---	---	---	----------	----			
Rock outcrop----	1-60	---	1.50-1.80	---	---	---	---	----------	----	---	8	---
19*----------	0-10	5-20	1.40-1.55	2.0-6.0	0.10-0.13	7.9-8.4	0-2	Low-------	0.20	5	3	.5-1
Escavada family	10-60	2-15	1.40-1.60	2.0-6.0	0.10-0.13	7.9-8.4	0-2	Low-------	0.15			

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
20, 21----------	0-3	10-20	1.45-1.55	2.0-6.0	0.11-0.13	7.9-8.4	0-2	Low-------	0.20	5	3	.1-.5
Grieta	3-20	20-35	1.40-1.50	0.6-2.0	0.13-0.20	7.9-8.4	0-2	Moderate	0.28			
	20-44	20-35	1.40-1.50	0.6-2.0	0.13-0.20	7.9-8.4	0-2	Moderate	0.28			
	44-60	10-20	1.45-1.55	2.0-6.0	0.11-0.13	7.9-8.4	0-2	Low-------	0.20			
22*:												
Gypsiorthids----	0-60	---	---	---	---	---	---	----------	----	3	---	---
Torriorthents---	0-60	---	---	---	---	---	---	----------	----	5	---	---
23----------	0-4	10-15	1.35-1.50	2.0-6.0	0.03-0.04	7.9-8.4	8-32	Low-------	0.24	5	3	.5-1
Ives	4-60	10-15	1.35-1.50	0.6-2.0	0.02-0.04	7.9-8.4	8-32	Low-------	0.24			
24----------	0-4	10-18	1.40-1.55	0.6-2.0	0.01-0.03	7.9-9.0	4-32	Low-------	0.24	5	3	.5-1
Ives	4-49	5-18	1.40-1.55	0.6-2.0	0.01-0.03	7.9-9.0	4-32	Low-------	0.24			
	49-62	2-10	1.50-1.60	2.0-6.0	0.01-0.02	7.9-9.0	4-32	Low-------	0.17			
25----------	0-13	10-18	1.45-1.60	0.6-2.0	0.03-0.05	7.9-9.0	4-32	Low-------	0.55	5	3	.5-1
Ives	13-55	5-18	1.40-1.55	0.6-2.0	0.01-0.03	7.9-9.0	4-32	Low-------	0.24			
	55-62	2-10	1.50-1.60	2.0-6.0	0.01-0.02	7.9-9.0	4-32	Low-------	0.17			
26, 27, 28-------	0-9	20-35	1.20-1.30	0.2-0.6	0.01-0.12	7.9-9.0	4-32	Moderate	0.28	5	5	<.5
Jocity	9-41	20-35	1.20-1.30	0.2-0.6	0.01-0.12	7.9-9.0	4-32	Moderate	0.28			
	41-60	5-20	1.40-1.55	2.0-6.0	0.01-0.11	7.9-9.0	4-32	Low-------	0.24			
29----------	0-9	40-50	1.45-1.60	0.06-0.2	0.02-0.13	7.9-9.0	4-32	High------	0.24	5	4	<.5
Jocity	9-41	20-35	1.20-1.30	0.2-0.6	0.01-0.12	7.9-9.0	4-32	Moderate	0.28			
	41-60	5-20	1.40-1.55	2.0-6.0	0.01-0.11	7.9-9.0	4-32	Low-------	0.24			
30----------	0-2	5-15	1.35-1.50	2.0-6.0	0.12-0.14	7.9-8.4	0-2	Low-------	0.24	1	3	1-2
Kech	2-5	18-27	1.30-1.40	0.6-2.0	0.14-0.16	7.9-8.4	0-2	Low-------	0.32			
	5-11	18-27	1.30-1.40	0.6-2.0	0.11-0.14	7.9-8.4	0-2	Low-------	0.24			
	11-15	27-35	1.25-1.40	0.6-2.0	0.13-0.17	7.9-8.4	0-2	Moderate	0.24			
	15	---	---	---	---	---	---	----------	----			
31*:												
Kech----------	0-2	5-15	1.35-1.50	2.0-6.0	0.07-0.11	7.9-8.4	0-2	Low-------	0.17	1	3	1-2
	2-12	18-27	1.30-1.40	0.6-2.0	0.11-0.14	7.9-8.4	0-2	Low-------	0.24			
	12	---	---	---	---	---	---	----------	----			
Rock outcrop----	0-60	---	1.50-1.80	---	---	---	---	----------	----	---	8	---
32----------	0-1	1-12	1.50-1.60	6.0-20	0.06-0.08	7.9-8.4	0-2	Low-------	0.15	5	2	<1
Kinan	1-54	5-18	1.40-1.55	2.0-6.0	0.11-0.15	7.9-8.4	0-2	Low-------	0.20			
