United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with United States Department of the Interior, Bureau of Land Management; National Park Service; and the Arizona Agricultural Experiment Station

Soil Survey of Coconino County Area, Arizona, North Kaibab Part

How to Use This Soil Survey

General Soil Map

The general soil map, which is a color map, 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.

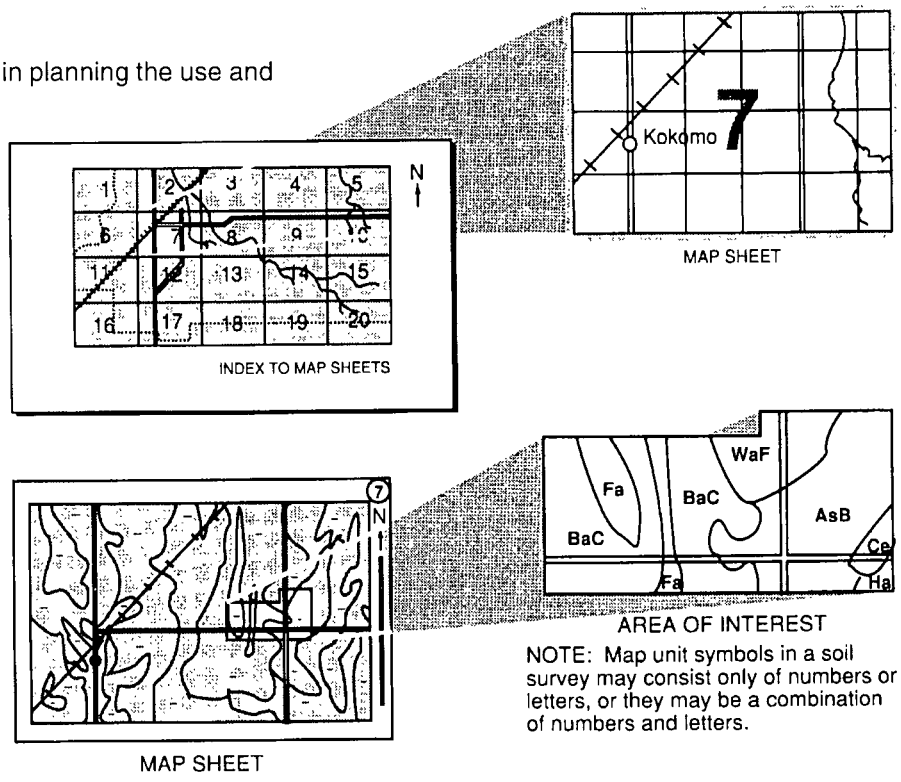
Detailed Soil Maps

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

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

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

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



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 1981. Soil names and descriptions were approved in 1991. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1983. This survey was made cooperatively by the Natural Resources Conservation Service, the Bureau of Land Management, the National Park Service, and the Arizona Agricultural Experiment Station. The survey is part of the technical assistance furnished to the Fredonia Natural Resource Conservation District and the Navajo Mountain Soil and Water Conservation District.

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

Cover: Overlooking Paria River Canyon from the Paria Plateau.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is http://www.nrcs.usda.gov (click on "Technical Resources").

Contents

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Foreword

This soil survey contains information that can be used in land-planning programs in the Coconino County Area, Arizona, North Kaibab Part. 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, and agronomists can use it to evaluate the potential of the soil and the management needed for efficient 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 subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey soils are poorly suited to use as septic tank absorption fields.

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.

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Soil Survey of Coconino County Area, Arizona, North Kaibab Part

By Wendell Jorgensen, Natural Resources Conservation Service

Fieldwork by Wendell Jorgensen, Mark H. Clark, and Edward R. Fenn
Natural Resources Conservation Service

United States Department of Agriculture, Natural Resources Conservation Service;
and
United States Department of Interior, Bureau of Land Management; and
National Park Service;
in cooperation with
the Arizona Agricultural Experiment Station

An older survey, "Physical Land Conditions in the Fredonia Soil Conservation District in Arizona," was published in 1950. This earlier survey covers a part of the present survey. The present survey, however, updates the earlier survey and provides additional information and larger maps that show the soils in greater detail.

Descriptions, names, and delineations of soils in this survey do not fully agree with those on soil maps for adjacent survey areas. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, or the extent of soils within the survey.

General Nature of the Survey Area

This section briefly discusses the history and development, transportation, natural resources, physiology, geology, and climate of the survey area.

Settlement and Development

Indians have lived in this survey area for centuries (fig. 1). The earliest known inhabitants were the Virgin Branch of the Anasazi Culture. The Anasazi incursion from the east continued sporadically from 700 A.D. to 1100 A.D. About 1150 A.D., Numic-speaking people spread south and east along the southern Colorado Plateau. They were mainly foragers but some small groups learned farming techniques from the Anasazi people.

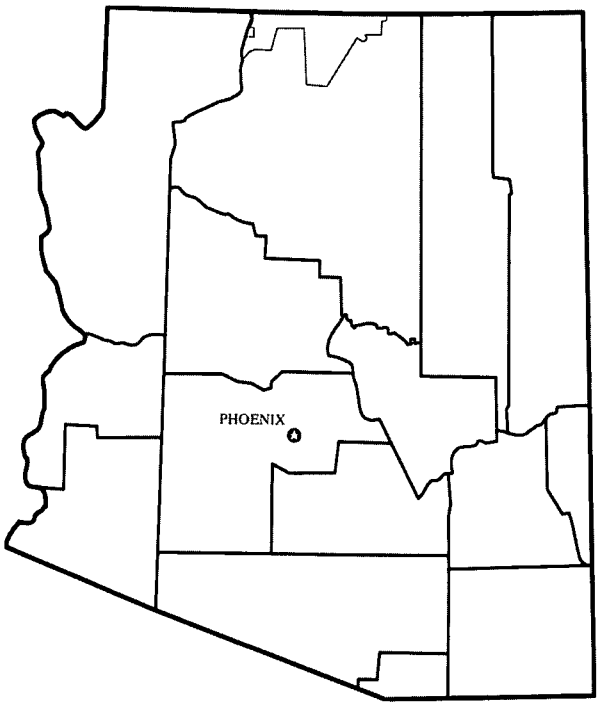

Figure 1.— Location of Coconino County Area, North Kaibab Part, in Arizona.

In 1776, a Spanish expedition of about 8 men, known as the Dominquez-Escalante Expedition, visited the area. They started in Santa Fe, New Mexico, and went north through Colorado and back

Figure 2.—An abandoned line shack. The trend on the Arizona Strip is to commute to the ranch.

down through Utah and Arizona looking for a suitable crossing of the Colorado River to establish a direct trade route to the Spanish settlement in Monterey, California. The next group to enter the area were trappers, a few more Spaniards, miners, and finally some early Mormon frontiersmen. The Fredonia area was settled in the early 1800s (fig. 2).

Construction of Glen Canyon Dam on the Colorado River, which formed Lake Powell, began in 1957 and was completed in 1964. The city of Page, established in response to a need to house the employees who worked on the Glen Canyon Dam, was incorporated in 1975. Seasonal populations fluctuate significantly as a result of tourism and recreation on Lake Powell. Several river rafting companies are located here and throughout the survey area. Thousands of tourists pass through the survey area every year to visit some of the scenic national parks in northern Arizona and southern Utah, such as the North and South Rims of the Grand Canyon, Zion, Bryce, Cedar Breaks, Capitol Reef, and numerous other state parks and scenic areas. Population centers for this survey area are Fredonia, with a population of about 2,000, and Page, which has a population of about 6,000.

Transportation

Two federal and two state highways cross the survey area. U.S. Highway 89A crosses from east to west via Marble Canyon through Fredonia north to Kanab, Utah. Highway 389 joins U.S. Highway 89A in Fredonia from the west. State Highway 98 from Kaibito joins U.S. 89 in Page, and Indian Route 20 south of Page joins State Highway 98 in Page.

Natural Resources

Soil is one of the most important natural resources in the survey area, as the economy is based mainly on forage production for the cattle industry and some farming in the Fredonia area. Recreation—boating, fishing, and rafting on the Colorado River—is the second most important economic activity, especially in the Page area. The beautiful geologic scenery draws thousands of tourists and outdoor enthusiasts

each year to the survey area. Electric power generated by the Glen Canyon Dam is another important resource. Uranium has been mined in the survey area since 1980.

Physiography and Geology

The survey area is in the eastern part of what is known as the Arizona Strip, which is that portion of northwestern Arizona bounded by Utah to the north, Nevada to the west, and the Colorado River to the south and east. The survey area is bordered by the Kaibab National Forest, the Kaibab Indian Reservation, the Navajo Indian Reservation, Utah, the Grand Canyon National Park, the Glen Canyon National Recreation Area, and Mohave County. Also included is a small area around Page, Arizona, which borders the eastern edge of the area. The survey includes parts of the Grand Canyon National Park and Glen Canyon National Recreation Area. About 80 percent of the survey area is administered by the Bureau of Land Management, and 20 percent is in Glen Canyon National Recreation Area under the jurisdiction of the National Park Service. The survey area has a total of about 739,050 acres, or 1,154.8 square miles.

Kanab Creek, a perennial stream forming the western boundary of most of this survey area, is the major drainage system to the nearby Colorado River for the western part of the survey area. In the eastern half of the survey area, the Colorado River is the major drainageway and approximates the eastern boundary.

The survey area is in the Colorado Plateau physiographic and geologic province. The survey area consists mainly of soils on plateaus, hills, fan terraces, and alluvial fans with a few deeply incised canyons. The varying formations and geologic erosion contribute to the diverse and colorful scenery of the area.

The soil survey area is complex, both in the variety of the terrain and the soils, which have weathered from sedimentary geologic limestone, claystones, siltstone, shale, sandstone, and unconsolidated soil material. Some geologic strata are quite high in content of calcium sulfate (gypsum), making the alluvium quite diverse. The majority of the soils in the survey area are formed in material derived from Kaibab limestone, Navajo sandstone, or the gypsiferous Moenkopi shale. The remaining one-third of the survey area consists of soils derived from other rock. Most of the soils are on undulating to rolling plateaus.

Elevations range from 2,800 feet at the Colorado River near South Canyon to 7,300 feet on the southern edge of the Paria Plateau. Generally, most of the survey area is between 3,800 and 6,500 feet.

Climate

In Coconino County Area, Arizona, summers are warm, especially at lower elevations, and winters are cold. Precipitation is normally light at lower elevations during all months of the year, and land is mainly used for range. At higher elevations, precipitation is much greater, and snow accumulates to considerable depths.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Fredonia station and Page station, Arizona, for the period 1951 to 1975 and 1958 to 1981, respectively. Table 2 shows probable dates of the first freeze in the fall and the last freeze in the spring. Table 3 provides data on length of the growing season.

In winter, the average temperatures at Fredonia and Page stations are 34 and 36 degrees, respectively. The average daily minimum temperature is 19 degrees at Fredonia station and 27 degrees at Page station. The lowest temperature occurred at Fredonia station on January 6, 1973, and is -20 degrees. In summer, the average temperature is 71 degrees at Fredonia station and 80 degrees at Page station. The average daily maximum temperature is about 92 degrees. The highest recorded temperature, which occurred at Page station on June 21, 1968, is 109 degrees.

Growing degree days, shown in table 1, 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 10 inches at Fredonia station and 6 inches at Page station. Of this, 45 percent usually falls in April through September, which includes the growing season for most crops. The heaviest one-day rainfall during the period of record was 2 inches at Page station on December 31, 1978. Thunderstorms occur on about 50 days each year, and most occur in summer.

Average seasonal snowfall is 22 inches at Fredonia station and 6 inches at Page station. The greatest snow depth at any one time during the period of record was 18 inches at Fredonia station and 9 inches at Page station. On the average, 7 days at Fredonia station and 3 days at Page station had at least one inch of snow on the ground, but 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 average percentage of possible sunshine is 85 percent in summer and 75 percent in winter. The prevailing wind is from the south-southwest. Average windspeed is highest, 9 miles per hour, in the spring.

Every few years a blizzard strikes the survey area with high winds and drifting snow. Even at 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 of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept or model of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

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

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

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

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 be flooded in most years, but they cannot predict that a soil will always be flooded on any specific date.

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

Map Unit Composition

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

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

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of soil data. The objectives 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 components of one map 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 can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

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

Soil Descriptions

1. Pennell-Kinan

Shallow and very deep, well drained, gently sloping to steep, loamy and gravelly loamy soils; on plateaus and hills

Setting

Topography: plateaus and hills
Location: between the Vermilion Cliffs and the Colorado River
Slope range: 3 to 45 percent
Vegetation: fourwing saltbush, shadscale, galleta, and Indian ricegrass
Elevation: 3,500 to 5,000 feet
Mean annual precipitation: 6 to 11 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days

Composition

Percent of survey area: 7
Pennell soils: 45
Kinan soils: 35
Minor soils: 20

Soil Properties and Qualities

Pennell

Depth: shallow
Drainage class: well drained
Parent material: alluvium from limestone
Textural class: loamy
Distinctive properties: shallow soil over limestone

Kinan

Depth: very deep
Drainage class: well drained
Parent material: alluvium from limestone
Textural class: gravelly and loamy
Distinctive properties: very deep, very limy soil

Minor soils

- Pagina soils
- Jocity soils on stream terraces

Use and Management

Major management factors: limited available water capacity, hazard of erosion by water, depth to bedrock
Major use: rangeland and wildlife habitat

2. Sheppard-Pagina-Needle

Shallow to very deep, somewhat excessively drained and excessively drained, nearly level to steep, sandy and loamy soils, on plateaus and hills

Setting

Topography: plateaus and hills
Location: Glen Canyon National Recreation Area

Slope range: 1 to 35 percent
Vegetation: blackbrush, sand sagebrush, and Indian ricegrass
Elevation: 3,600 to 5,600 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days

Composition

Percent of survey area: 10
Sheppard soils: 30
Pagina soils: 25
Needle soils: 15
Minor soils: 30

Soil Properties and Qualities

Sheppard

Depth: very deep
Drainage class: excessively drained
Parent material: eolian sand from sandstone
Textural class: sandy
Distinctive properties: very deep soil on lower concave slopes

Pagina

Depth: moderately deep
Drainage class: somewhat excessively drained
Parent material: eolian sand and alluvium from sandstone
Textural class: loamy
Distinctive properties: moderately deep, very limy soil over soft sandstone

Needle

Depth: shallow
Drainage class: excessively drained
Parent material: eolian sand and alluvium from sandstone
Textural class: sandy
Distinctive properties: shallow over sandstone

Minor soils

- Rock outcrop
- Wahweap soils

Use and Management

Major management factors: limited available water capacity, hazard of erosion by wind and water, depth to bedrock
Major use: rangeland and wildlife habitat

3. Aneth-Monue

Very deep, somewhat excessively drained and well drained, nearly level to hilly, sandy and loamy soils; on fan terraces

Setting

Topography: fan terraces
Location: south of Paria Plateau
Slope range: 1 to 16 percent
Vegetation: fourwing saltbush and Indian ricegrass
Elevation: 4,200 to 5,400 feet
Mean annual precipitation: 7 to 11 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days

Composition

Percent of survey area: 4
Aneth soils: 50
Monue soils: 25
Minor soils: 25

Soil Properties and Qualities

Aneth

Depth: very deep
Drainage class: somewhat excessively drained
Parent material: alluvium from sandstone
Textural class: sandy
Distinctive properties: stratified substratum

Monue

Depth: very deep
Drainage class: well drained
Parent material: alluvium from sandstone
Textural class: loamy
Distinctive properties: contrasting texture substratum

Minor soils

- Pagina soils
- Torriorthents

Use and Management

Major management factors: limited available water capacity, hazard of erosion by wind and water
Major use: rangeland and wildlife habitat

4. Jocity-Glenyon

Very deep, well drained, nearly level, loamy and

clayey over sandy soils; on stream terraces, flood plains, and alluvial fans

Setting

Topography: stream terraces, flood plains, and alluvial fans
Location: Fredonia vicinity and Johnson Wash
Slope range: 0 to 3 percent
Vegetation: greasewood, squirreltail, fourwing saltbush, and galleta
Elevation: 4,400 to 5,300 feet
Mean annual precipitation: 7 to 11 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days

Composition

Percent of survey area: 3
Jocity soils: 75
Glenyon soils: 10
Minor soils: 15

Soil Properties and Qualities

Jocity

Depth: very deep
Drainage class: well drained
Parent material: mixed alluvium
Textural class: loamy
Distinctive properties: very deep loamy profile

Glenyon

Depth: very deep
Drainage class: well drained
Parent material: mixed alluvium
Textural class: clayey over sandy
Distinctive properties: clay over sand at moderate depths

Minor soils

- Doak soils on fan terraces
- Clayhole soils
- Sheppard soils

Use and Management

Major management factors: limited available water capacity and hazard of erosion by water
Major use: rangeland, wildlife habitat, urban land, and cropland

5. Torriorthents-Clayhole

Very shallow to very deep, well drained, nearly level to steep, loamy and variable textured soils, high in gypsum; on alluvial fans and hills

Setting

Topography: alluvial fans and hills
Location: east of Fredonia and between Marble Canyon and Lees Ferry
Slope range: 1 to 50 percent
Vegetation: shadscale, winterfat, and galleta
Elevation: 3,500 to 5,500 feet
Mean annual precipitation: 7 to 11 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days

Composition

Percent of survey area: 3
Torriorthents: 55
Clayhole soils: 25
Minor soils: 20

Soil Properties and Qualities

Torriorthents

Depth: very shallow to very deep
Drainage class: well drained
Parent material: gypsiferous shale
Textural class: variable
Distinctive properties: gypsiferous shale likely above 60 inches

Clayhole

Depth: very deep
Drainage class: well drained
Parent material: Alluvium from gypsiferous shale
Textural class: loamy
Distinctive properties: loamy gypsiferous profile

Minor soils

- Doak soils on fan terraces
- Jocity soils on stream terraces
- Rock outcrop

Use and Management

Major management factors: limited available water capacity, hazard of erosion by wind and water, and high content of gypsum
Major use: rangeland, wildlife habitat, urban land, and cropland.