	54-60	20-35	1.20-1.30	0.2-0.6	0.14-0.16	7.9-8.4	0-2	Low-------	0.28			
33*:												
Leanto----------	0-1	1-10	1.45-1.55	2.0-6.0	0.04-0.07	7.9-8.4	0-2	Low-------	0.20	1	2	<1
	1-10	12-18	1.35-1.45	0.6-6.0	0.07-0.15	7.9-8.4	0-2	Low-------	0.24			
	10-14	12-18	1.35-1.45	0.6-2.0	0.10-0.15	7.9-8.4	0-2	Low-------	0.24			
	14	---	---	---	---	---	---	----------	----			
Bisoodi---------	0-1	10-20	1.35-1.50	2.0-6.0	0.09-0.11	7.4-8.4	0-2	Low-------	0.15	1	3	1-2
	1-14	5-18	1.25-1.50	0.6-2.0	0.10-0.14	7.9-8.4	0-2	Low-------	0.24			
	14-18	---	---	---	---	---	---	----------	----			
	18	---	---	---	---	---	---	----------	----			

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
									K	T		
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
34*:												
Leanto----------	0-1	5-18	1.45-1.65	2.0-6.0	0.07-0.11	7.9-8.4	0-2	Low-------	0.17	1	3	<1
	1-10	12-18	1.35-1.45	0.6-6.0	0.07-0.15	7.9-8.4	0-2	Low-------	0.24			
	10-14	12-18	1.35-1.45	0.6-2.0	0.10-0.15	7.9-8.4	0-2	Low-------	0.24			
	14	---	---	---	---	---	---	----------	----			
Bisoodi---------	0-1	10-20	1.35-1.50	2.0-6.0	0.09-0.11	7.4-8.4	0-2	Low-------	0.15	1	3	1-2
	1-14	5-18	1.25-1.50	0.6-2.0	0.10-0.14	7.9-8.4	0-2	Low-------	0.24			
	14-18	---	---	---	---	---	---	----------	----			
	18-28	---	---	---	---	---	---	----------	----			
Rock outcrop----	0-60	---	2.50-2.80	---	---	---	---	----------	----	---	8	---
35----------	0-2	7-27	1.00-1.05	0.6-2.0	0.04-0.07	6.6-8.4	0-2	Low-------	0.05	3	8	1-2
Lozinta	2-21	7-27	1.00-1.05	0.6-2.0	0.04-0.07	6.6-8.4	0-2	Low-------	0.05			
	21-60	0-1	---	>20	0.01-0.03	6.6-8.4	0-2	Low-------	0.02			
36----------	0-3	20-35	1.20-1.30	0.2-0.6	0.13-0.16	7.9-8.4	0-2	Moderate	0.28	5	5	1-2
Manzano	3-27	20-35	1.20-1.30	0.2-0.6	0.13-0.16	7.9-8.4	0-2	Moderate	0.28			
	27-36	20-35	1.20-1.30	0.2-0.6	0.13-0.16	7.9-8.4	0-2	Moderate	0.28			
	36-60	20-35	1.20-1.30	0.2-0.6	0.13-0.16	7.9-8.4	0-2	Moderate	0.28			
37----------	0-6	3-5	1.45-1.60	2.0-6.0	0.05-0.08	7.9-8.4	0-8	Low-------	0.15	5	2	<1
Marcou	6-47	10-15	1.35-1.50	0.6-2.0	0.09-0.11	8.5-9.0	2-8	Low-------	0.20			
	47-54	20-35	1.20-1.30	0.6-2.0	0.09-0.14	8.5-9.0	2-8	Low-------	0.28			
	54-60	1-10	1.50-1.60	6.0-20	0.02-0.04	8.5-9.0	2-8	Low-------	0.15			
38----------	0-60	---	---	---	---	---	---	----------	----	3	---	80-95
Medisaprists												
39*:												
Mellenthin------	0-1	5-20	1.40-1.55	2.0-6.0	0.06-0.10	7.9-8.4	0-2	Low-------	0.17	1	8	1-2
	1-6	10-27	1.35-1.45	0.6-2.0	0.07-0.12	7.9-8.4	0-2	Low-------	0.10			
	6-12	10-27	1.35-1.45	0.6-2.0	0.07-0.12	7.9-8.4	0-2	Low-------	0.10			
	12-20	---	---	---	---	---	---	----------	----			
	20	---	---	---	---	---	---	----------	----			
Rock outcrop----	0-60	---	1.50-1.80	---	---	---	---	----------	----	---	8	---
40, 41----------	0-5	45-50	1.15-1.30	<0.06	0.03-0.05	7.9-9.0	16-32	High------	0.28	5	4	<.5
Navajo	5-60	40-60	1.15-1.30	<0.06	0.03-0.05	7.9-9.0	16-32	High------	0.28			
42----------	0-5	45-50	1.15-1.30	<0.06	0.03-0.05	7.9-9.0	8-32	High------	0.28	5	4	<.5
Navajo	5-60	40-60	1.15-1.30	<0.06	0.03-0.05	7.9-9.0	8-32	High------	0.28			
43----------	0-2	10-20	1.15-1.25	0.2-0.6	0.19-0.21	7.9-8.4	0-2	Low-------	0.43	5	4L	<1
Nuffel	2-12	27-35	1.20-1.30	0.2-0.6	0.19-0.21	7.9-8.4	0-2	Moderate	0.37			
	12-60	18-35	1.15-1.30	0.2-0.6	0.19-0.21	7.9-8.4	0-2	Moderate	0.37			
44*:												
Padilla---------	0-8	25-35	1.25-1.50	0.2-0.6	0.19-0.21	7.4-8.4	0-2	Moderate	0.24	5	5	1-2
	8-60	35-55	1.15-1.30	0.06-0.2	0.14-0.17	7.9-8.4	0-2	High------	0.20			
Cerrillos-------	0-2	5-20	1.40-1.55	2.0-6.0	0.10-0.13	7.9-8.4	0-0	Low-------	0.20	2	3	.5-1
	2-15	25-35	1.20-1.30	0.2-0.6	0.12-0.16	7.9-8.4	0-0	Moderate	0.28			
	15-34	27-35	1.20-1.30	0.2-0.6	0.17-0.20	7.9-9.0	0-4	Moderate	0.28			
	34-60	25-35	1.20-1.30	0.2-0.6	0.11-0.15	7.9-9.0	0-4	Moderate	0.28			

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
45*:												
Pensom----------	0-17	0-8	1.50-1.60	6.0-20	0.05-0.07	7.4-8.4	0-0	Low-------	0.20	3	2	1-2
	17-41	2-10	1.50-1.60	6.0-20	0.09-0.11	7.9-8.4	0-0	Low-------	0.24			
	41-51	5-20	1.40-1.55	6.0-20	0.13-0.18	7.9-8.4	0-2	Low-------	0.24			
	51	---	---	---	---	---	---	----------	----			
Chedeski--------	0-1	5-15	1.20-1.30	2.0-6.0	0.13-0.15	7.4-7.8	0-2	Low-------	0.24	2	3	<1
	1-13	12-27	1.30-1.40	0.6-2.0	0.14-0.16	7.4-8.4	0-2	Low-------	0.24			
	13-16	18-27	1.30-1.40	0.6-2.0	0.14-0.16	7.9-8.4	0-2	Low-------	0.24			
	16-26	---	---	---	---	---	---	----------	----			
	26	---	---	---	---	---	---	----------	----			
46*:												
Penzance--------	0-3	27-35	1.20-1.30	0.2-0.6	0.17-0.21	7.9-8.4	<4	Moderate	0.24	5	4L	<1
	3-60	35-50	1.20-1.60	0.06-0.2	0.12-0.21	7.9-9.0	<4	High------	0.20			
Grieta----------	0-3	10-20	1.45-1.55	2.0-6.0	0.11-0.13	7.9-8.4	0-2	Low-------	0.20	5	3	.1-.5
	3-20	20-35	1.40-1.50	0.6-2.0	0.13-0.20	7.9-8.4	0-2	Moderate	0.28			
	20-44	20-35	1.40-1.50	0.6-2.0	0.13-0.20	7.9-8.4	0-2	Moderate	0.28			
	44-60	10-20	1.45-1.55	2.0-6.0	0.11-0.13	7.9-8.4	0-2	Low-------	0.20			
47----------	0-1	5-20	1.40-1.55	2.0-6.0	0.12-0.15	7.4-7.8	0-0	Low-------	0.24	5	3	1-2
Poley	1-4	7-27	1.40-1.50	0.6-2.0	0.15-0.18	7.4-7.8	0-0	Low-------	0.32			
	4-13	27-35	1.20-1.30	0.2-0.6	0.18-0.21	7.4-7.8	0-2	Moderate	0.28			
	13-22	35-45	1.25-1.55	0.06-0.2	0.12-0.21	7.4-8.4	0-2	High------	0.32			
	22-47	35-45	1.25-1.55	0.06-0.2	0.12-0.21	7.9-9.0	0-4	High------	0.32			
	47-60	20-35	1.20-1.30	0.2-0.6	0.12-0.16	7.9-9.0	0-4	Moderate	0.28			
48----------	0-1	10-15	1.40-1.55	0.6-2.0	0.10-0.15	7.4-8.4	2-8	Low-------	0.49	3	3	.5-1
Purgatory	1-20	10-15	1.35-1.45	0.6-2.0	0.12-0.16	7.4-8.4	2-8	Low-------	0.37			