6. Rock Outcrop-Torriorthents

Rock outcrop and very shallow to very deep, well

drained, steep to very steep, variable textured soils; on hills and canyon walls

Setting

Topography: hills and canyon walls
Location: Vermilion Cliffs, Marble Canyon, and Kanab Creek
Slope range: 25 to 65 percent
Vegetation: fourwing saltbush, galleta, and Indian ricegrass
Elevation: 2,900 to 6,600 feet
Mean annual precipitation: 7 to 11 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days

Composition

Percent of survey area: 9
Rock outcrop: 50
Torriorthents: 30
Minor soils: 20

Soil Properties and Qualities

Rock outcrop

Parent material: sandstone, limestone and other similar material
Distinctive properties: bare rock

Torriorthents

Depth: very shallow to very deep
Drainage class: well drained
Parent material: alluvium and colluvium from mixed sources
Textural class: variable
Distinctive properties: steep cliffs

Minor soils

- Sheppard soils

Use and Management

Major management factors: limited available water capacity, hazard of erosion by water, depth to bedrock
Major use: rangeland and wildlife habitat

7. Strych-Monue-Byson

Very deep and moderately deep to a hardpan, well drained, nearly level and undulating, loamy to extremely gravelly loamy soils; on fan terraces

Setting

Topography: fan terraces
Location: House Rock Valley
Slope range: 1 to 6 percent
Vegetation: in areas of higher precipitation, dominantly big sagebrush, squirreltail, and Indian ricegrass; in areas of lower precipitation, fourwing saltbush and Indian ricegrass
Elevation: 4,800 to 5,800 feet
Mean annual precipitation: 7 to 14 inches
Mean annual air temperature: 52 to 57 degrees F.
Frost-free period: 150 to 180 days

Composition

Percent of survey area: 7
Strych soils: 40
Monue soils: 30
Bison soils: 15
Minor soils: 15

Soil Properties and Qualities

Strych

Depth: very deep
Drainage class: well drained
Parent material: alluvium from limestone
Textural class: extremely gravelly loamy
Distinctive properties: very limy soil

Monue

Depth: very deep
Drainage class: well drained
Parent material: alluvium from sandstone
Textural class: loamy

Bison

Depth: moderately deep to a hardpan
Drainage class: well drained
Parent material: alluvium from limestone
Textural class: gravelly loamy
Distinctive properties: 20 to 40 inches deep over a hardpan

Minor soils

- Seeg soils on fan terraces
- Curob and Pennell soils on hills
- Clayhole soil on alluvial fans

Use and Management

Major management factors: limited available water capacity and hazard of erosion by wind
Major use: rangeland and wildlife habitat

8. Mellenthin-Curhollow

Shallow, well drained, nearly level to very steep, very

gravelly and extremely gravelly loamy soils; on fan terraces and hills

Setting

Topography: fan terraces and hills
Location: southwestern portion of the survey area
Slope range: 1 to 60 percent
Vegetation: big sagebrush, fourwing saltbush, and Indian ricegrass
Elevation: 4,800 to 6,200 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F.
Frost-free period: 150 to 165 days

Composition

Percent of survey area: 21
Mellenthin soils: 40
Curhollow soils: 40
Minor soils: 20

Soil Properties and Qualities

Mellenthin

Depth: shallow
Drainage class: well drained
Parent material: alluvium and colluvium from limestone
Textural class: extremely gravelly loamy
Distinctive properties: shallow over limestone

Curhollow

Depth: shallow
Drainage class: well drained
Parent material: alluvium from limestone
Textural class: very gravelly loamy
Distinctive properties: shallow soil over a hardpan

Minor soils

- Monierco soils on the hills southeast of Fredonia
- Rock outcrop
- Manikan soil on stream terraces

Use and Management

Major management factors: limited available water capacity, hazard of erosion by water, depth to bedrock, and hardpan
Major use: rangeland and wildlife habitat

9. Pensom-Arches

Shallow and deep, excessively drained, nearly level to hilly, sandy soils; on dunes on plateaus

Setting

Topography: dunes on plateaus
Location: Paria Plateau
Slope range: 1 to 16 percent
Vegetation: at higher elevations, Utah juniper, pinyon, and big sagebrush; at lower elevations, big sagebrush, fourwing saltbush, and Indian ricegrass
Elevation: 5,000 to 7,100 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F.
Frost-free period: 150 to 165 days

Composition

Percent of survey area: 29
Pensom soils: 50
Arches soils: 40
Minor soils: 10

Soil Properties and Qualities

Pensom

Depth: deep
Drainage class: excessively drained
Parent material: eolian sand from sandstone
Textural class: sandy
Distinctive properties: deep dunes on high plateaus

Arches

Depth: shallow
Drainage class: excessively drained
Parent material: eolian sand from sandstone
Textural class: sandy
Distinctive properties: shallow dunes on high plateaus

Minor soils

- Rock outcrop throughout the unit with a major portion along the Paria River
- Barx soil on fan terraces

Use and Management

Major management factors: limited available water capacity, hazard of erosion by wind and water, depth to bedrock
Major use: rangeland and wildlife habitat

10. Yumtheska-Disterheff-Houserock

Shallow to very deep, well drained, nearly level to steep, very gravelly loamy to clayey soils; on plateaus and hills

Setting

Topography: plateaus and hills
Location: Buckskin Mountains and Jacob Canyon area
Slope range: 2 to 30 percent
Vegetation: Utah juniper, pinyon, black sagebrush, blue grama
Elevation: 5,800 to 6,600 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F.
Frost-free period: 135 to 150 days

Composition

Percent of survey area: 7
Yumtheska soils: 55
Disterheff soils: 15
Houserock soils: 10
Minor soils: 20

Soil Properties and Qualities

Yumtheska

Depth: shallow
Drainage class: well drained
Parent material: alluvium from limestone
Textural class: very gravelly loamy
Distinctive properties: shallow soil over limestone

Disterheff

Depth: very deep
Drainage class: well drained
Parent material: alluvium from cherty limestone
Textural class: clayey
Distinctive properties: very limy lower part

Houserock

Depth: shallow
Drainage class: well drained
Parent material: alluvium from cherty limestone
Textural class: very gravelly clayey
Distinctive properties: shallow soil over limestone

Minor soils:

- Bidonia soil at slightly lower elevations
- Mellenthin soil at slightly lower elevations

Use and Management

Major management factors: limited available water capacity, hazard of erosion by water, depth to bedrock
Major use: grazeable woodland 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 landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans, 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, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Jocity silty clay loam, 1 to 3 percent clay slopes, is a phase of the Jocity 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. Needle-Sheppard complex, 2 to 12 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Yumtheska-Houserock association, 4 to 20 percent slopes, is an example.

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

Table 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—Aneth fine sand, 2 to 16 percent slopes

Setting

Landform: fan terraces
Flooding: none
Elevation: 4,200 to 5,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Aneth soil and similar soils: 75 percent
Contrasting inclusions: 25 percent

Typical Profile

0 to 2 inches—yellowish red fine sand
2 to 26 inches—yellowish red loamy fine sand
26 to 40 inches—reddish brown sandy loam
40 to 60 inches—light reddish brown loamy fine sand

Soil Properties and Qualities

Parent material: alluvium from sandstone
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: rapid
Available water capacity: moderate
Potential rooting depth: 60 or more inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: very high

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 16 percent
- Soils that have more than 35 percent rock fragments
- Areas that are gullied on drainages
- Soils that are shallow and soils that are moderately deep on the higher convex areas
- Areas of Rock outcrop
- Areas of boulders and/or stones near upper end of fan terraces

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—Indian ricegrass, needlegrasses, galleta, Mormon tea
- Present plant community—Indian ricegrass, needlegrasses, snakeweed

Important forage species: Indian ricegrass, galleta, needlegrasses

Major management factors: Hazard of erosion by wind and water, limited available water capacity, and seepage

General management considerations:
- Ground cover should be maintained or improved to reduce erosion hazard.
- Earthen water impoundments are limited because of seepage potential.
- Readily responds to proper management.

Suitable management practices:
- Proper grazing use
- Planned grazing system
- Fencing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: moderately suited
- Burrowing animals find this site suitable for digging.

Interpretive Groups

Land capability classification: VIIe, nonirrigated
Range site: Sandy Upland 7- 11" p.z.

2—Arches-Pensom complex, 4 to 12 percent slopes

Setting

Landform: plateaus
Landscape position: Arches soil—stabilized dunes in convex position; Pensom soil—stabilized dunes on an overall concave position (fig. 3)
Flooding: none
Elevation: 5,200 to 6,600 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Arches soil and similar soils: 45 percent
Pensom soil and similar soils: 45 percent
Contrasting inclusions: 10 percent

Typical Profile

Arches

Rock fragments on surface—0 to 10 percent
0 to 16 inches—yellowish red fine sand
16 inches—sandstone

Pensom

0 to 2 inches—reddish yellow fine sand

Figure 3.—Arches-Pensom complex, cool, 4 to 12 percent slopes. Trees are on the Arches soil.

2 to 55 inches—brown, strong brown and yellowish red fine sand
55 inches—sandstone

Soil Properties and Qualities

Arches

Parent material: eolian sand from sandstone
Depth class: shallow
Drainage class: excessively drained
Permeability: rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: very severe

Pensom

Parent material: eolian sand from sandstone
Depth class: deep
Drainage class: excessively drained
Permeability: very rapid
Available water capacity: low
Potential rooting depth: 40 to 60 inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: very high

Inclusions

Contrasting inclusions:
- Areas of Rock outcrop
- Areas of blowing sand dunes

Similar inclusions
- Soils that are similar to Pensom but deeper than 60 inches to bedrock
- Soils that have a layer of high lime accumulation
- Soils that are moderately deep on convex areas

Use and Management

Grazeable Woodland-Rangeland

Dominant vegetation on the Arches soil:
- Potential plant community—Indian ricegrass, needleandthread, pinyon, juniper
- Present plant community—Blue grama, squirreltail, Indian ricegrass, snakeweed, juniper

Dominant vegetation on the Pensom soil:
- Potential plant community—needleandthread, Indian ricegrass, dropseeds and Mormon tea
- Present plant community—Blue grama, dropseeds, sagebrush, snakeweed, juniper

Important forage species: Arches—Indian ricegrass, New Mexico feathergrass, fourwing saltbush, Pensom—Indian ricegrass, blue grama, galleta, dropseeds

Major management factors: Limited available water capacity, hazard of erosion by wind and water, and seepage on both soils. Depth to bedrock on Arches soil.

General management considerations on the Arches and Pensom soils:
- Ground cover should be maintained or improved to reduce erosion hazard.
- Earthen water impoundments are limited by seepage potential on both soils and on the Arches part by depth to bedrock.
- Range seeding limited by low to very low available water capacity.
- Use brush management in areas where unpalatable species have increased significantly.

Suitable management practices on the Arches and Pensom soils:
- Proper grazing use
- Planned grazing system
- Fencing
- Deferred grazing

Wildlife Habitat

Suitability of the Arches and Pensom soil for desertic herbaceous plants and desertic shrubs, trees and vines: moderately suited

Interpretive Groups

Land capability classification: Arches and Pensom—VIIe, nonirrigated
Woodland site: Arches—Sandstone Upland 10-14" p.z.
Range site: Pensom—Sandy Upland 10-14" p.z.

3—Arches-Pensom complex, cool, 4 to 12 percent slopes

Setting

Landform: plateaus
Landscape position: Arches—generally on higher convex slopes
Flooding: none
Elevation: 6,600 to 7,100 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Arches soil and similar soils: 45 percent
Pensom soil and similar soils: 35 percent
Contrasting inclusions: 20 percent

Typical Profile

Arches

0 to 1 inch—yellowish red fine sand
1 to 16 inches—yellowish red fine sand
16 inches—sandstone

Pensom

0 to 2 inches—reddish yellow fine sand
2 to 55 inches—brown, strong brown and yellowish red fine sand
55 inches—sandstone

Soil Properties and Qualities

Arches

Parent material: eolian sand from sandstone
Depth class: shallow
Drainage class: excessively drained
Permeability: rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: very high

Pensom

Parent material: eolian sand from sandstone
Depth class: deep
Drainage class: excessively drained
Permeability: very rapid
Available water capacity: low
Potential rooting depth: more than 40 inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: very high

Inclusions

Contrasting inclusions:
- Areas of Rock outcrop
- Soils that have slopes of more than 12 percent

Similar inclusions:
- Soils that are similar to Pensom but deeper than 60 inches to bedrock
- Soils that have slopes of less than 4 percent
- Soils that are sandy and moderately deep to bedrock

Use and Management

Grazeable Woodland-Rangeland

Dominant vegetation on the Arches soil:
- Potential plant community—juniper, pinyon, sagebrush
- Present plant community—blue grama, sagebrush, pinyon, juniper

Dominant vegetation on the Pensom soil:
- Potential plant community—Indian ricegrass, blue grama, sand sagebrush
- Present plant community—sagebrush, juniper, pinyon

Important forage species: Arches—Indian ricegrass, blue grama, squirreltail; Pensom—Indian ricegrass, blue grama

Major management factors: Seepage, limited available water capacity, hazard of erosion by wind and water on both soils. Depth to bedrock on Arches soil.

General management considerations on the Arches and Pensom soils:
- Fuelwood production for this unit is 6-8 cords/acre.
- Ground cover should be maintained or improved to prevent erosion hazard.
- Brush management and range seeding are limited by shallow depth to bedrock (Arches) and limited available water capacity (both).

Suitable management practices on the Arches and Pensom soils:
- Proper grazing use
- Planned grazing systems
- Fencing

Wildlife Habitat

Suitability of the Arches and Pensom soil for coniferous trees: moderately suited
- These woodlands of pinyon pine and juniper provide habitat for many species. Firewood gatherers should not disturb nest trees.

Interpretive Groups

Land capability classification: Arches and Pensom—VIIe, nonirrigated
Woodland site: Arches—Sandstone Upland 10-14" p.z.
Range site: Pensom—Sandy Upland 10-14" p.z.

4—Barx gravelly loam, 1 to 6 percent slopes

Setting

Landform: fan terraces
Flooding: none
Elevation: 5,000 to 5,300 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Barx soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

Rock fragments on surface—20 percent gravel
0 to 3 inches—strong brown gravelly loam
3 to 29 inches—yellowish red clay loam
29 to 60 inches—pink and light brown loam

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderate
Shrink-swell potential: moderate
Lime content: more than 15 percent between 22 and 42 inches

Inclusions

Contrasting inclusions:
- Soils that are similar to Barx but having a lime-cemented hardpan at 20 to 40 inches on some older surfaces on convex slopes.
- Soils that are similar to Barx but that have a clayey subsoil; on stream terraces.
- Soils that are gravelly and very gravelly and shallow to a lime-cemented hardpan on the higher convex positions.
- Soils that have slopes of more than 6 percent

Similar inclusions
- Barx soils that have fine sandy loam surfaces
- Soils that are similar to Barx but do not have the layer of clay accumulation

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—western wheatgrass, big sagebrush, fourwing saltbush, blue grama
- Present plant community—western wheatgrass, blue grama, sagebrush

Important forage species: western wheatgrass, fourwing saltbush

Major management factors: Hazard of erosion by wind and water

General management considerations:
- Overuse can occur because livestock prefer this site over other sites in adjacent area.
- Readily responds to proper management.
- Use brush management in areas where unpalatable species have increased significantly.
- Use planned grazing systems to obtain better livestock distribution.
- Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices:
- Proper grazing use
- Planned grazing system
- Fencing
- Deferred grazing
- Range seeding
- Brush management

Wildlife Habitat

Suitability for herbaceous plants and shrubs: well suited
- Open rangeland wildlife prefer this site.

Interpretive Groups

Land capability classification: VIs, nonirrigated
Range site: Loamy Upland 10-14" p.z.