	20-27	30-35	1.20-1.30	0.6-2.0	0.19-0.21	7.4-8.4	2-8	Moderate	0.37			
	27-60	---	---	---	---	---	---	----------	----			
49----------	0-4	5-25	1.15-1.25	0.6-2.0	0.18-0.21	7.4-8.4	0-2	Low-------	0.37	5	5	1-2
Radnik	4-45	8-27	1.40-1.50	0.6-2.0	0.15-0.18	7.4-8.4	0-2	Low-------	0.32			
	45-60	20-35	1.20-1.30	0.2-0.6	0.13-0.16	7.4-8.4	0-2	Moderate	0.28			
50*:												
Riverwash-------	0-60	---	---	---	---	---	---	----------	----	---	---	---
Typic Torrifluvents--	0-60	---	---	---	---	---	---	----------	----	3	---	---
51*:												
Riverwash-------	0-60	---	---	---	---	---	---	----------	----	---	---	---
Ustic Torrifluvents--	0-60	---	---	---	---	---	---	----------	----	3	---	---
52*:												
Rock outcrop----	0-60	---	2.50-2.80	---	---	---	---	----------	----	---	8	---
Arches----------	0-13	3-8	1.40-1.50	6.0-20	0.08-0.10	7.4-8.4	0-0	Low-------	0.28	1	2	<1
	13	---	---	---	---	---	---	----------	----			
53*:												
Rock outcrop----	0-60	---	2.50-2.80	---	---	---	---	----------	----	---	8	---

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
									K	T		
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
53*:												
Deama	0-3	18-27	1.35-1.45	0.6-2.0	0.07-0.12	7.4-8.4	0-2	Low	0.10	1	8	1-2
	3-12	18-27	1.35-1.45	0.6-2.0	0.07-0.12	7.4-8.4	0-2	Low	0.10			
	12-19	18-27	1.30-1.40	0.6-2.0	0.04-0.05	7.4-8.4	0-2	Low	0.10			
	19	---	---	---	---	---	---	---	---			
54*:												
Rock outcrop	0-60	---	1.50-1.80	---	---	---	---	---	---	---	8	---
Epikom	0-3	5-18	1.45-1.65	2.0-6.0	0.07-0.11	7.9-8.4	0-2	Low	0.17	1	3	<.5
	3-14	12-18	1.35-1.45	0.6-2.0	0.10-0.15	7.9-8.4	0-2	Low	0.24			
	14	---	---	---	---	---	---	---	---			
55*:												
Rock outcrop	0-60	---	2.50-2.80	---	---	---	---	---	---	---	8	---
Kech	0-2	5-15	1.35-1.50	2.0-6.0	0.07-0.11	7.9-8.4	0-2	Low	0.17	1	3	1-2
	2-12	18-27	1.30-1.40	0.6-2.0	0.11-0.14	7.9-8.4	0-2	Low	0.24			
	12-16	27-35	1.25-1.40	0.6-2.0	0.13-0.17	7.9-8.4	0-2	Moderate	0.24			
	16	---	---	---	---	---	---	---	---			
56*:												
Rock outcrop	0-60	---	2.50-2.80	---	---	---	---	---	---	---	8	---
Leanto	0-1	5-18	1.45-1.65	2.0-6.0	0.07-0.11	7.9-8.4	0-2	Low	0.17	1	3	<1
	1-10	12-18	1.35-1.45	0.6-6.0	0.07-0.15	7.9-8.4	0-2	Low	0.24			
	10-14	12-18	1.35-1.45	0.6-2.0	0.10-0.15	7.9-8.4	0-2	Low	0.24			
	14	---	---	---	---	---	---	---	---			
57*:												
Rock outcrop	0-60	---	2.50-2.80	---	---	---	---	---	---	---	8	---
Mellenthin	0-5	10-27	1.35-1.45	0.6-2.0	0.07-0.12	7.9-8.4	0-2	Low	0.10	1	8	1-2
	5-11	10-27	1.35-1.45	0.6-2.0	0.07-0.12	7.9-8.4	0-2	Low	0.10			
	11-14	10-27	1.30-1.40	0.6-2.0	0.04-0.07	7.9-8.4	0-2	Low	0.05			
	14	---	---	---	---	---	---	---	---			
58*:												
Rock outcrop	0-60	---	2.50-2.80	---	---	---	---	---	---	---	8	---
Needle	0-7	0-10	1.35-1.45	>20	0.05-0.07	7.4-8.4	0-2	Low	0.10	1	1	<1