5—Barx-Pensom complex, 1 to 6 percent slopes

Setting

Landform: Barx—fan terraces; Pensom—plateaus
Landscape position: Barx—smooth portion of landscape; Pensom—stabilized dunes
Flooding: none
Elevation: 5,000 to 5,500 feet

Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Barx soil and similar soils: 70 percent
Pensom soil and similar soils: 20 percent
Contrasting inclusions: 10 percent

Typical Profile

Barx

0 to 3 inches—strong brown fine sandy loam
3 to 29 inches—yellowish red clay loam
29 to 60 inches—pink and light brown loam

Pensom

0 to 2 inches—reddish yellow fine sand
2 to 55 inches—brown, strong brown and yellowish red fine sand
55 inches—sandstone

Soil Properties and Qualities

Barx

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: high
Potential rooting depth: more than 60 inches
Runoff: medium
Hazard of water erosion: severe
Hazard of wind erosion: moderately high
Shrink-swell potential: moderate
Lime content: more than 15 percent between 22 to 42 inches
Corrosivity: steel—high; concrete—low

Pensom

Parent material: eolian sand from sandstone
Depth class: deep
Drainage class: excessively drained
Permeability: very rapid
Available water capacity: low
Potential rooting depth: 40 to 60 inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: very high
Corrosivity: steel—high; concrete—low

Inclusions

Contrasting inclusions
- Areas of Arches soils on higher convex positions
- Soils that are sandy and moderately deep

Similar inclusions
- Soil similar to Pensom but deeper than 60 inches to bedrock

Use and Management

Rangeland

Dominant vegetation on the Barx soil:
- Potential plant community—Indian ricegrass, needleandthread, blue grama, galleta
- Present plant community—needleandthread, Indian ricegrass, blue grama, Bigelow sagebrush

Dominant vegetation on the Pensom soil:
- Potential plant community—needleandthread, Indian ricegrass, dropseeds, Mormon tea
- Present plant community—blue grama, dropseeds, sagebrush, snakeweed, juniper

Important forage species: Barx—Indian ricegrass, squirreltail, black grama, winterfat; Pensom—Indian ricegrass, blue grama, galleta, dropseeds

Major management factors: Hazard of erosion by wind and water on both soils. Limited available water capacity and seepage for Pensom soil.

General management considerations on the Barx-Pensom soils:
- Barx soils respond well to proper management.
- Earthen water impoundments are limited by seepage potential and depth to bedrock on the Pensom soils.
- Ground cover should be maintained or improved to reduce the erosion hazard.
- Easy access and large variety of palatable plants encourage a constant grazing pressure.
- Use brush management in areas where unpalatable species have increased significantly.

Suitable management practices on the Barx-Pensom soils:
- Proper grazing use
- Planned grazing systems
- Fencing

- Deferred grazing

Wildlife Habitat

Suitability of the Barx-Pensom soils for herbaceous plants and shrubs for wildlife habitat: well suited

Interpretive Groups

Land capability classification: Barx—VIs, nonirrigated; Pensom—VIIe, nonirrigated
Range site: Barx—Sandy Loam Upland 10-14" p.z.; Pensom—Sandy Upland 10-14" p.z.

6—Bidonia-Rock outcrop complex, 1 to 15 percent slopes

Setting

Landform: plateaus
Flooding: none
Elevation: 4,900 to 5,300 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Bidonia soil and similar soils: 70 percent
Rock outcrop: 15 percent
Contrasting inclusions: 15 percent

Typical Profile

Bidonia

0 to 2 inches—strong brown sandy loam
2 to 6 inches—reddish brown loam
6 to 12 inches—yellowish red sandy clay
12 inches—sandstone

Rock outcrop

Rock outcrop consists of exposed areas of sandstone.

Soil Properties and Qualities

Bidonia

Parent material: alluvium from sandstone
Depth class: shallow
Drainage class: well drained
Permeability: slow
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderately high
Shrink-swell potential: high

Inclusions

Contrasting inclusions:
- Soils that have more than 35 percent rock fragments
- Soils that are shallow to deep with loamy sand texture
- Soils that have slopes of more than 15 percent

Similar inclusions:
- Soils that are similar to Bidonia but lacking the layer of clay accumulation

Use and Management

Grazeable Woodland

Dominant vegetation:
- Potential plant community—juniper, pinyon, blue grama, sagebrush
- Present plant community—blue grama, sagebrush, pinyon, juniper

Important forage species: Indian ricegrass, blue grama, squirreltail

Major management factors: Hazard of erosion by wind and water, limited available water capacity, and shallow depth to bedrock

General management considerations:
- Ground cover should be maintained or improved to prevent erosion hazard.
- Brush management limited to associated deep soils in open parks of sagebrush.
- Range seeding is limited by shallow depth to bedrock and very low available water capacity.

Suitable management practices:
- Proper woodland grazing
- Planned grazing system
- Fencing
- Deferred grazing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: well suited
- Scattered pinyon and juniper trees add structural diversity to this mainly open grassland.

Interpretive Groups

Land capability classification: Bidonia—VIs, nonirrigated
Woodland site: Bidonia-Sandstone Upland 10-14" p.z.
Rock outcrop is not assigned a capability subclass or a range site.

7—Bison-Curob complex, 2 to 6 percent slopes

Setting

Landform: fan terraces
Landscape position: Bison—slightly lower portions of the landscape; Curob—slightly higher portions of the landscape
Flooding: none
Elevation: 4,800 to 5,200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Bison soil and similar soils: 55 percent
Curob soil and similar soils: 25 percent
Contrasting inclusions: 20 percent

Typical Profile

Bison

Rock fragments on surface—20 percent gravel
0 to 4 inches—brown gravelly loam
4 to 26 inches—brown, yellowish red and pink gravelly loam
26 to 38 inches—fractured lime-cemented hardpan
38 to 60 inches—yellowish red gravelly loam

Curob

Rock fragments on surface—45 percent pebbles
0 to 3 inches—light brown very gravelly loam
3 to 7 inches—light brown gravelly loam
7 to 13 inches—brown very gravelly loam
13 to 19 inches—lime-cemented hardpan
19 to 60 inches—light brown extremely gravelly loamy coarse sand

Soil Properties and Qualities

Bison

Parent material: alluvium from limestone
Depth class: moderately deep to a hardpan
Drainage class: well drained
Permeability: moderate
Available water capacity: moderate
Potential rooting depth: 20 to 40 inches
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderate

Curob

Parent material: alluvium from limestone
Depth class: shallow to a hardpan
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of water erosion: slight
Hazard of wind erosion: very slight

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 6 percent

Similar inclusions:
- Deep soils that lack a lime-cemented hardpan and are near stream terraces
- Soils that lack a layer with a high content of lime
- Soils that have slopes of less than 2 percent

Use and Management

Rangeland

Dominant vegetation on the Bison soil:
- Potential plant community—black grama, blue grama, Indian ricegrass, needleandthread
- Present plant community—gramas, needlegrasses, squirreltail, threeawn

Dominant vegetation on the Curob soil:
- Potential plant community—Indian ricegrass, needleandthread, blue grama, squirreltail
- Present plant community—gramas, dropseeds, needlegrasses

Important forage species: Bison—Indian ricegrass, black grama, fourwing saltbush; Curob—Indian ricegrass, blue grama, squirreltail, winterfat

Major management factors: Depth to a lime-cemented hardpan, limited available water capacity on both soils, and hazard of erosion by wind and water on Bison soils

General management considerations on the Bison-Curob soils:
- Bison responds well to proper management.
- Curob soils have limited potential for range seeding because of very low available water capacity.
- Earthen water impoundments are limited because of shallow and moderate depths to hardpan.
- Vigor of desirable forage plants should be maintained or improved for erosion control.
- Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices on the Bison-Curob soils:
- Proper grazing use

- Fencing
- Deferred grazing

Wildlife Habitat

Suitability of the Bison-Curob soil for herbaceous plants and shrubs: well suited

Interpretive Groups

Land capability classification: Bison and Curob—VIIs, nonirrigated
Range site: Bison—Loamy Upland 7- 11" p.z.; Curob—Shallow Loamy 7-11" p.z.

8—Clayhole silty clay loam, 1 to 5 percent slopes

Setting

Landform: alluvial fans
Flooding: rare
Elevation: 4,700 to 5,500 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Clayhole soil and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 3 inches—yellowish red silty clay loam
3 to 44 inches—reddish yellow silt loam and loam that have common gypsum crystals
44 to 60 inches—yellowish red silty clay loam that have many gypsum crystals

Soil Properties and Qualities

Parent material: alluvium from gypsiferous shale
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderate
Corrosivity: concrete—high; steel (uncoated)—high
Gypsum content: common to many gypsum crystals below the surface layer.

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 5 percent
- Soils that are similar to Clayhole but having a clayey subsurface layer
- Soils that have silty clay loam textures throughout on flood plains
- Soils that are similar to Clayhole but on flood plains

Similar inclusions:
- Soils that have slopes of less than 1 percent
- Soils having a loam surface

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—galleta, shadscale, fourwing saltbush
- Present plant community—galleta, gyp dropseed, shadscale

Important forage species: galleta, fourwing saltbush, Indian ricegrass

Major management factors: Content of gypsum, hazard of erosion by wind and water

General management considerations:
- The vegetation of this soil is difficult to restore once the plant cover has been altered.
- Ground cover should be maintained or improved to reduce the erosion hazard.
- Good livestock distribution is needed in order to use the forage properly.

Suitable management practices:
- Proper grazing use
- Planned grazing system
- Fencing
- Deferred grazing

Building Site Development

General management considerations:
- Introduction of water in any amount will cause some degree of subsidence because of the gypsum content of the soil.
- Excavation increases the risk of wind and water erosion.
- Some areas of this unit may be subject to salt heaves because of the expansion of sodium sulfate salts. This action is likely to crack concrete slab floors, driveways, and sidewalks.
- Concrete placed in contact with this soil is subject to disintegration as a result of the chemical reaction of gypsum.

Suitable management practices:

- Rain gutters should be used to dump rain at least 6 feet from the foundations.
- Revegetate disturbed areas at construction sites as soon as possible to reduce the risk of wind erosion.
- Reduce the risk of erosion and maintenance cost by stabilizing areas that have been disturbed.
- Preserve the existing plant cover during construction to reduce the risk of erosion.
- Consider the depth to which frost penetrates in designing footings and road bases.
- Offset the risk of corrosion to concrete and uncoated steel pipe by using sulfate-resistant cement and treated steel pipe that have cathodic protectors.
- Install culverts to carry seasonal runoff where roads cross natural drainageways.
- Design roads to control surface runoff and stabilize cut slopes.
- Provide drains to control surface runoff and keep soil loss at a minimum.
- Stabilize disturbed areas to reduce the risk of erosion and the maintenance cost resulting from erosion.
- Seed road cuts and fills to permanent vegetation.

Wildlife Habitat

Suitability for herbaceous plants and shrubs: poorly suited

Interpretive Groups

Land capability classification: VIIs, nonirrigated
Range site: Gypsum Upland 7-11" p.z.

9—Clayhole-Torriorthents complex, 2 to 25 percent slopes

Setting

Landform: Clayhole—alluvial fans; Torriorthents—hills
Landscape position: Clayhole—uneroded areas; Torriorthents—geologically eroded areas
Flooding: Clayhole—rare; Torriorthents—none
Slope range: Clayhole—2 to 8 percent; Torriorthents—5 to 25 percent
Elevation: 4,300 to 5,300 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Clayhole and similar soils: 55 percent
Torriorthents and similar soils: 25 percent
Contrasting inclusions: 20 percent

Typical Profile

Clayhole

0 to 3 inches—yellowish red loam
3 to 44 inches—reddish yellow silt loam and loam that have common gypsum crystals
44 to 60 inches—yellowish red silty clay loam that have many gypsum crystals

Torriorthents

Rock fragments on surface—10 to 60 percent chert fragments
The Torriorthents are 4 to more than 60 inches deep over weathered bedrock. The soils are variable in texture.

Soil Properties and Qualities

Clayhole

Parent material: alluvium from gypsiferous shale
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: moderate
Potential rooting depth: more than 60 inches
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderate
Corrosivity: steel (uncoated)—high; concrete—high
Gypsum content: many crystals below 18 inches

Torriorthents

Parent material: alluvium from gypsiferous shales
Depth class: very shallow to deep
Drainage class: well drained
Permeability: moderate to slow
Available water capacity: very low to high
Potential rooting depth: 4 to 60 or more inches
Runoff: medium to very rapid
Hazard of water erosion: very severe
Hazard of wind erosion: high
Corrosivity: steel (uncoated)—high; concrete—high
Gypsum content: high below the surface layer

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 25 percent
- Soils that are similar to Clayhole but have a clayey subsoil and lack gypsum; on flood plains
- Soils that are similar to Clayhole but lack gypsum

- Areas of soils that are almost pure powdery gypsum
- Soils that have a high content of lime

Similar inclusions:
- Soils that have slopes of less than 2 percent

Use and Management

Rangeland

Dominant vegetation on the Clayhole soil:
- Potential plant community—galleta, shadscale, fourwing saltbush
- Present plant community—galleta, shadscale, goldenweed

Dominant vegetation on the Torriorthents soil:
- Potential plant community—galleta, shrubby buckwheat, Utah serviceberry
- Present plant community—cliffrose, goldenweed, shadscale

Important forage species: Clayhole—galleta, fourwing saltbush, Indian ricegrass; Torriorthents—galleta, squirreltail, black grama

Major management factors: Hazard of erosion by water and wind, steep slopes, content of gypsum, and shallow soil depth (part of Torriorthents)

General management considerations on the Clayhole-Torriorthents soils:
- The vegetation of this unit is difficult to restore once the plant cover has been altered.
- This site is fragile and adapts well only to light stocking rates.
- When disturbed, serious erosion occurs.
- Ground cover should be maintained or improved to reduce the erosion hazard.
- Good livestock distribution is needed in order to use the forage properly.

Suitable management practices on the Clayhole-Torriorthents soils:
- Proper grazing use
- Planned grazing system
- Fencing
- Deferred grazing

Wildlife Habitat

Suitability of the Clayhole-Torriorthents soil for herbaceous plants and shrubs: poorly suited

Interpretive Groups

Land capability classification: Clayhole—VIIs, nonirrigated; Torriorthents—VIIe, nonirrigated
Range site: Clayhole—Gypsum Upland 7-11" p.z.; Torriorthents—Gypsum Hills 7-11" p.z.

10—Curhollow-Mellenthin complex, 2 to 12 percent slopes

Setting

Landform: Curhollow—fan terraces; Mellenthin—hills
Landscape position: Curhollow—flatter tops; Mellenthin—backslopes and narrow summits
Flooding: none
Elevation: 4,800 to 5,800 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Curhollow soil and similar soils: 65 percent
Mellenthin soil and similar soils: 15 percent
Contrasting inclusions: 20 percent

Typical Profile

Curhollow

0 to 2 inches—reddish brown loam
2 to 8 inches—reddish brown very gravelly loam
8 to 13 inches—reddish brown very gravelly loam
13 to 19 inches—lime-cemented hardpan
19 inches—limestone

Mellenthin

Rock fragments on surface—40 percent gravel
0 to 2 inches—light brown very gravelly loam
2 to 8 inches—strong brown very gravelly loam
8 to 13 inches—strong brown extremely gravelly sandy loam
13 inches—limestone

Soil Properties and Qualities

Curhollow

Parent material: alluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderate
Depth to a lime-cemented hardpan: 10 to 20 inches

Mellenthin

Parent material: alluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: moderate

Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: very slight

Inclusions

Contrasting inclusions:
- Soils that are moderately deep; on toeslopes
- Soils that are deep; on toeslopes
- Rock outcrop

Similar inclusions:
- Soils that are similar to Curhollow but have soil material below the hardpan
- Soils that lack a layer of high lime accumulation
- Soils less than 8 inches deep
- Soils that are similar to Curhollow but have a redder hue

Use and Management

Rangeland

Dominant vegetation on the Curhollow-Mellenthin soils:
- Potential plant community—black grama, blue grama, needlegrasses, big sagebrush
- Present plant community—needlegrasses, blue grama, squirreltail, sagebrush

Important forage species on the Curhollow-Mellenthin soils: New Mexico feathergrass, western wheatgrass, fourwing saltbush

Major management factors: Depth to hardpan or bedrock, limited available water capacity, and hazard of erosion by wind and water

General management considerations on the Curhollow-Mellenthin soils:
- Desirable grasses recover slowly because of competition from shrubby plants for moisture.
- Range seeding limited by very low available water capacity.
- Earthen water impoundments are limited because of shallow depth to bedrock.
- Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices on the Curhollow-Mellenthin soils:
- Proper grazing use
- Planned grazing system
- Fencing
- Deferred grazing

Wildlife Habitat

Suitability of the Curhollow-Mellenthin soils for herbaceous plants and shrubs: moderately suited
- Scattered pinyon pine and juniper trees add structural diversity to this open grassland.

Interpretive Groups

Land capability classification: Curhollow-Mellenthin—VIs, nonirrigated
Range site: Curhollow-Mellenthin—Shallow Loamy 10-14" p.z.