	7-9	0-15	1.45-1.55	6.0-20	0.05-0.08	7.4-8.4	0-2	Low	0.10			
	9	---	---	---	---	---	---	---	---			
59	0-1	27-40	1.20-1.30	0.2-0.6	0.06-0.18	7.9-9.0	4-16	Moderate	0.32	1	4L	<1
Shalet	1-4	27-35	1.20-1.30	0.2-0.6	0.06-0.18	7.9-9.0	4-16	Moderate	0.28			
	4-7	---	---	---	---	---	---	---	---			
	7-60	---	---	---	---	---	---	---	---			
60*:												
Sheppard	0-60	2-5	1.50-1.60	6.0-20	0.06-0.08	7.4-8.4	0-0	Low	0.24	5	2	0-.5
Grieta	0-3	10-20	1.45-1.55	2.0-6.0	0.11-0.13	7.9-8.4	0-2	Low	0.20	5	3	.1-.5
	3-21	20-35	1.40-1.50	0.6-2.0	0.13-0.20	7.9-8.4	0-2	Moderate	0.28			
	21-60	10-20	1.45-1.55	2.0-6.0	0.11-0.13	7.9-8.4	0-2	Low	0.20			
61	0-60	2-5	1.50-1.60	6.0-20	0.05-0.07	7.4-8.4	0-0	Low	0.20	5	1	0-.5
Sheppard												

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
62----------	0-4	10-18	1.45-1.55	2.0-6.0	0.07-0.11	7.4-8.4	0-4	Low-------	0.17	3	4	>1
Sheza	4-15	27-35	1.20-1.30	0.2-0.6	0.09-0.16	7.9-8.4	0-4	Low-------	0.20			
	15-28	5-18	1.30-1.40	0.6-2.0	0.05-0.11	7.9-8.4	0-4	Low-------	0.05			
	28-60	1-5	1.30-1.40	6.0-20	0.02-0.04	7.9-8.4	0-4	Low-------	0.05			
63----------	0-5	40-60	1.30-1.60	0.01-0.05	0.14-0.16	7.4-7.8	0-2	High------	0.20	5	4	1-2
Springerville	5-60	40-60	1.30-1.60	0.01-0.05	0.14-0.16	7.4-7.8	0-2	High------	0.20			
64*----------	0-9	40-60	1.25-1.45	0.01-0.05	0.15-0.17	7.4-7.8	0-0	High------	0.37	5	7	1-2
Springerville family	9-60	40-60	1.30-1.50	0.01-0.05	0.14-0.16	7.4-7.8	0-0	High------	0.32			
65----------	0-2	27-40	1.20-1.30	0.06-0.2	0.12-0.18	7.4-8.4	0-0	Moderate	0.24	3	4L	1-2
Thunderbird	2-18	40-55	1.30-1.60	0.01-0.05	0.12-0.16	7.4-8.4	0-0	High------	0.32			
	18-27	40-55	1.25-1.35	0.01-0.05	0.12-0.16	7.4-8.4	0-0	High------	0.17			
	27-31	27-35	1.35-1.45	0.06-0.2	0.08-0.14	7.4-8.4	0-0	Low-------	0.10			
	31	---	---	---	---	---	---	----------	----			
66*:												
Torriorthents---	0-60	---	---	---	---	---	---	----------	----	5	---	---
Calciorthids----	0-60	---	---	---	---	---	---	Low-------	----	5	---	---
67----------	0-6	25-35	1.25-1.35	0.2-0.6	0.19-0.21	7.4-8.4	0-4	Moderate	0.37	5	4L	<1
Tours	6-36	18-35	1.30-1.40	0.2-0.6	0.19-0.21	7.9-8.4	0-4	Moderate	0.37			
	36-60	2-10	1.20-1.55	0.6-2.0	0.09-0.18	7.9-8.4	0-4	----------	----			
68, 69----------	0-6	30-40	1.20-1.30	0.2-0.6	0.05-0.07	7.9-9.0	16-32	Moderate	0.43	5	4L	.2-.5
Tours	6-47	27-40	1.20-1.30	0.2-0.6	0.05-0.07	7.9-9.0	16-32	Moderate	0.37			
	47-60	5-20	1.20-1.55	0.6-2.0	0.03-0.04	7.9-9.0	16-32	Low-------	0.32			
70----------	0-3	4-8	1.50-1.60	6.0-20	0.06-0.08	7.9-8.4	0-2	Low-------	0.15	5	2	.2-.6
Trail	3-60	4-8	1.40-1.50	2.0-6.0	0.06-0.09	7.9-9.0	0-8	Low-------	0.20			
71*:												
Ustollic Haplargids-----	0-60	---	---	---	---	---	---	----------	----	4	---	---
Ustollic Haplargids-----	0-60	---	---	---	---	---	---	----------	----	4	---	---