11—Curob loamy sand, 2 to 10 percent slopes

Setting

Landform: fan terraces
Flooding: none
Elevation: 3,600 to 4,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Curob soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 9 inches—yellowish red loamy sand
9 to 16 inches—yellowish red gravelly sandy loam
16 inches—lime-cemented hardpan over bedrock

Soil Properties and Qualities

Parent material: alluvium from sandstone
Depth class: shallow to a hardpan
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: high

Inclusions

Contrasting inclusions:
- Soils that are more than 20 inches deep to a hardpan
- Sandy soils that are moderately deep to sandstone
- Soils that are less than 20 inches to bedrock, without a hardpan

- Soils that have slopes of more than 10 percent

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—Indian ricegrass, needleandthread, fourwing saltbush, Mormon tea
- Present plant community—threeawn, gramas, squirreltail, barberry

Important forage species: Indian ricegrass, squirreltail, fourwing saltbush

Major management factors: Depth to hardpan, seepage, limited available water capacity, and hazard of erosion by wind and water

General management considerations:
- Ground cover should be maintained or improved to reduce the erosion hazard.
- Earthen water impoundments are limited because of seepage.
- Limited potential for range seeding because of very low available water capacity.
- Good distribution is important to the proper utilization of the forage species.

Suitable management practices:
- Proper grazing use
- Planned grazing systems
- Fencing
- Deferred grazing

Wildlife Habitat:

Suitability for herbaceous plants and shrubs: poorly suited
- Burrowing animals find this site suitable for digging.

Interpretive Groups

Land capability classification: VIIs, nonirrigated
Range site: Sandstone Upland 7-11" p.z.

12—Curob very gravelly loam, 2 to 12 percent slopes

Setting

Landform: fan terraces
Flooding: none
Elevation: 4,800 to 5,200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Curob soil and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

Rock fragments on surface—45 percent gravel
0 to 3 inches—light brown very gravelly loam
3 to 7 inches—light brown gravelly loam
7 to 13 inches—brown very gravelly loam
13 to 19 inches—lime-cemented hardpan
19 to 60 inches—light brown extremely gravelly loamy coarse sand

Soil Properties and Qualities

Parent material: alluvium from limestone
Depth class: shallow to a hardpan
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Lime content: very limy layer occurs at about 6 inches
Hazard of water erosion: moderate
Hazard of wind erosion: very slight

Inclusions

Contrasting inclusions:
- Soils that are deep and on hills
- Soils that are moderately deep to a hardpan
- Soils that are shallow to limestone
- Soils that have slopes of more than 12 percent

Similar inclusions:
- Soils that have less than 35 percent rock fragments in the profile

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—Indian ricegrass, galleta, needlegrasses, winterfat
- Present plant community—needlegrasses, blue grama, threeawn, Mormon tea

Important forage species: Indian ricegrass, galleta, winterfat

Major management factors: Depth to hardpan, hazard of erosion by water, and limited available water capacity

General management considerations:
- Desirable grasses recover slowly because of competition from shrubby plants for moisture.
- Range seeding limited by very low available water capacity.
- Earthen water impoundments are limited because of shallow depth to hardpan.
- Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices:
- Proper grazing use
- Planned grazing system
- Fencing
- Deferred grazing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: poorly suited

Interpretive Groups

Land capability classification: VIIs, nonirrigated
Range site: Shallow Loamy 7-11" p.z.

13—Disterheff very gravelly loam, 2 to 15 percent slopes

Setting

Landform: plateaus
Flooding: none
Elevation: 6,000 to 6,600 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 150 days

Composition

Disterheff soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

Rock fragments on surface—45 percent gravel
0 to 3 inches—brown very gravelly loam
3 to 7 inches—reddish brown clay loam
7 to 22 inches—red clay
22 to 37 inches—yellowish red and pink, limy, gravelly clay loam
37 to 60 inches—yellowish red and pink, limy, very gravelly clay loam

Soil Properties and Qualities

Parent material: alluvium from cherty limestone
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: moderate
Potential rooting depth: more than 60 inches
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: very slight
Lime content: high content of lime below about 22 inches

Inclusions

Contrasting inclusions:
- Soils moderately deep to bedrock
- Soils that are very gravelly, clayey and shallow (Houserock) on higher convex positions
- Soils that are very gravelly, loamy and shallow (Yumtheska)
- Soils that have slopes of more than 15 percent

Similar inclusions:
- Soils that are similar to Disterheff but have more than 35 percent rock fragments
- Soils that are similar to Disterheff but have silty clay textured subsoils

Use and Management

Grazeable Woodland

Dominant vegetation:
- Potential plant community—western wheatgrass, blue grama, sagebrush, juniper, pinyon
- Present plant community—pinyon, juniper, blue grama, sagebrush

Important forage species: western wheatgrass, blue grama, fourwing saltbush

Major management factors: Hazard of erosion by water

General management considerations:
- Fuelwood production for this unit is 5-6 cords per acre.
- Reduce risk of erosion by proper installation and maintenance of access roads.
- Moderate to severe erosion hazard which limits vehicle access.
- Responds well to good management.

Suitable management practices:
- Proper woodland grazing
- Access roads
- Forest land erosion control system
- Forest land management

Wildlife Habitat

Suitability for coniferous trees: poorly suited
- Firewood gatherers should not disturb nest trees.

Interpretive Groups

Land capability classification: VIs, nonirrigated
Woodland site: Loamy Upland 14-18" p.z.

14—Disterheff-Houserock complex, 3 to 15 percent slopes

Setting

Landform: plateaus
Landscape position: Disterheff—generally lower concave slopes; Houserock—generally higher convex slopes
Flooding: none
Elevation: 6,000 to 6,600 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 150 days

Composition

Disterheff soil and similar soils: 65 percent
Houserock soil and similar soils: 20 percent
Contrasting inclusions: 15 percent

Typical Profile

Disterheff

Rock fragments on surface—30 percent gravel
0 to 3 inches—brown gravelly loam
3 to 7 inches—reddish brown clay loam
7 to 22 inches—red clay
22 to 37 inches—reddish brown and pink, limy, gravelly clay loam
37 to 60 inches—yellowish red and pink, limy, very gravelly clay loam

Houserock

Rock fragments on surface—30 percent gravel, 2 percent cobbles and few stones
0 to 3 inches—reddish brown gravelly loam
3 to 8 inches—reddish brown very gravelly clay loam
8 to 19 inches—red very gravelly clay
19 inches—limestone

Soil Properties and Qualities

Disterheff

Parent material: alluvium from cherty limestone
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: moderate
Potential rooting depth: more than 60 inches
Runoff: medium
Hazard of water erosion: severe
Hazard of wind erosion: moderate

Houserock

Parent material: alluvium from cherty limestone
Depth class: shallow
Drainage class: well drained
Permeability: slow
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of water erosion: severe
Hazard of wind erosion: moderate

Inclusions

Contrasting inclusions:
- Areas of Rock outcrop
- Soils that have slopes of more than 15 percent

Similar inclusions:
- Soils that have slopes of less than 3 percent
- Soils that are similar to Disterheff but have more than 35 percent rock fragments
- Soils that are similar to Houserock but have less than 35 percent rock fragments

Use and Management

Grazeable Woodland

Dominant vegetation on the Disterheff soil:
- Potential plant community—blue grama, sagebrush, juniper, pinyon
- Present plant community—juniper, pinyon, sagebrush, blue grama

Dominant vegetation on the Houserock soil:
- Potential plant community—blue grama, sagebrush, juniper, pinyon
- Present plant community—juniper, pinyon, sagebrush, blue grama

Important forage species: Disterheff—western wheatgrass, blue grama, fourwing saltbush; Houserock—Indian ricegrass, squirreltail, blue grama, fourwing saltbush.

Major management factors: Hazard of erosion by wind and water on both soils. Limited available water capacity and shallow depth on Houserock soil.

General management considerations on the Disterheff soil:
- Fuelwood production for this soil is 3-6 cords per acre.

- Responds well to good management.
- Reduce risk of erosion by proper installation and maintenance of access roads.
- Moderate to severe erosion hazard limits vehicle access.

General management considerations on the Houserock soil:
- Fuelwood production for this soil is 3-6 cords per acre.
- Reduce risk of erosion by proper installation and maintenance of access roads.
- Brush management and range seeding limited by shallow depth and very low available water capacity.
- Earthen water impoundments are limited because of shallow depth to bedrock.
- Moderate to severe erosion hazard which limits vehicle access.

Suitable management practices on the Disterheff-Houserock soils:
- Proper woodland grazing
- Access roads
- Forest land erosion control system
- Forest land management

Wildlife Habitat

Suitability of the Disterheff-Houserock soils for coniferous trees: moderately suited

Interpretive Groups

Land capability classification: Disterheff and Houserock—VIe, nonirrigated
Woodland site: Disterheff—Loamy Upland 14-18" p.z.; Houserock—Shallow Loamy 14-18" p.z.

15—Doak fine sandy loam, 1 to 6 percent slopes

Setting

Landform: fan terraces
Flooding: none
Elevation: 4,700 to 5,200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Doak soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 2 inches—brown fine sandy loam
2 to 8 inches—strong brown loam
8 to 22 inches—strong brown clay loam
22 to 60 inches—reddish yellow sandy clay loam

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: high
Potential rooting depth: more than 60 inches
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderately high
Shrink-swell potential: moderate
Lime content: less than 12 percent

Inclusions

Contrasting inclusions:
- Soils that have bedrock within 20 to 40 inches
- Soils that have slopes of more than 6 percent

Similar inclusions:
- Soils that have sandy clay loam and fine sandy loam subsoils
- Soils that are similar to Doak but lack the layer of high lime accumulation
- Soils that have slopes of less than 1 percent

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—needlegrasses, Indian ricegrass, gramas, fourwing saltbush
- Present plant community—squirreltail, needlegrasses, blue grama, Mormon tea

Important forage species: Indian ricegrass, blue grama, fourwing saltbush, squirreltail

Major management factors: Hazard of erosion by wind and water

General management considerations:
- Ground cover should be maintained or improved to reduce erosion hazard.
- Readily responds to proper management.

Suitable management practices:
- Proper grazing use
- Fencing
- Deferred grazing
- Water developments

Wildlife Habitat

Suitability for herbaceous plants and shrubs: moderately suited

- Burrowing animals find this site suitable for digging.

Interpretive Groups

Land capability classification: VIIs, nonirrigated
Range site: Sandy Loam Upland 7-11" p.z.

16—Glenyon silty clay loam, 0 to 2 percent slopes

Setting

Landform: low stream terraces
Flooding: none (protected)
Elevation: 4,700 to 5,000 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Glenyon soil and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—yellowish red silty clay loam
2 to 34 inches—strong brown and light brown silty clay loam
34 to 60 inches—light brown loamy sand and loamy fine sand

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: high
Potential rooting depth: more than 60 inches
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: moderate
Salinity: before leaching, 4-7 mmhos; after leaching, 1-4 mmhos

Inclusions

Contrasting inclusions:
- Stabilized sand dunes
- Soils that have sand at 20 inches
- Soils that have sandy surfaces
- Soils that have slopes of more than 2 percent

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—western wheatgrass, blue grama, fourwing saltbush, inland saltgrass
- Present plant community—western wheatgrass, blue grama, big sagebrush, snakeweed, juniper

Important forage species: western wheatgrass, fourwing saltbush, Indian ricegrass, galleta

Major management factors: Moderately slow permeability, hazard of erosion by wind.

General management considerations:
- Overuse can occur because livestock prefer this site over other sites in the adjacent area.
- Readily responds to proper management.
- Use brush management in areas where unpalatable species have increased significantly.
- Planned grazing systems help provide better livestock distribution.
- Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices:
- Proper grazing use
- Planned grazing systems
- Deferred grazing
- Fencing

Cropland

General management considerations:
- Soil becomes compacted if pastures are grazed when wet.
- A tillage pan forms easily if the soil is tilled excessively or when wet.
- All climatically suited crops respond well to irrigation on this soil.
- Leveling is needed for efficient application of irrigation water.
- Germination is difficult because of crusting when the soil dries out.
- Electrical conductivity is about 7 mmhos before the soil is irrigated and 1 to 4 mmhos after a few years of regular irrigation.
- An irrigation-induced water table fluctuates from 20 inches to deeper than 60 inches, depending on the amount of water applied.

Suitable management practices:
- Use proper stocking rate and pasture rotation, and restrict grazing during wet periods to prevent soil compaction.
- Mow periodically to maintain uniform growth, discourage selective grazing, and reduce clump growth.
- Application of irrigation water should be adjusted to the available water capacity of the soil, the intake rate, and the needs of the crop.
- Water should be applied at a rate that insures the root zone is sufficiently moistened.
- Use all crop residue, plow under cover crops, and use a crop rotation system to maintain or build up organic matter, reduce surface crusting, improve water intake rate, and improve soil tilth.
- Use conservation tillage to prevent compaction and formation of a plow layer.
- Yields: alfalfa—3.5T, barley and wheat—2,500 pounds per acre.

Building Site Development

General management considerations:
- Introduction of water in any amount may cause some degree of subsidence when gypsum is present in the soil.
- Surface disturbance and excavation increase the risk of wind and water erosion.
- There may be an irrigation-induced water table present.
- Some areas of this unit may be subject to salt heave because of the expansion of sodium sulfate salts.
- This action is likely to crack concrete slab floors, driveways, and sidewalks.

Suitable management practices:
- Rain gutters should be used to divert the rain at least 6 feet from the foundations.
- Revegetate disturbed areas at construction sites as soon as possible to reduce the risk of wind erosion.
- Preserve the existing plant cover during construction to reduce the risk of erosion.
- Offset the risk of corrosion to concrete and uncoated steel pipe by using sulfate-resistant cement and treated steel pipe with cathodic protectors or by using corrosion-resistant materials.
- Seed road cuts and fills to permanent vegetation.

Wildlife Habitat

Suitability for herbaceous plants and shrubs: moderately suited
- Open rangeland wildlife prefer this site.

Interpretive Groups

Land capability classification: IIs, irrigated; VIIs, nonirrigated
Range site: Saline Upland, Loamy 7-11" p.z.

17—Houserock-Disterheff complex, 3 to 15 percent slopes

Setting

Landform: plateaus
Landscape position: Houserock—higher portions of landscape, usually convex; Disterheff—lower portions of landscape
Flooding: none
Elevation: 6,000 to 6,600 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 150 days

Composition

Houserock soil and similar soils: 70 percent
Disterheff soil and similar soils: 15 percent
Contrasting inclusions: 15 percent

Typical Profile

Houserock

Rock fragments on surface—30 percent gravel, 2 percent cobbles, and few stones
0 to 3 inches—reddish brown gravelly loam
3 to 8 inches—reddish brown very gravelly clay loam
8 to 19 inches—red very gravelly clay and extremely gravelly clay
19 inches—limestone

Disterheff

Rock fragments on surface—30 percent gravel
0 to 3 inches—brown gravelly loam
3 to 7 inches—reddish brown clay loam
7 to 22 inches—red clay
22 to 37 inches—reddish brown and pink, limy, gravelly clay loam
37 to 60 inches—yellowish red and pink, limy, very gravelly clay loam

Soil Properties and Qualities

Houserock

Parent material: alluvium from cherty limestone
Depth class: shallow
Drainage class: well drained

Permeability: slow
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of water erosion: severe
Hazard of wind erosion: moderate

Disterheff

Parent material: alluvium from cherty limestone
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: severe
Hazard of wind erosion: moderate

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 15 percent
- Areas of Rock outcrop
- Deep soils that have more than 35 percent rock fragments

Similar inclusions:
- Soils that are 20 to 40 inches to bedrock
- Shallow soils that have less than 35 percent rock fragments
- Soils that have slopes of less than 3 percent
- Soils that are similar to Houserock that have silty clay subsoils

Use and Management

Grazeable Woodland

Dominant vegetation on the Houserock soil:
- Potential plant community—juniper, pinyon, big sagebrush, blue grama
- Present plant community—juniper, blue grama, snakeweed

Dominant vegetation on the Disterheff soil:
- Potential plant community—juniper, pinyon, big sagebrush, blue grama
- Present plant community—juniper, pinyon, blue grama, big sagebrush

Important forage species: Houserock—blue grama, fourwing saltbush, New Mexico feathergrass; Disterheff—western wheatgrass, fourwing saltbush, blue grama

Major management factors: Depth to bedrock, (Houserock), limited available water capacity, and hazard of erosion by wind and water

General management considerations on the Houserock soil:
- Earthen water impoundments are limited because of shallow depth to bedrock.
- Brush management and range seeding are limited by shallow depth and low available water capacity.
- Moderate to severe erosion hazard limits vehicle access.
- Reduce risk of erosion hazard by proper installation and maintenance of access roads.
- Fuelwood production for Houserock soils is 2-4 cords/acre.

Suitable management practices on the Disterheff soils:
- Moderate to severe erosion hazard limits vehicle access.
- Reduce risk of erosion hazard by proper installation and maintenance of access roads.
- Fuelwood production for Disterheff soils is 5-6 cords/acre.
- Responds well to good management.

Suitable management practices on the Houserock-Disterheff soils:
- Proper woodland grazing
- Access roads
- Forest land erosion control system
- Forest land management
- Firebreak

Wildlife Habitat

Suitability of the Houserock-Disterheff soils for coniferous trees: poorly suited
- Firewood gatherers should not disturb nest trees.

Interpretive Groups

Land capability classification: Houserock-Disterheff—VIs, nonirrigated
Woodland site: Houserock—Shallow Loamy 14-18" p.z.; Disterheff—Loamy Upland 14-18" p.z.

18—Jocity clay loam, 1 to 3 percent slopes

Setting

Landform: flood plains and alluvial fans
Flooding: occasional, for very brief periods
Elevation: 4,400 to 5,300 feet

Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Jocity soil and similar soils: 90 percent
Contrasting inclusions: 10 percent

Typical Profile

0 to 4 inches—brown clay loam
4 to 60 inches—stratified reddish brown, yellowish red and strong brown loam and silt loam

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: very high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: moderate

Inclusions

Contrasting inclusions:
- Soils that are sandy throughout
- Soils that have a high content of gypsum
- Soils that consist of riverwash deposits

Similar inclusions:
- Soils high in lime on stream terraces
- Soils that have 1 to 15 percent gravel
- Soils that have slopes of less than 1 percent
- Soils that have slopes of more than 3 percent

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—western wheatgrass, blue grama, fourwing saltbush
- Present plant community—blue grama, threeawn, ring muhly

Important forage species: western wheatgrass, blue grama

Major management factors: Occasional flooding, hazard of erosion by wind

General management considerations:
- Grazing should be delayed until the soil is sufficiently dry to prevent trampling.
- Grazing rotation systems should be used to avoid this soil during wet periods.
- Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices:
- Proper grazing use
- Planned grazing systems
- Fencing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: well suited
- High production on this soil makes it attractive to many species of wildlife.

Interpretive Groups

Land capability classification: VIIs, nonirrigated
Range site: Clayey Bottom 7-11" p.z.

19—Jocity silty clay loam, 1 to 3 percent slopes

Setting

Landform: stream terraces
Flooding: none
Elevation: 4,500 to 5,000 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Jocity soil and similar soils: 90 percent
Contrasting inclusions: 10 percent

Typical Profile

0 to 4 inches—brown silty clay loam
4 to 60 inches—stratified reddish brown, yellowish red and strong brown loam and silt loam

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: very high

Potential rooting depth: 60 or more inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: moderate

Inclusions

Contrasting inclusions:
- Soils that are gullied, particularly along Johnson Wash and Upper Kanab Creek
- Soils that are saline-sodic
- Soils that have a high content of gypsum

Similar inclusions:
- Soils that have slopes of less than 1 percent

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—galleta, fourwing saltbush
- Present plant community—squirreltail, blue grama, shadscale

Important forage species: galleta, fourwing saltbush, squirreltail, winterfat

Major management factors: Hazard of water erosion, gullying, and hazard of wind erosion (fig. 4)

General management considerations:
- The vegetation of this soil is difficult to restore once the plant cover has been altered.
- Ground cover should be maintained or improved to reduce the erosion hazard.
- Good livestock distribution is needed in order to use the forage properly.

Suitable management practices:
- Proper grazing use
- Planned grazing system
- Fencing
- Deferred grazing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: well suited

Figure 4.—Jocity silty clay loam, 1 to 3 percent slopes. Headcutting of these soils creates deep gullies.

• High production on this soil makes it attractive to many species of wildlife.

Cropland

General management considerations:
• Soil becomes compacted if pastures are grazed when wet.
• A tillage pan forms easily if the soil is tilled excessively or when wet.
• All climatically suited crops respond well to irrigation on this soil.
• Leveling is needed for efficient application of irrigation water.

Suitable management practices:
• Use proper stocking rate and pasture rotation, and restrict grazing during wet periods to prevent soil compaction.
• Mow periodically to maintain uniform growth, discourage selective grazing, and reduce clump growth.
• Application of irrigation water should be adjusted to the available water capacity of the soil, the intake rate, and the needs of the crop.
• Water should be applied at a rate that insures the root zone is sufficiently moistened.
• Use all crop residue, plow under cover crops and use crop rotation system to maintain or build up organic matter, reduce surface crusting, improve water intake rate, and improve soil tilth.
• Use conservation tillage to prevent compaction and formation of a plow layer.

Building Site Development

General management considerations:
• Gullying
• Surface disturbance and excavation increases the risk of wind and water erosion
• Moderately slow permeability
• Subsidence caused by the content of gypsum
• Some areas of this unit may be subject to salt heave because of the expansion of sodium sulfate salts. This action is likely to crack concrete slab floors, driveways, and sidewalks.

Suitable management practices:
• Revegetate disturbed areas at construction sites as soon as possible to reduce the risk of wind erosion.
• Reduce the risk of erosion and maintenance cost by stabilizing areas that have been disturbed.
• Preserve the existing plant cover during construction to reduce the risk of erosion.
• Offset the risk of corrosion to concrete and uncoated steel pipe by using sulfate-resistant cement and treated steel pipe with cathodic protectors.
• Provide drains to control surface runoff and keep soil loss at a minimum.
• Seed road cuts and fills to permanent vegetation.
• Compensate for the moderately slow permeability by increasing the size of the absorption fields.

Interpretive Groups

Land capability classification: IIe, irrigated, VIIs, nonirrigated
Range site: Clayey Upland 7-11" p.z.

20—Keeseha loam, 1 to 6 percent slopes

Setting

Landform: fan terraces
Flooding: none
Elevation: 4,800 to 5,400 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Keeseha soil and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

Rock fragments on surface—10 percent gravel
0 to 1 inch—yellowish red loam
1 to 14 inches—red clay loam and clay
14 to 19 inches—pink gravelly clay loam
19 to 60 inches—pinkish white gravelly sandy loam

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: moderate
Potential rooting depth: more than 60 inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: moderate
Shrink-swell potential: high

Inclusions

Contrasting inclusions:
• Soils that have a high content of gypsum below 12 inches
• Areas of Rock outcrop

Similar inclusions:
- Soils that have clay loam texture throughout
- Soils that have slopes of less than 1 percent
- Soils that have clay loam subsoils (Barx)

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—western wheatgrass, blue grama, big sagebrush, fourwing saltbush
- Present plant community—blue grama, western wheatgrass, threeawn, snakeweed

Important forage species: western wheatgrass, blue grama, fourwing saltbush

Major management factors: Slow permeability and hazard of erosion by wind and by water

General management considerations:
- Readily responds to management.
- Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices:
- Proper grazing use
- Fencing
- Deferred grazing
- Range seeding

Wildlife Habitat

Suitability for herbaceous plants and shrubs: moderately suited
- A preferred site of open rangeland for wildlife.

Interpretive Groups

Land capability classification: VIs, nonirrigated
Range site: Clay Loam Upland 10-14" p.z.

21—Kinan-Pennell complex, 4 to 15 percent slopes

Setting

Landform: plateaus
Landscape position: Kinan—areas that are slightly lower in elevation, usually concave; Pennell—generally on convex slopes slightly higher in elevation (fig. 5)
Flooding: none
Elevation: 3,500 to 5,000 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Kinan soil and similar soils: 60 percent
Pennell soil and similar soils: 25 percent
Contrasting inclusions: 15 percent

Typical Profile

Kinan

Rock fragments on surface—30 percent gravel
0 to 1 inch—yellowish red gravelly sandy loam
1 to 13 inches—yellowish red sandy loam
13 to 27 inches—yellowish red and pinkish white very gravelly sandy loam
27 to 60 inches—pinkish white and very pale brown loam

Pennell

Rock fragments on surface—20 percent gravel
0 to 4 inches—yellowish red gravelly sandy loam
4 to 7 inches—yellowish red sandy loam
7 to 14 inches—yellowish red very gravelly sandy loam
14 to 19 inches—pink sandy loam
19 inches—limestone

Soil Properties and Qualities

Kinan

Parent material: alluvium from limestone
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: moderate
Potential rooting depth: more than 60 inches
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderately high

Pennell

Parent material: alluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: moderate
Hazard of wind erosion: moderate

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 15 percent
- Soils that have a high content of gypsum
- Soils that have a loamy fine sand surface

Figure 5.—Kinan-Pennell complex, 4 to 15 percent slopes. Good range production is possible when these soils are properly managed.

Similar inclusions:
- Soils that are moderately deep
- Soils that have more than 35 percent rock fragments
- Soils that have a hardpan between 10 and 20 inches
- Soils that have slopes of less than 4 percent

Use and Management

Rangeland

Dominant vegetation on the Kinan soil:
- Potential plant community—Indian ricegrass, sand dropseed, galleta, Mormon tea, fourwing saltbush
- Present plant community—sand dropseed, galleta, Mormon tea

Dominant vegetation on the Pennell soil:
- Potential plant community—sand dropseed, galleta, Mormon tea, Indian ricegrass, fourwing saltbush
- Present plant community—sand dropseed, galleta, winterfat

Important forage species: Kinan—Indian ricegrass, sand dropseed, black grama, fourwing saltbush; Pennell—Indian ricegrass, sand dropseed, winterfat

Major management factors: Depth to bedrock on the Pennell soils, seepage, hazard of wind and water erosion, and limited available water capacity

General management considerations on the Kinan soil:
- Responds well to proper management.
- Earthen water impoundments are limited because of seepage potential.
- Good livestock distribution is essential to proper range utilization.

• Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices on the Pennell soil:
• Limited potential for range seeding because of very low available water capacity.
• Earthen water impoundments are limited because of shallow depth to bedrock.
• Good livestock distribution is essential to proper range utilization.

Suitable management practices on the Kinan-Pennell soils:
• Proper grazing use
• Planned grazing systems
• Fencing

Wildlife Habitat

Suitability of the Kinan-Pennell soils for herbaceous plants and shrubs: moderately suited
• A preferred site of open-range wildlife.

Interpretive Groups

Land capability classification: Kinan and Pennell—VIIs, nonirrigated
Range site: Kinan—Gravelly Upland 6-10" p.z.; Pennell—Gravelly Upland 6-10" p.z.

22—Kinan-Pennell complex, dry, 4 to 15 percent slopes

Setting

Landform: plateaus
Landscape position: Kinan-generally on lower concave slopes; Pennell-generally on upper convex slopes
Flooding: none
Elevation: 3,500 to 5,000 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Kinan soil and similar soils: 60 percent
Pennell soil and similar soils: 20 percent
Contrasting inclusions: 20 percent

Typical Profile

Kinan

Rock fragments on surface—30 percent gravel
0 to 1 inch—yellowish red gravelly sandy loam
1 to 13 inches—yellowish red sandy loam
13 to 27 inches—yellowish red and pinkish white very gravelly sandy loam
27 to 60 inches—pinkish white and very pale brown loam

Pennell

Rock fragments on surface—20 percent gravel
0 to 4 inches—yellowish red gravelly sandy loam
4 to 7 inches—yellowish red sandy loam
7 to 14 inches—yellowish red very gravelly sandy loam
14 to 19 inches—pink sandy loam
19 inches—limestone

Soil Properties and Qualities

Kinan

Parent material: alluvium from limestone
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderately high

Pennell

Parent material: alluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderate

Inclusions

Contrasting inclusions:
• Soils that have slopes more than 15 percent
• Soils that have a high content of gypsum
• Soils that have a loamy fine sand surface

Similar inclusions:
• Soils that are moderately deep
• Soils that have more than 35 percent rock fragments
• Soils that have slopes less than 4 percent

Use and Management

Rangeland

Dominant vegetation on the Kinan soil:
• Potential plant community—Indian ricegrass, sand dropseed, black grama, shadscale

• Present plant community—sand dropseed, galleta, Mormon tea, shadscale, pricklypear

Dominant vegetation on the Pennell soil:
• Potential plant community—Indian ricegrass, sand dropseed, galleta, shadscale, Mormon tea
• Present plant community—sand dropseed, galleta, shadscale, pricklypear

Important forage species: Kinan—Indian ricegrass, black grama, sand dropseed; Pennell—Indian ricegrass, sand dropseed, black grama

Major management factors: Limited available water capacity and depth to bedrock (Pennell soil); seepage, hazard of water and wind erosion.

General management considerations on the Kinan soil:
• Responds well to proper management.
• Earthen water impoundments are limited because of seepage potential.
• Good livestock distribution is essential to proper range utilization.
• Ground cover should be maintained or improved to prevent erosion hazard.

General management considerations on the Pennell soil:
• Limited potential for range seeding because of very low available water capacity.
• Earthen water impoundments are limited because of shallow depth to bedrock.
• Good livestock distribution is essential to proper range utilization.
• Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices on the Kinan-Pennell soils:
• Proper grazing use
• Planned grazing systems
• Fencing

Wildlife Habitat

Suitability of the Kinan-Pennell soils for herbaceous plants and shrubs: moderately suited
• Open rangeland wildlife prefer this site.

Interpretive Groups

Land capability classification: Kinan and Pennell—VIIs, nonirrigated
Range site: Kinan—Gravelly Upland, Alkaline 6-10" p.z.; Pennell—Gravelly Upland, Alkaline 6-10" p.z.

23—Klondike sandy clay loam, 2 to 15 percent slopes

Setting

Landform: hills
Flooding: none
Elevation: 4,800 to 5,400 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Klondike soil and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

Rock fragments on surface—5 percent channers
0 to 1 inches—reddish brown sandy clay loam
1 to 11 inches—reddish brown and yellowish red loam
11 inches—fractured calcareous sandstone

Soil Properties and Qualities

Parent material: alluvium from sandstone, siltstone, and shale
Depth class: shallow
Drainage class: well drained
Permeability: moderately slow
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: severe
Hazard of wind erosion: moderate

Inclusions

Contrasting inclusions:
• Soils that have slopes of more than 15 percent
• Soils that are moderately deep over sandstone on toeslopes
• Soils that are deep and contain more than 35 percent rock fragments; on toeslopes
• Soils that are clayey
• Areas of Rock outcrop

Similar inclusions:
• Soils that are similar to Klondike but have more than 35 percent rock fragments

Use and Management

Rangeland

Dominant vegetation on the Klondike soil:

• Potential plant community—black grama, needleandthread, blue grama, big sagebrush
• Present plant community—blue grama, squirreltail, sagebrush

Important forage species: black grama, blue grama, fourwing saltbush

Major management factors: Depth to bedrock, limited available water capacity, and hazard of erosion by water and wind

General management considerations:
• Range seeding is limited by very low available water capacity.
• Earthen water impoundments are limited because of shallow depth to bedrock.
• Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices:
• Proper grazing use
• Planned grazing system
• Fencing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: moderately suited
• Scattered pinyon pine and juniper trees add structural diversity to this open grassland.

Interpretive Groups

Land capability classification: VIs, nonirrigated
Range site: Shallow Loamy 10-14" p.z.

24—Manikan silty clay loam, 1 to 3 percent slopes

Setting

Landform: stream terraces
Flooding: none
Elevation: 4,700 to 5,400 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Manikan soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 3 inches—yellowish red silty clay loam
3 to 30 inches—light brown loam
30 to 42 inches—light brown silty clay loam
42 to 60 inches—light brown loam

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: high gullying potential
Hazard of wind erosion: moderate

Inclusions

Contrasting inclusions:
• Gullied areas
• Soils high in lime; on fan terraces
• Areas that have clay loam subsoils on fan terraces (Barx)
• Soils that have slopes of more than 3 percent
• Areas subject to rare flooding on alluvial fans

Similar inclusions:
• Soils that are silty throughout
• Areas that have silt loam, loam, and sandy loam surface layers
• Soils that have slopes of less than 1 percent

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—blue grama, black grama, big sagebrush, squirreltail
• Present plant community—squirreltail, galleta, fourwing saltbush, big sagebrush

Important forage species: western wheatgrass, fourwing saltbush, blue grama, and black grama

Major management factors: Crusting of the surface, hazard of erosion by wind and water, gullying potential

General management considerations:
• Seeding is difficult because of shrinking and swelling of the soil.
• Seed only plants tolerant of shrinking and swelling.
• Vegetation is difficult to restore once disturbed or altered.
• Grazing should be delayed until the soil has dried sufficiently to withstand trampling and prevent compaction.
• Ground cover should be maintained or improved to reduce erosion hazard.

Suitable management practices:
• Proper grazing use

- Planned grazing systems
- Fencing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: poorly suited
- Poor vegetative diversity

Interpretive Groups

Land capability classification: VIs, nonirrigated
Range site: Clayey Upland 10-14" p.z.

25—Mellenthin very gravelly loam, 1 to 25 percent slopes

Setting

Landform: hills (fig. 6)
Flooding: none
Elevation: 4,800 to 5,800 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Mellenthin soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

Rock fragments on surface—45 percent gravel
0 to 2 inches—light brown very gravelly loam
2 to 8 inches—strong brown very gravelly loam
8 to 13 inches—strong brown, limy extremely gravelly sandy loam
13 inches—fractured limestone

Soil Properties and Qualities

Parent material: alluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: very slight
Depth to a limy layer: high content of lime below 8 inches

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 25 percent

Similar inclusions:
- Soils that have a lime-cemented hardpan at shallow depth (Curhollow)
- Soils that are similar to Mellenthin but are moderately deep to bedrock and have less than 35 percent rock fragments; on toeslopes

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—black grama, blue grama, needleandthread, big sagebrush
- Present plant community—sagebrush, blue grama, needlegrasses, western wheatgrass

Important forage species: black grama, blue grama, galleta, western wheatgrass, fourwing saltbush

Major management factors: Depth to bedrock, limited available water capacity, and hazard of water erosion

General management considerations:
- Range seeding limited by very low available water capacity.
- Earthen water impoundments are limited because of shallow depth to bedrock.
- Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices:
- Proper grazing use
- Planned grazing systems
- Fencing
- Deferred grazing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: moderately suited
- Scattered pinyon pine and juniper trees add structural diversity to this open grassland.