Ustollic Haplargids-----	0-60	---	---	---	---	---	---	----------	----	4	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," and "apparent" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
1---------- Arntz	C	None--------	---	---	>6.0	---	---	30-60	Soft	Moderate	High.
2---------- Atarque	D	None--------	---	---	>6.0	---	---	6-20	Hard	High-----	Low.
3*: Badland---------	D	None--------	---	---	>6.0	---	---	0-1	Soft	High-----	High.
Torriorthents---	D	None--------	---	---	>6.0	---	---	5-20	Soft	High-----	High.
4---------- Bagley	B	Occasional	Brief-----	Jul-Sep	>6.0	---	---	>60	---	Moderate	Low.
5, 6---------- Barx	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
7---------- Bisoodi	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
8*: Burnswick-------	B	None--------	---	---	>6.0	---	---	>60	---	High-----	High.
Marcou----------	B	None--------	---	---	>6.0	---	---	>60	---	High-----	High.
9---------- Burnswick	B	None--------	---	---	>6.0	---	---	>60	---	High-----	High.
10*: Calciorthids----	B	None--------	---	---	>6.0	---	---	10-50	Hard	High-----	Low.
Torriorthents---	D	None--------	---	---	>6.0	---	---	10-55	Hard	High-----	Moderate.
Rock outcrop----	D	None--------	---	---	>6.0	---	---	0-1	Hard	---	---
11---------- Cerrillos	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
12*: Cerrillos-------	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Ubank-----------	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
13---------- Claysprings	D	None--------	---	---	>6.0	---	---	6-20	Soft	High-----	Low.
14*---------- Deama family	D	None--------	---	---	>6.0	---	---	15-20	Hard	High-----	Low.
15*: Deama-----------	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
Rock outcrop----	D	None--------	---	---	>6.0	---	---	0-1	Hard	---	---

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
16*---------- Dune land	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
17---------- Epikom	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
18*:											
Epikom----------	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
Rock outcrop----	D	None--------	---	---	>6.0	---	---	0-1	Hard	---	---
19*---------- Escavada family	A	Rare--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
20, 21---------- Grieta	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
22*:											
Gypsiorthids----	B	None--------	---	---	>6.0	---	---	40-60	Hard	High-----	High.
Torriorthents---	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Moderate.
23---------- Ives	D	Occasional	Brief-----	Jul-Sep	0.5-5.0	Apparent	Jul-Sep	>60	---	High-----	High.
24, 25---------- Ives	B	Occasional	Brief-----	Jul-Sep	>6.0	---	---	>60	---	High-----	Moderate.
26, 27, 28, 29--- Jocity	B	Occasional	Very brief	Jul-Sep	>6.0	---	---	>60	---	High-----	Low.