Interpretive Groups

Land capability classification: VIs, nonirrigated
Range site: Shallow Loamy 10-14 p.z.

26—Mellenthin very gravelly loam, 30 to 60 percent slopes

Setting

Landform: hills
Flooding: none

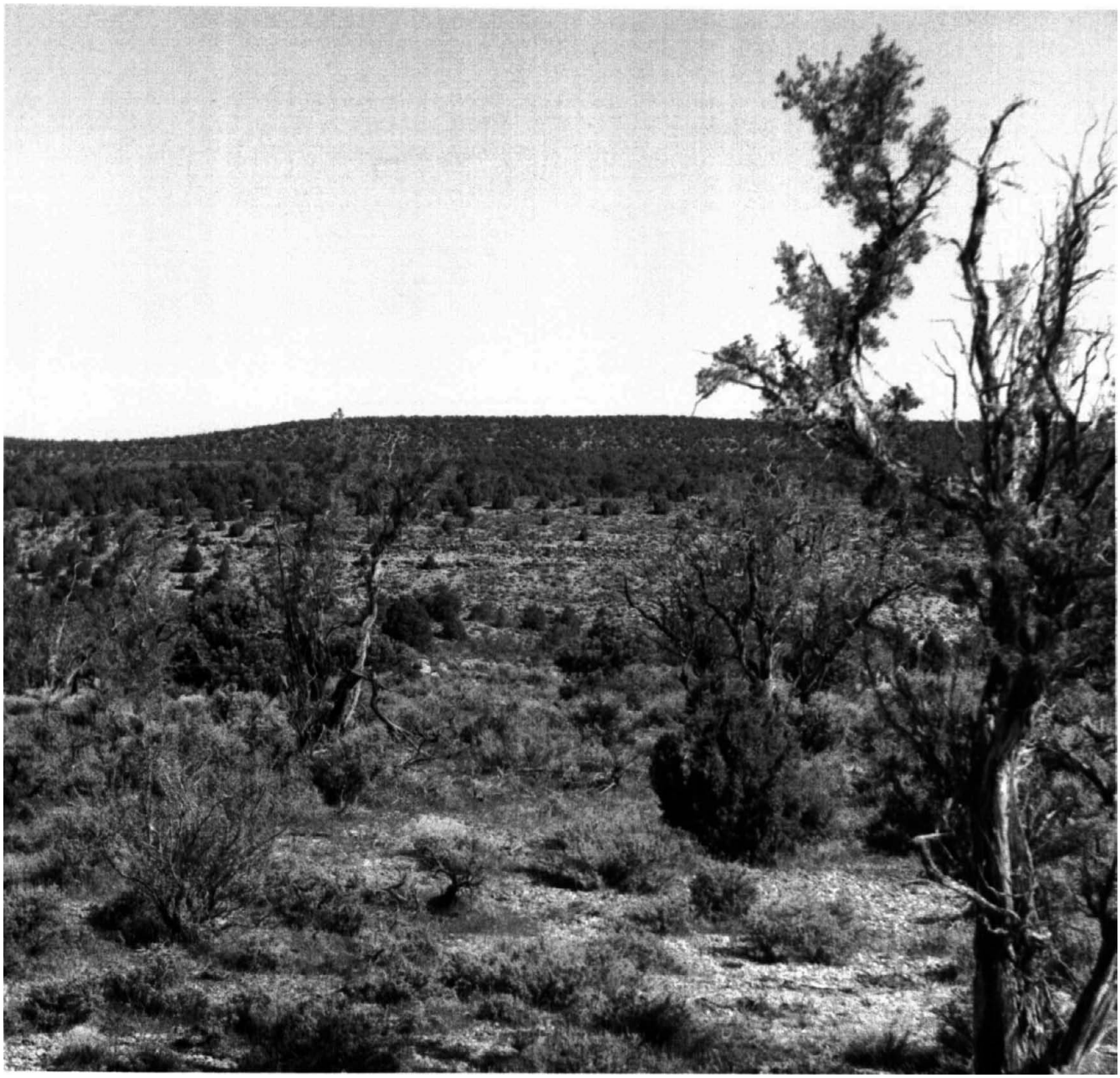

Figure 6.—Mellenthin very gravelly loam, 1 to 25 percent slopes, at the lower elevations. Disterheff-Houserock complex, 3 to 15 percent slope, is at the higher elevations.

Elevation: 5,600 to 6,200 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Mellenthin soil and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

Rock fragments on surface—50 percent gravel, 5 percent cobbles, and a few stones
0 to 2 inches—light brown very gravelly loam
2 to 8 inches—strong brown very gravelly loam
8 to 13 inches—strong brown, limy extremely gravelly sandy loam
13 inches—fractured limestone

Soil Properties and Qualities

Parent material: alluvium and colluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: very severe
Hazard of wind erosion: very slight
Depth to a limy layer: high content of lime below about 8 inches

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 60 percent
- Areas of Strych soils on toeslopes
- Areas of Rock outcrop

Similar inclusions:
- Areas of Curhollow soils
- Soils that have slopes of less than 30 percent
- Areas of higher precipitation (14- to 18-inch pz)

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—needleandthread, blue grama, big sagebrush
- Present plant community—needlegrasses, blue grama, sagebrush

Important forage species: blue grama, Indian ricegrass, fourwing saltbush

Major management factors: Depth to bedrock, limited available water capacity, hazard of water erosion, and slope

General management considerations:
- Brush management is limited by steep slopes and low productivity.
- Very slow response to management.
- High water erosion hazard when disturbed.
- Ground cover should be maintained or improved to prevent erosion hazard.
- In areas of higher precipitation (14- to 18-inch p.z.), pinyon and juniper trees dominate the site. Site guides for this precipitation zone better describe the plant community in this part of the unit.

Suitable management practices:
- Proper grazing use
- Planned grazing systems
- Fencing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: moderately suited
- Scattered pinyon and juniper trees add structural diversity.

Interpretive Groups

Land capability classification: VIIe, nonirrigated
Range site: Limestone Breaks 10-14" p.z.

27—Monierco clay loam, 2 to 15 percent slopes

Setting

Landform: hills
Flooding: none
Elevation: 4,800 to 5,000 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Monierco soil and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 1 inch—yellowish red clay loam
1 to 10 inches—red clay loam
10 to 19 inches—reddish brown gravelly loam
19 inches—fractured siltstone

Soil Properties and Qualities

Parent material: alluvium from sandstone and shale
Depth class: shallow
Drainage class: well drained
Permeability: moderately slow
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: rapid
Hazard of water erosion: severe
Hazard of wind erosion: moderate

Inclusions

Contrasting inclusions:
- Soils that are loamy and moderately deep on toeslopes
- Areas of Rock outcrop
- Soils that have slopes of more than 15 percent

Similar inclusions:
- Soils that have slopes of less than 2 percent

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—Indian ricegrass, needleandthread, galleta, winterfat
• Present plant community—blue grama, needlegrasses, threeawn, fourwing saltbush

Important forage species: Indian ricegrass, galleta, winterfat, squirreltail

Major management factors: Limited available water capacity, depth to bedrock, hazard of erosion by water and wind

General management considerations:
• Desirable grasses recover slowly because shrubby plants compete for moisture.
• Range seeding is limited by very low available water capacity.
• Earthen water impoundments are limited because of shallow soil depth.
• Good livestock distribution is necessary for proper forage use.
• Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices:
• Proper grazing use
• Planned grazing systems
• Fencing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: poorly suited
• Scattered pinyon pine and juniper trees add structural diversity to this open grassland.

Interpretive Groups

Land capability classification: VIIs, nonirrigated
Range site: Shallow Loamy 7-11" p.z.

28—Monue sandy loam, 1 to 6 percent slopes

Setting

Landform: fan terraces
Flooding: none
Elevation: 5,000 to 5,300 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Monue soil and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 1 inch—yellowish red sandy loam
1 to 43 inches—yellowish red fine sandy loam
43 to 60 inches—yellowish red silty clay loam

Soil Properties and Qualities

Parent material: alluvium from sandstone
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid, upper part; moderately slow, lower part
Available water capacity: high
Potential rooting depth: 60 or more inches
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderately high

Inclusions

Contrasting inclusions:
• Soils that have slopes of more than 6 percent
• Soils that have a sandy loam surface and clay subsoil
• Soils that are deep and have more than 35 percent rock fragments

Similar inclusions:
• Soils that have a high content of lime

Use and Management

Rangeland

Dominant vegetation:
• Potential plant community—Indian ricegrass, needleandthread, blue grama, fourwing saltbush
• Present plant community—squirreltail, needlegrasses, Indian ricegrass, fourwing saltbush

Important forage species: Indian ricegrass, squirreltail, fourwing saltbush

Major management factors: Hazard of erosion by wind and water

General management considerations:
• Ground cover should be maintained or improved to reduce erosion hazard.
• Readily responds to proper management.

Suitable management practices:
• Proper grazing use

- Planned grazing systems
- Deferred grazing
- Water developments

Wildlife Habitat

Suitability for herbaceous plants and shrubs: moderately suited

Interpretive Groups

Land capability classification: VIIs, nonirrigated
Range site: Sandy Loam Upland 7-11" p.z.

29—Monue-Seeg complex, 1 to 6 percent slopes

Setting

Landform: fan terraces
Flooding: none
Elevation: 5,000 to 5,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Monue soil and similar soils: 55 percent
Seeg soil and similar soils: 25 percent
Contrasting inclusions: 20 percent

Typical Profile

Monue

0 to 43 inches—yellowish red fine sandy loam
43 to 60 inches—yellowish red silty clay loam

Seeg

0 to 3 inches—yellowish red fine sandy loam
3 to 10 inches—yellowish red gravelly fine sandy loam
10 to 18 inches—reddish yellow and pink gravelly fine sandy loam
18 to 46 inches—pink very gravelly loam
46 to 60 inches—reddish yellow and pink fine sandy loam

Soil Properties and Qualities

Monue

Parent material: alluvium from sandstone
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid, upper part; moderately slow, lower part
Available water capacity: high
Potential rooting depth: 60 or more inches
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderately high

Seeg

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: moderate
Potential rooting depth: 60 or more inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: moderately high
Depth to a limy layer: more than 15 percent below a depth of 8 to 16 inches

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 6 percent
- Soils that are deep and loamy but have less than 35 percent rock fragments
- Soils that have a hardpan at 20 to 40 inches

Similar inclusions:
- Soils that are similar to Seeg but do not have the high content of lime

Use and Management

Rangeland

Dominant vegetation on the Monue-Seeg soils:
- Potential plant community—needleandthread, Indian ricegrass, blue grama, black grama, fourwing saltbush
- Present plant community—squirreltail, needlegrasses, blue grama, Mormon tea

Important forage species: Indian ricegrass, blue grama, black grama, and fourwing saltbush on both soils

Major management factors: Hazard of erosion by wind and water, limited available water capacity (Seeg), and seepage (Monue)

General management considerations on the Monue-Seeg soils:
- Ground cover should be maintained or improved to reduce erosion hazard.
- Readily responds to proper management.

Suitable management practices on the Monue-Seeg soils:
- Proper grazing use
- Fencing
- Deferred grazing
- Water developments

Wildlife Habitat

Suitability of the Monue-Seeg soils for herbaceous plants and shrubs: moderately suited

Interpretive Groups

Land capability classification: Monue-Seeg—VIIs, nonirrigated
Range site: Monue-Seeg—Sandy Loam Upland 7-11" p.z.

30—Needle-Rock outcrop complex, 4 to 15 percent slopes

Setting

Landform: plateaus (fig. 7)
Flooding: none
Elevation: 3,800 to 5,000 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Needle soil and similar soils: 70 percent
Rock outcrop and similar areas: 15 percent
Contrasting inclusions: 15 percent

Typical Profile

Needle

0 to 2 inches—reddish yellow fine sand
2 to 11 inches—reddish yellow and red fine sand
11 inches—sandstone

Rock Outcrop

Rock outcrop consists of areas of exposed sandstone.

Soil Properties and Qualities

Needle

Parent material: eolian sand and alluvium from sandstone
Depth class: shallow
Drainage class: excessively drained
Permeability: very rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: very high

Inclusions

Contrasting inclusions:
- Soils that are similar to Needle but moderately deep to sandstone
- Soils that are deep and sandy throughout, on toeslopes (Sheppard)
- Soils that are shallow to a lime-cemented hardpan, on short fan terraces

Use and Management

Rangeland

Dominant vegetation on the Needle soil:
- Potential plant community—Indian ricegrass, needleandthread, fourwing saltbush, Mormon tea
- Present plant community—gramas, needlegrasses, squirreltail

Important forage species: Indian ricegrass, fourwing saltbush, squirreltail

Major management factors: Depth to bedrock, limited available water capacity, and hazard of erosion by wind and water

General management considerations on the Needle soil:
- Ground cover should be maintained or improved to reduce erosion hazard.
- Earthen water impoundments are limited because of shallow depth to bedrock.
- Range seeding limited by very low available water capacity.

Suitable management practices on the Needle soil:
- Proper grazing use
- Planned grazing system
- Fencing
- Deferred grazing

Wildlife Habitat

Suitability of the Needle soil for herbaceous plants and shrubs: poorly suited
- Wildlife use of this unit is limited to transients from adjacent sites.

Interpretive Groups

Land capability classification: Needle—VIIe, nonirrigated
Range site: Needle—Sandstone Upland 6-10" p.z.

31—Needle-Sheppard complex, 2 to 12 percent slopes

Setting

Landform: plateaus
Landscape position: Needle—higher convex slopes; Sheppard—dunes and lower concave slopes.

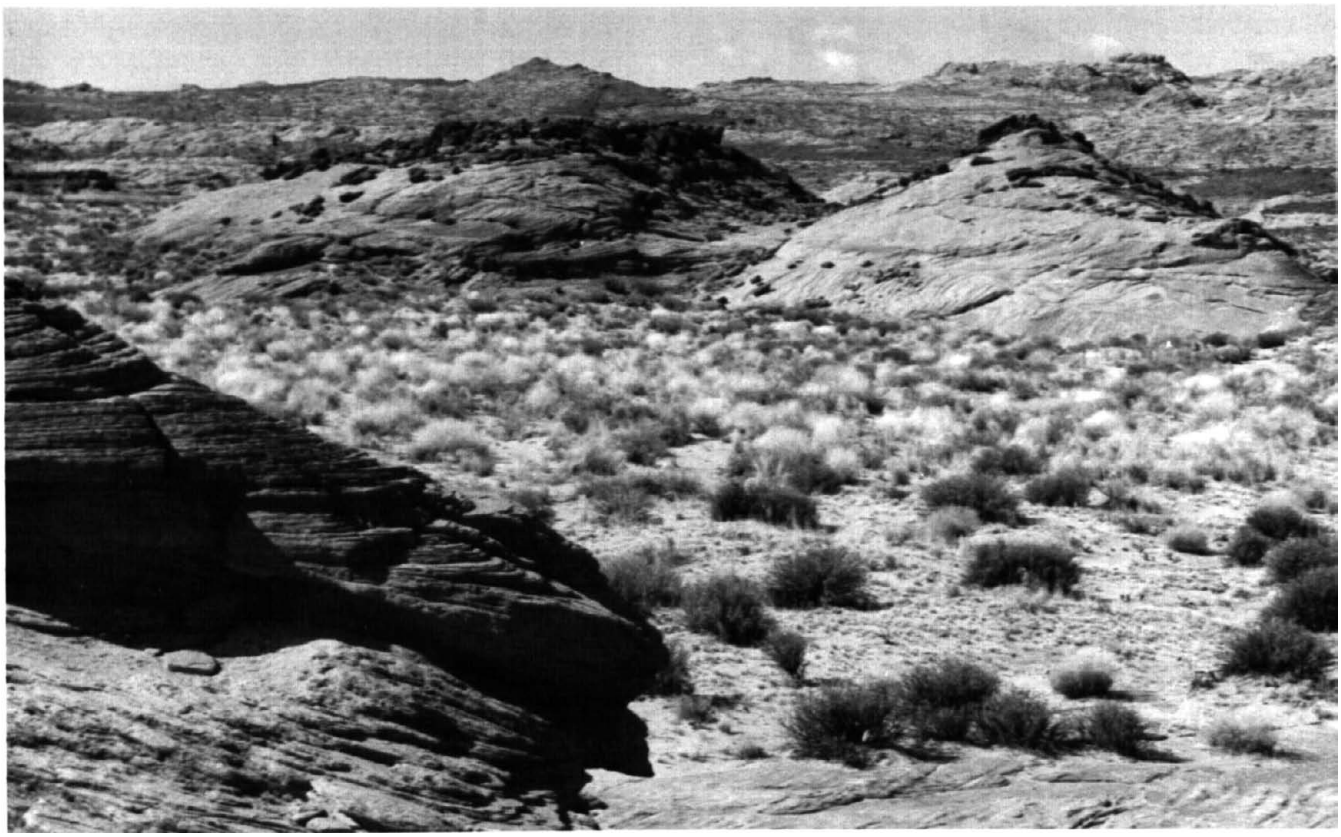

Figure 7.—Needle-Rock outcrop complex, 4 to 15 percent slopes. Care must be taken when using this sandy soil.

Flooding: none
Elevation: 4,000 to 5,600 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Needle soil and similar soils: 60 percent
Sheppard soil and similar soils: 20 percent
Contrasting inclusions: 20 percent

Typical Profile

Needle

0 to 2 inches—reddish yellow fine sand
2 to 11 inches—reddish yellow and red fine sand
11 inches—sandstone

Sheppard

0 to 4 inches—yellowish red fine sand
4 to 60 inches—reddish yellow fine sand

Soil Properties and Qualities

Needle

Parent material: eolian sand and alluvium from sandstone
Depth class: shallow
Drainage class: excessively drained
Permeability: very rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: very high

Sheppard

Parent material: eolian sand from sandstone
Depth class: very deep
Drainage class: excessively drained
Permeability: rapid
Available water capacity: low
Potential rooting depth: more than 60 inches

Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: very high

Inclusions

Contrasting inclusions:
- Areas of Rock outcrop
- Soils that are similar to Needle but have as much as 35 percent rock fragments and a high content of lime
- Areas of coppice dunes

Similar inclusions:
- Soils that are similar to Sheppard but moderately deep to sandstone

Use and Management

Rangeland

Dominant vegetation on the Needle soil:
- Potential plant community—Indian ricegrass, needleandthread, fourwing saltbush, Mormon tea
- Present plant community—threeawn, gramas, squirreltail, barberry

Dominant vegetation on the Sheppard soil:
- Potential plant community—galleta, Indian ricegrass, black grama, squirreltail, sand sage
- Present plant community—blue grama, galleta, sand dropseed, sand sage

Major management factors: Depth to bedrock (Needle), limited available water capacity, seepage, and hazard of erosion by wind and water

General management considerations on the Needle-Sheppard soils:
- Ground cover should be maintained or improved to reduce the erosion hazard.
- Earthen water impoundments are limited because of seepage potential and depth to bedrock (Needle).
- Needle soil has limited potential for range seeding because of very low available water capacity.
- Good distribution is important to the proper utilization of the forage species.

Suitable management practices:
- Proper grazing use
- Planned grazing systems
- Fencing
- Deferred grazing

Building Site Development

General management considerations:
- This unit is highly susceptible to wind erosion.
- Surface disturbance and excavation increase the risk of wind and water erosion.
- Cutbanks are not stable and therefore are subject to caving.
- The quality of roadbeds can be adversely affected by limited soil strength.
- Excavation is limited by depth to bedrock.

Suitable management practices:
- Revegetate disturbed areas at construction sites as soon as possible to reduce the risk of wind erosion.
- Preserve the existing plant cover during construction to reduce the risk of erosion.
- Construct special retainer walls in shallow excavations to prevent cutbanks from caving in.
- Offset the risk of corrosion to uncoated steel by using corrosion-resistant material or by using coatings and cathodic protectors.
- Provide drains to control surface runoff and keep soil loss at a minimum.
- Seed road cuts and fills to permanent vegetation.
- The deep cuts needed to level the road surface can expose hard bedrock that is difficult to excavate.
- Septic tank absorption fields may function poorly because of the limited depth to bedrock.

Wildlife Habitat

Suitability of the Needle-Sheppard soils for herbaceous plants and shrubs: moderately suited
- Burrowing animals find this site suitable for digging.

Interpretive Groups

Land capability classification: Needle—VIIs, nonirrigated; Sheppard—VIIe, nonirrigated
Range site: Needle—Sandstone Upland 6-10" p.z.; Sheppard—Sandy Upland 6- 10" p.z.

32—Pagina loamy sand, 1 to 3 percent slopes

Setting

Landform: plateaus
Flooding: none
Elevation: 3,600 to 4,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Pagina soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 2 inches—yellowish red loamy sand
2 to 22 inches—yellowish red and reddish yellow loamy fine sand
22 to 38 inches—pinkish white limy sandy loam
38 inches—partially weathered calcareous sandstone

Soil Properties and Qualities

Parent material: eolian sand and alluvium from sandstone
Depth class: moderately deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 20 to 40 inches
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: high
Depth to a limy layer: about 22 inches
Corrosivity: high potential to uncoated steel

Inclusions

Contrasting inclusions:
- Areas of shallow soils on higher convex positions (Wahweap)
- Areas of deep sandy soils in concave positions (Sheppard)
- Soils that have slopes of more than 3 percent

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—galleta, squirreltail, blackbrush
- Present plant community—blue grama, sand dropseed, sand sage, blackbrush

Important forage species: galleta, black grama, squirreltail, fourwing saltbush

Major management factors: Limited available water capacity, hazard of erosion by wind, depth to weathered bedrock

General management considerations:
- Urban development has taken over most of this unit.
- A few small areas still retain a native plant community but they are managed with adjoining units.
- Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices:
- Proper grazing use

Building Site Development

General management considerations:
- This soil is highly susceptible to wind erosion.
- Surface disturbance and excavation increases the risk of wind and water erosion.
- Cutbanks are not stable and therefore are subject to caving.
- The quality of roadbeds can be adversely affected by limited soil strength.
- Excavation is limited by depth to weathered bedrock.

Suitable management practices:
- Revegetate disturbed areas at construction sites as soon as possible to reduce the risk of wind erosion.
- Preserve the existing plant cover during construction to reduce the risk of erosion.
- Construct special retainer walls in shallow excavations to prevent cutbanks from caving in.
- Offset the risk of corrosion to uncoated steel by using corrosion-resistant material or by using coatings and cathodic protectors.
- Provide drains to control surface runoff and keep soil loss at a minimum.
- Seed road cuts and fills to permanent vegetation.
- The deep cuts needed to level the road surface can expose bedrock that is difficult to excavate.
- Septic tank absorption fields may function poorly because of the limited depth to bedrock.

Wildlife Habitat

Suitability for herbaceous plants and shrubs: moderately suited
- Burrowing animals find this site suitable for digging.

Interpretive Groups

Land capability classification: VIIe, nonirrigated
Range site: Sandy Loam Upland, Calcareous 6-10" p.z.

33—Pagina-Wahweap complex, 3 to 16 percent slopes

Setting

Landform: plateaus
Landscape position: Pagina—intermingled, generally lower concave slopes; Wahweap—generally high convex slopes
Flooding: none

Elevation: 3,600 to 4,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Pagina soil and similar soils: 60 percent
Wahweap soil and similar soils: 20 percent
Contrasting inclusions: 20 percent

Typical Profile

Pagina

0 to 2 inches—yellowish red fine sand
2 to 22 inches—yellowish red and reddish yellow loamy fine sand
22 to 38 inches—pinkish white limy sandy loam
38 inches—partially weathered calcareous sandstone

Wahweap

0 to 1 inch—yellowish red fine sand
1 to 12 inches—yellowish red gravelly loamy fine sand
12 to 19 inches—yellowish red limy extremely gravelly fine sandy loam
19 inches—partially weathered sandstone

Soil Properties and Qualities

Pagina

Parent material: eolian sand and alluvium from sandstone
Depth class: moderately deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 20 to 40 inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: very high
Depth to a limy layer: about 22 inches

Wahweap

Parent material: eolian sand and alluvium from sandstone
Depth class: shallow
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 10 to 20 inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: very high
Depth to a limy layer: about 12 inches

Inclusions

Contrasting inclusions:
- Soils that have slopes greater than 16 percent
- Areas of Sheppard soils in concave positions
- Soils that are similar to Pagina but have more than 35 percent rock fragments
- Soils that are similar to Wahweap but are less than 35 percent rock fragments
- Areas of coppice dunes

Similar inclusions:
- Soils that are similar to Pagina but sandy throughout
- Soils that have slopes of less than 3 percent

Use and Management

Rangeland

Dominant vegetation on the Pagina soil:
- Potential plant community—galleta, squirreltail, blackbrush
- Present plant community—blue grama, galleta, sand dropseed

Dominant vegetation on the Wahweap soil:
- Potential plant community—Indian ricegrass, needleandthread, fourwing saltbush, blackbrush
- Present plant community—threeawn, gramas, squirreltail, blackbrush

Important forage species: Pagina—galleta, black grama, squirreltail, fourwing saltbush; Wahweap—Indian ricegrass, squirreltail, fourwing saltbush

Major management factors: Hazard of erosion by wind and water, depth to bedrock, seepage, and limited available water capacity

General management considerations on the Pagina-Wahweap soils:
- Ground cover should be maintained or improved to reduce the erosion hazard.
- Earthen water impoundments are limited because of seepage potential and depth to bedrock.
- Limited potential for range seeding because of low available water capacity.
- Good distribution is important to the proper utilization of the forage species.

Suitable management practices on the Pagina-Wahweap soils:
- Proper grazing use
- Planned grazing systems
- Fencing
- Deferred grazing

Wildlife Habitat

Suitability of the Pagina-Wahweap soils for herbaceous plants and shrubs: moderately suited
- Burrowing animals find this site suitable for digging.

Interpretive Groups

Land capability classification: Pagina-Wahweap—VIIe, nonirrigated
Range site: Pagina—Sandy Loam Upland, Calcareous 6- 10" p.z.; Wahweap—Shallow Sandy Loam, Calcareous 6-10" p.z.

34—Pennell cobbly loam, 3 to 10 percent slopes

Setting

Landform: plateaus
Flooding: none
Elevation: 4,400 to 5,000 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Pennell soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

Rock fragments on surface—10 percent gravel, 20 percent cobbles, and 1 percent stones
0 to 4 inches—yellowish red cobbly loam
4 to 7 inches—yellowish red sandy loam
7 to 14 inches—yellowish red very gravelly sandy loam
14 to 19 inches—pink sandy loam
19 inches—limestone

Soil Properties and Qualities

Parent material: alluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of water erosion: moderate
Hazard of wind erosion: moderate

Inclusions

Contrasting inclusions:
- Soils that are deep; on toeslopes
- Soils that are moderately deep to bedrock on toeslopes
- Soils that have slopes of more than 10 percent

Similar inclusions:
- Soils that are shallow to a hardpan

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—galleta, Indian ricegrass, black grama,
- Present plant community—galleta, black grama,

Important forage species: galleta, Indian ricegrass, black grama

Major management factors: Limited available water capacity, depth to bedrock, hazard of erosion by wind and water

General management considerations:
- Brush management and range seeding are limited by shallow depth to bedrock and very low available water capacity.
- Earthen water impoundments are limited by shallow depth to bedrock.
- Ground cover should be maintained or improved to reduce erosion hazard.

Suitable management practices:
- Proper grazing use
- Fencing
- Planned grazing system

Wildlife Habitat

Suitability for herbaceous plants and shrubs: poorly suited

Interpretive Groups

Land capability classification: VIIs, nonirrigated
Range site: Shallow Loamy 7-11" p.z.

35—Pennell gravelly sandy loam, 20 to 45 percent slopes

Setting

Landform: hills
Flooding: none
Elevation: 3,500 to 5,000 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Pennell soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

Rock fragments on surface—30 percent gravel
0 to 4 inches—yellowish red gravelly sandy loam
4 to 7 inches—yellowish red sandy loam
7 to 14 inches—yellowish red very gravelly sandy loam
14 to 19 inches—pink sandy loam
19 inches—limestone

Soil Properties and Qualities

Parent material: alluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: rapid
Hazard of water erosion: very severe
Hazard of wind erosion: moderate

Inclusions

Contrasting inclusions:
- Areas of Kinan gravelly sandy loam; on toeslopes
- Areas of Torriorthents on escarpments that have slopes greater than 25 percent
- Soils that are similar to Pennell but are moderately deep to limestone; on toeslopes

Similar inclusions:
- Soils that have slopes less than 20 percent
- Areas that have very gravelly sandy loam surfaces

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—Indian ricegrass, sand dropseed, galleta, Mormon tea, fourwing saltbush
- Present plant community—Indian ricegrass, sand dropseed, galleta

Important forage species: Indian ricegrass, galleta, fourwing saltbush, sand dropseed

Major management factors: Limited available water capacity, depth to bedrock, hazard of erosion by water and wind, slope

General management considerations:
- Brush management and range seeding are limited by shallow depth to bedrock and very low available water capacity.
- Management alternatives are very limited by steep slopes, low rainfall, and low productivity.
- Ground cover should be maintained or improved in order to reduce erosion hazard.

Suitable management practices:
- Proper grazing use
- Fencing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: poorly suited

Interpretive Groups

Land capability classification: VIIs, nonirrigated
Range site: Gravelly Upland 6-10" p.z.

36—Pennell sandy loam, 20 to 45 percent slopes

Setting

Landform: hills
Flooding: none
Elevation: 3,500 to 5,000 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Pennell soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

Rock fragments on surface—10 percent gravel
0 to 4 inches—yellowish red sandy loam
4 to 7 inches—yellowish red sandy loam
7 to 14 inches—yellowish red very gravelly sandy loam
14 to 19 inches—pink sandy loam
19 inches—limestone

Soil Properties and Qualities

Parent material: alluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: very severe
Hazard of wind erosion: moderately high

Inclusions

Contrasting inclusions:
- Areas of Kinan gravelly sandy loam, on toeslopes
- Areas of Torriorthents on escarpments that have slopes greater than 25 percent
- Soils that are similar to Pennell but moderately deep

Similar inclusions:
- Areas of Pennell gravelly loam
- Soils that have slopes less than 20 percent
- Areas that have very gravelly sandy loam surfaces

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—Indian ricegrass, galleta, shadscale, sand dropseed
- Present plant community—Indian ricegrass, galleta, snakeweed, shadscale, sand dropseed

Important forage species: Indian ricegrass, galleta, sand dropseed

Major management factors: Limited available water capacity, depth to bedrock, hazard of erosion by water and wind, slope

General management considerations:
- Brush management and range seeding are limited by shallow depth to bedrock and very low available water capacity.
- Earthen water impoundments are limited by shallow depth to bedrock.
- Ground cover should be maintained or improved to prevent erosion hazard.

Suitable management practices:
- Proper grazing use
- Planned grazing systems
- Fencing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: poorly suited

Interpretive Groups

Land capability classification: VIIs, nonirrigated
Range site: Gravelly Upland, Alkaline 6-10" p.z.

37—Pensom fine sand, 2 to 16 percent slopes

Setting

Landform: plateaus
Landscape position: stabilized dunes (fig. 8)
Flooding: none
Elevation: 5,200 to 6,600 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Pensom soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 2 inches—reddish yellow fine sand
2 to 55 inches—brown, strong brown and yellowish red fine sand
55 inches—sandstone

Soil Properties and Qualities

Parent material: eolian sand from sandstone
Depth class: deep
Drainage class: excessively drained
Permeability: very rapid
Available water capacity: low
Potential rooting depth: 40 to 60 inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: very high

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 16 percent
- Areas of Arches on some higher convex positions
- Soils that are shallow, moderately deep and deep, and have sandy loam subsoils
- Areas of shifting sand dunes

Similar inclusions:
- Soils that are similar to Pensom but deeper than 60 inches to bedrock
- Soils that are sandy and moderately deep

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—Indian ricegrass, needleandthread, dropseeds, sand sage
- Present plant community—Indian ricegrass, galleta, needleandthread, sand sage

Important forage species: Indian ricegrass, fourwing saltbush, galleta

Major management factors: Hazard of erosion by wind and water, limited available water capacity, and seepage

Figure 8.—Pensom fine sand, 2 to 16 percent slopes, occurs near the north end of Paria Plateau.

General management considerations:
- Ground cover should be maintained or improved to reduce the erosion hazard.
- Earthen water impoundments are limited by seepage potential.
- Range seeding limited by low available water capacity.
- Brush management can be used where unpalatable plant species have increased significantly.

Suitable management practices:
- Proper grazing use
- Planned grazing system
- Fencing
- Deferred grazing
- Brush management

Wildlife Habitat

Suitability for herbaceous plants and shrubs: well suited
- Burrowing animals find this soil suitable for digging.

Interpretive Groups

Land capability classification: VIIe, nonirrigated
Range site: Sandy Upland 10-14" p.z.