30---------- Kech	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
31*:											
Kech----------	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
Rock outcrop----	D	None--------	---	---	>6.0	---	---	0-1	Hard	---	---
32---------- Kinan	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
33*:											
Leanto----------	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
Bisoodi---------	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
34*:											
Leanto----------	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
Bisoodi---------	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
Rock outcrop----	D	None--------	---	---	>6.0	---	---	0-1	Hard	---	---
35---------- Lozinta	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
36---------- Manzano	B	Occasional	Brief-----	Jul-Sep	>6.0	---	---	>60	---	High-----	Low.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
37---------- Marcou	B	None--------	---	---	>6.0	---	---	>60	---	High-----	High.
38---------- Medisaprists	D	Frequent----	Brief-----	Jan-Dec	0-3.0	Apparent	Jan-Dec	>60	---	High-----	High.
39*:											
Mellenthin------	D	None--------	---	---	>6.0	---	---	8-20	Hard	High-----	Low.
Rock outcrop----	D	None--------	---	---	>6.0	---	---	0-1	Hard	---	---
40, 41---------- Navajo	D	Occasional	Brief-----	Jul-Sep	>6.0	---	---	>60	---	High-----	High.
42---------- Navajo	D	Occasional	Brief-----	Jul-Sep	+.5-6.0	Apparent	Jul-Sep	>60	---	High-----	High.
43---------- Nuffel	B	Occasional	Very brief	Jul-Sep	>6.0	---	---	>60	---	High-----	Low.
44*:											
Padilla---------	C	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Cerrillos-------	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
45*:											
Pensom----------	A	None--------	---	---	>6.0	---	---	45-60	Hard	High-----	Low.
Chedeski--------	B	None--------	---	---	>6.0	---	---	10-20	Soft	High-----	Low.
46*:											
Penzance--------	C	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Grieta----------	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
47---------- Poley	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
48---------- Purgatory	C	None--------	---	---	>6.0	---	---	20-40	Soft	High-----	High.
49---------- Radnik	B	Occasional	Brief-----	Jul-Sep	>6.0	---	---	>60	---	High-----	Low.
50*:											
Riverwash-------	D	Frequent----	Brief to long.	Jan-Dec	0-6.0	Apparent	Jan-Dec	0-60	Hard	High-----	Low.
Typic Torrifluvents--	B	Frequent----	Brief-----	Mar-Sep	1.0-6.0	Apparent	Mar-Sep	40-60	Hard	High-----	Moderate.
51*:											
Riverwash-------	D	Frequent----	Brief to long.	Jan-Dec	0-6.0	Apparent	Jan-Dec	0-60	Hard	High-----	Low.
Ustic Torrifluvents--	B	Frequent----	Brief-----	Mar-Sep	1.0-6.0	Apparent	Mar-Sep	40-60	Hard	High-----	Low.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
52*:											
Rock outcrop----	D	None--------	---	---	>6.0	---	---	0-1	Hard	---	---
Arches----------	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
53*:											
Rock outcrop----	D	None--------	---	---	>6.0	---	---	0-1	Hard	---	---
Deama-----------	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
54*:											
Rock outcrop----	D	None--------	---	---	>6.0	---	---	0-1	Hard	---	---
Epikom----------	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
55*:											
Rock outcrop----	D	None--------	---	---	>6.0	---	---	0-1	Hard	---	---
Kech------------	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
56*:											
Rock outcrop----	D	None--------	---	---	>6.0	---	---	0-1	Hard	---	---
Leanto----------	D	None--------	---	---	>6.0	---	---	10-20	Hard	High-----	Low.
57*:											
Rock outcrop----	D	None--------	---	---	>6.0	---	---	0-1	Hard	---	---
Mellenthin------	D	None--------	---	---	>6.0	---	---	8-20	Hard	High-----	Low.
58*:											
Rock outcrop----	D	None--------	---	---	>6.0	---	---	0-1	Hard	---	---
Needle----------	D	None--------	---	---	>6.0	---	---	5-20	Hard	High-----	Low.
59---------- Shalet	D	None--------	---	---	>6.0	---	---	4-15	Soft	High-----	High.
60*:											
Sheppard--------	A	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Grieta----------	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
61---------- Sheppard	A	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
62---------- Sheza	C	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
63---------- Springerville	D	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
64*---------- Springerville family	D	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
65---------- Thunderbird	D	None--------	---	---	>6.0	---	---	20-40	Hard	Moderate	Low.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
66*:											
Torriorthents---	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
Calciorthids----	B	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
67---------- Tours	B	Occasional	Very brief	Jul-Sep	>6.0	---	---	>60	---	High-----	Low.
68, 69---------- Tours	B	Occasional	Very brief	Jul-Sep	>6.0	---	---	>60	---	High-----	High.
70---------- Trail	B	Occasional	Very brief	Jul-Sep	>6.0	---	---	>60	---	High-----	Low.
71*:											
Ustollic Haplargids-----	B	None--------	---	---	>6.0	---	---	40-70	Soft	High-----	Low.
Ustollic Haplargids-----	B	None--------	---	---	>6.0	---	---	40-70	Soft	High-----	Low.
Ustollic Haplargids-----	B	None--------	---	---	>6.0	---	---	40-70	Soft	High-----	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Arches	Mixed, mesic Lithic Torripsamments
Arntz	Fine-loamy, gypsic, mesic Cambic Gypsiorthids
Atarque	Loamy, mixed, mesic Lithic Haplustalfs
Bagley	Fine, mixed, mesic Cumulic Haplustolls
Barx	Fine-loamy, mixed, mesic Ustollic Haplargids
Bisoodi	Loamy, mixed, mesic Lithic Ustollic Calciorthids
Burnswick	Fine-loamy, mixed, mesic Typic Camborthids
Calciorthids	Calciorthids
Cerrillos	Fine-loamy, mixed, mesic Ustollic Haplargids
Chedeski	Loamy, mixed, mesic, shallow Ustochreptic Camborthids
Claysprings	Clayey, montmorillonitic (calcareous), mesic, shallow Typic Torriorthents
Deama	Loamy-skeletal, carbonatic, mesic Lithic Calciustolls
Deama family	Loamy-skeletal, carbonatic, mesic Lithic Calciustolls
Epikom	Loamy, mixed, mesic Lithic Camborthids
Escavada family	Sandy, mixed, mesic Ustic Torrifluvents
Grieta	Fine-loamy, mixed, mesic Typic Haplargids
Gypsiorthids	Gypsiorthids
Ives	Coarse-loamy, mixed (calcareous), mesic Typic Torrifluvents
Jocity	Fine-loamy, mixed (calcareous), mesic Typic Torrifluvents
Kech	Loamy, mixed, mesic Lithic Ustollic Haplargids
Kinan	Coarse-loamy, mixed, mesic Typic Calciorthids
Leanto	Loamy, mixed, mesic Lithic Camborthids
Lozinta	Ashy-skeletal over fragmental or cindery, mixed mesic Vitrandic Ustochrepts
Manzano	Fine-loamy, mixed, mesic Cumulic Haplustolls
Marcou	Coarse-loamy, mixed (calcareous), mesic Typic Torriorthents
Medisaprists	Medisaprists
Mellenthin	Loamy-skeletal, mixed, mesic Lithic Ustollic Calciorthids
Navajo	Fine, mixed (calcareous), mesic Vertic Torrifluvents
Needle	Mixed, mesic Lithic Torripsamments
Nuffel	Fine-silty, mixed (calcareous), mesic Ustic Torrifluvents
Padilla	Fine, mixed, mesic Ustollic Haplargids
Pensom	Mixed, mesic Ustic Torripsamments
Penzance	Fine, montmorillonitic, mesic Vertic Haplargids
Poley	Fine, mixed, mesic Ustollic Haplargids
Purgatory	Fine-loamy, gypsic, mesic Typic Gypsiorthids
Radnik	Coarse-loamy, mixed (calcareous), mesic Ustic Torrifluvents
Shalet	Loamy, mixed (calcareous), mesic, shallow Typic Torriorthents
Sheppard	Mixed, mesic Typic Torripsamments
Sheza	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Ustollic Haplargids
*Springerville	Fine, montmorillonitic, mesic Aridic Haplusterts
Springerville family	Fine, montmorillonitic, mesic Aridic Haplusterts
Thunderbird	Fine, montmorillonitic, mesic Aridic Argiustolls
Torriorthents	Torriorthents
Tours	Fine-silty, mixed (calcareous), mesic Typic Torrifluvents
Trail	Sandy, mixed, mesic Typic Torrifluvents
Typic Calciorthids	Typic Calciorthids
Typic Torrifluvents	Typic Torrifluvents
Ubank	Coarse-loamy, carbonatic, mesic Ustollic Calciorthids
Ustic Torrifluvents	Ustic Torrifluvents
Ustollic Haplargids	Ustollic Haplargids

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