38—Pensom-Arches complex, 4 to 12 percent slopes

Setting

Landform: plateaus
Landscape position: Pensom—dunes, generally on lower concave slopes; Arches—dunes generally on higher convex slope
Flooding: none
Elevation: 5,400 to 5,800 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F

Frost-free period: 150 to 165 days

Composition

Pensom soil and similar soils: 55 percent
Arches soil and similar soils: 35 percent
Contrasting inclusions: 10 percent

Typical Profile

Pensom

0 to 2 inches—reddish yellow loamy fine sand
2 to 55 inches—brown, strong brown and yellowish red fine sand
55 inches—sandstone

Arches

0 to 16 inches—yellowish red loamy fine sand
16 inches—sandstone

Soil Properties and Qualities

Pensom

Parent material: eolian sand from sandstone
Depth class: deep
Drainage class: excessively drained
Permeability: very rapid
Available water capacity: low
Potential rooting depth: 40 to 60 inches
Runoff: slow
Hazard of water erosion: severe
Hazard of wind erosion: high

Arches

Parent material: eolian sand from sandstone
Depth class: shallow
Drainage class: excessively drained
Permeability: rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: slow
Hazard of water erosion: severe
Hazard of wind erosion: high

Inclusions

Contrasting inclusions:
- Areas of Rock outcrop
- Areas of shifting sand dunes
- Soils that are moderately deep and have sandy loam subsurface textures
- Soils that have slopes of more than 12 percent

Similar inclusions:
- Soils that are deep and have sandy loam subsurface textures
- Soils that are similar to Pensom but moderately deep to bedrock

Use and Management

Rangeland

Dominant vegetation on the Pensom soil:
- Potential plant community—Indian ricegrass, needleandthread
- Present plant community—Blue grama, squirreltail, Indian ricegrass, snakeweed, juniper

Dominant vegetation on the Arches soil:
- Potential plant community—Needleandthread, Indian ricegrass, dropseeds, Mormon tea
- Present plant community—Blue grama, dropseeds, sagebrush, snakeweed, blackbrush, juniper

Important forage species: Pensom—Indian ricegrass, New Mexico feathergrass, fourwing saltbush; Arches—Indian ricegrass, blue grama, galleta, dropseeds

Major management factors: Depth to bedrock (Arches soil), hazard of erosion by wind and water, seepage, limited available water capacity

General management considerations on the Pensom-Arches soils:
- Ground cover should be maintained or improved to reduce the erosion hazard.
- Earthen water impoundments are limited by seepage potential on both soils and by depth to bedrock on Arches soil.
- Range seeding limited by low to very low available water capacity.
- Use brush management in areas where unpalatable species have increased significantly.

Suitable management practices on the Pensom-Arches soils:
- Proper grazing use
- Planned grazing systems
- Fencing
- Deferred grazing

Wildlife Habitat

Suitability of the Pensom-Arches soils for herbaceous plants and shrubs: moderately suited

Interpretive Groups

Land capability classification: Pensom and Arches—VIIe, nonirrigated
Range site: Pensom—Sandy Upland 10-14" p.z.; Arches—Sandstone Upland, Calcareous 10-14" p.z.

39—Pensom-Arches complex, moist, 4 to 16 percent slopes

Setting

Landform: plateaus
Landscape position: Pensom—dunes, generally on lower concave slopes; Arches—dunes, generally on higher convex slopes
Flooding: none
Elevation: 5,300 to 5,800 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Pensom soil and similar soils: 55 percent
Arches soil and similar soils: 35 percent
Contrasting inclusions: 10 percent

Typical Profile

Pensom

0 to 2 inches—reddish yellow loamy fine sand
2 to 55 inches—brown, strong brown and yellowish red fine sand
55 inches—sandstone

Arches

0 to 16 inches—yellowish red loamy fine sand
16 inches—sandstone

Soil Properties and Qualities

Pensom

Parent material: eolian sand from sandstone
Depth class: deep
Drainage class: excessively drained
Permeability: very rapid
Available water capacity: low
Potential rooting depth: 40 to 60 inches
Runoff: slow
Hazard of water erosion: severe
Hazard of wind erosion: high

Arches

Parent material: eolian sand from sandstone
Depth class: shallow
Drainage class: excessively drained
Permeability: rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: slow
Hazard of water erosion: severe
Hazard of wind erosion: high

Inclusions

Contrasting inclusions:
- Areas of Rock outcrop
- Areas of shifting sand dunes
- Soils that are moderately deep and have sandy loam subsurface textures
- Soils that have slopes of more than 16 percent

Similar inclusions:
- Soils that are similar to Pensom but deeper than 60 inches to bedrock
- Soils that are similar to Pensom but moderately deep to bedrock
- Soils that are deep and have sandy loam subsurface textures

Use and Management

Rangeland-Grazeable Woodland

Dominant vegetation on the Pensom soil:
- Potential plant community—Needleandthread, Indian ricegrass, dropseeds, Mormon tea
- Present plant community—Blue grama, dropseeds, sagebrush, snakeweed, juniper

Dominant vegetation on the Arches soil:
- Potential plant community—Indian ricegrass, needleandthread, juniper, pinyon
- Present plant community—Blue grama, squirreltail, Indian ricegrass, snakeweed, juniper

Important forage species: Pensom—Indian ricegrass, blue grama, galleta, dropseeds; Arches—Indian ricegrass, New Mexico feathergrass, fourwing saltbush

Major management factors: Depth to bedrock (Arches soil), hazard of erosion by wind and water, seepage, limited available water capacity

General management considerations on the Pensom-Arches soils:
- Ground cover should be maintained or improved to reduce the erosion hazard.
- Earthen water impoundments are limited by seepage potential on both soils and by depth to bedrock on the Arches soil.
- Range seeding is limited by low available water capacity.
- Use brush management in areas where unpalatable species have increased significantly.

Suitable management practices on the Pensom-Arches soils:
- Proper grazing use

- Planned grazing systems
- Fencing
- Deferred grazing

Wildlife Habitat

Suitability of the Pensom-Arches soils for herbaceous plants and shrubs: moderately suited

Interpretive Groups

Land capability classification: Pensom and Arches—VIIe, nonirrigated
Range site: Pensom—Sandy Upland 10-14" p.z.
Woodland Site: Arches—Sandstone Upland 10-14" p.z.

40—Pits, borrow

Use and Management

- This unit consists of areas where the upper layers of the soil material have been removed. Some areas are used as sources of fill material. The borrow pits are 2 to 20 feet deep and 5 to 40 acres in size.
- Some of the borrow pits are deep enough to be used as sites for sanitary landfill operations. To be well suited for this use, soils must be slowly permeable and have a source of cover material.
- This unit provides some wildlife habitat in areas where the pit intercepts runoff from the surrounding areas. These areas are intermittently filled with water, which provides better growing conditions for grasses, shrubs and trees. The result is additional vegetative cover and food for wildlife.
- Some of the shallower pits can be used for stock water tanks in rangeland. These borrow pits receive runoff intermittently from the surrounding area, or they can receive water from natural drainageways diverted into them.
- Areas of this unit can be graded or filled and reclaimed for other uses.

Interpretive Groups

- This unit is not placed in a capability subclass or range site.

41—Rock outcrop

Setting

Landform: plateaus and hills (fig. 9)
Elevation: 5,300 to 7,300 feet
Slope: 2 percent to near vertical
Mean annual precipitation: 6 to 14 inches
Frost-free period: 140 to 180 days

Composition

Rock outcrop of limestone and sandstone: 85 percent
Contrasting inclusions: 15 percent

Inclusions

Contrasting inclusions:
- Needle soils
- Sheppard soils
- Mellenthin soils

Use and Management

- Where accessible, the included portions of this unit are used for grazing.

Interpretive Groups

- Rock outcrop is not placed in a capability subclass or range site.

42—Rock outcrop-Needle complex, 4 to 50 percent slopes

Setting

Landform: hills (fig. 10)
Flooding: none
Slope range: Needle-4 to 35 percent; Rock outcrop-4 to 50 percent
Elevation: 3,800 to 5,600 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Rock outcrop: 55 percent
Needle soil and similar soils: 35 percent
Contrasting inclusions: 10 percent

Typical Profile

Needle

0 to 2 inches—reddish yellow fine sand
2 to 11 inches—reddish yellow and red fine sand
11 inches—sandstone

Soil Properties and Qualities

Needle

Parent material: eolian sand and alluvium from sandstone
Depth class: shallow
Drainage class: excessively drained
Permeability: very rapid
Available water capacity: very low

Figure 9.—Rock outcrop, looking into the Paria River Canyon. More than 85 percent of the surface is Rock outcrop.

Potential rooting depth: 10 to 20 inches
Runoff: slow
Hazard of water erosion: severe
Hazard of wind erosion: very high

Rock Outcrop

Rock outcrop consists of areas of exposed sandstone.

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 50 percent
- Areas of Sheppard soils in concave positions
- Soils that are sandy and moderately deep to bedrock; on toeslopes

Similar inclusions:
- Soils that have slopes of less than 4 percent

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—Indian ricegrass, needleandthread, Mormon tea, fourwing saltbush
- Present plant community—needlegrasses, gramas, galleta, fourwing saltbush

Important forage species: Indian ricegrass, galleta, fourwing saltbush

Major management factors: Slope, depth to bedrock, limited available water capacity, and hazard of erosion by wind and water

General management considerations:
- Steep slope and areas of Rock outcrop limit use of this unit.
- Ground cover should be maintained or improved to reduce erosion hazard.
- Brush management and range seeding limited by very low available water capacity.

Suitable management practices:
- Proper grazing use
- Deferred grazing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: poorly suited
- Burrowing animals find this area suitable for digging.

Interpretive Groups

Land capability classification: VIIe, nonirrigated
Range site: Sandstone Upland 6-10" p.z.
Rock outcrop is not assigned a capability subclass or range site.

43—Rock outcrop-Torriorthents complex, warm, 25 to 65 percent slopes

Setting

Landform: canyon walls (fig. 11)
Flooding: none
Elevation: 2,900 to 4,500 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 57 to 59 degrees F
Frost-free period: 180 to 200 days

Composition

Rock outcrop and similar areas: 65 percent
Torriorthents soil and similar soils: 20 percent
Contrasting inclusions: 15 percent

Typical Profile

Torriorthents

Rock fragments on surface—variable
Soils are highly variable in texture of the surface and subsurface but are dominantly loamy
Depth of soil over bedrock varies from 4 inches to more than 60 inches

Rock Outcrop

Rock outcrop consists of exposed areas of sandstone, limestone, and other rocks. It is on canyon walls and cliffs and has slopes ranging from 25 percent to vertical.

Soil Properties and Qualities

Torriorthents

Parent material: colluvium from mixed sources
Depth class: very shallow to very deep
Drainage class: well drained to somewhat excessively drained
Permeability: very slow to very rapid

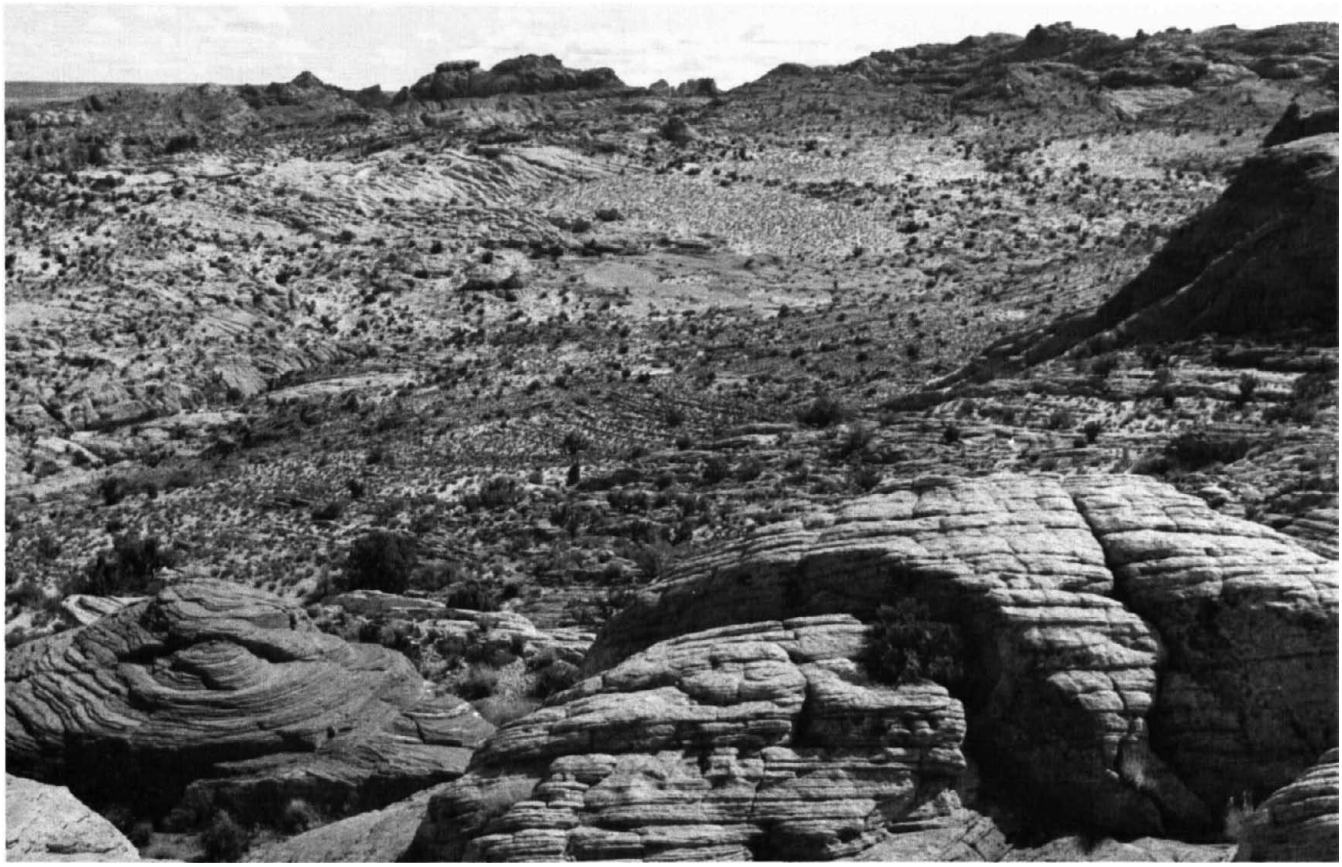

Figure 10.—Rock outcrop-Needle complex, 4 to 50 percent slopes. Very little production is possible in this map unit because of the high percentage of Rock outcrop.

Available water capacity: very low to high
Potential rooting depth: 4 inches to more than 60 inches
Runoff: very rapid
Hazard of water erosion: very severe
Hazard of wind erosion: slight

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 65 percent

Similar inclusions:
- Soils that have slopes of less than 25 percent

Use and Management

Rangeland

Dominant vegetation on the Torriorthents:
- Potential plant community—desert needlegrass, galleta, black grama, Bigelow sagebrush
- Present plant community—threeawn, bush muhly, opuntias

Important forage species: Indian ricegrass, black grama, bush muhly

Major management factors: Limited available water capacity, depth to bedrock, hazard of erosion by water, slope

General management considerations on the Torriorthents-Rock outcrop:
- Steep slopes and Rock outcrop limit access by livestock and result in overgrazing of less sloping areas.
- Management alternatives are very limited by steep slopes and Rock outcrop.
- Unit is located in the bottom of Marble Canyon along Colorado River and has limited use by domestic livestock.

Suitable management practices:
- Proper grazing use

Wildlife Habitat

Suitability for herbaceous plants and shrubs: poorly suited

Interpretive Groups

Land capability classification: VIIe, nonirrigated
Range site: Breaks 6-10" p.z.
Rock outcrop is not assigned a capability subclass or range site.

44—Sheppard loamy fine sand, 1 to 5 percent slopes

Setting

Landform: plateaus
Landscape position: old stabilized dunes
Flooding: none
Elevation: 3,600 to 4,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Sheppard soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 4 inches—yellowish red loamy fine sand
4 to 60 inches—reddish yellow fine sand

Soil Properties and Qualities

Parent material: eolian sand from sandstone
Depth class: very deep
Drainage class: excessively drained
Permeability: rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: high

Inclusions

Contrasting inclusions:
- Soils that are sandy, limy and shallow to partially weathered sandstone (Wahweap soils)
- Soils that are sandy and shallow to sandstone (Needle soils)
- Soils that are similar to Sheppard but are saline and somewhat poorly drained in the Lees Ferry area
- Soils that have slopes of more than 5 percent

Similar inclusions:
- Soils that are limy, sandy, and moderately deep to sandstone

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—Indian ricegrass, needleandthread, fourwing saltbush, Mormon tea

Figure 11.—Rock outcrop-Torriorthents complex, warm, 25 to 65 percent slopes. This unit occurs mostly in the Grand Canyon

• Present plant community—sand sage, Indian ricegrass, galleta, squirreltail

Important forage species: Indian ricegrass, galleta, squirreltail, fourwing saltbush

Major management factors: Hazard of erosion by wind and water, limited available water capacity, seepage

General management considerations:
• This unit is small and generally used for urban development so that only a few small areas still retain a native plant community.
• Ground cover should be maintained or improved to reduce erosion hazard.

Suitable management practices:
• Proper grazing use

Cropland

General management considerations:
• Because of the limited precipitation and limited available water capacity, all crops have to be irrigated.
• Because the water intake rate is rapid, the most suitable irrigation systems are sprinkler and trickle.
• Because the soil is droughty, light and frequent irrigations are essential. More efficient use of fertilizer can be obtained through light, frequent applications.

Suitable Management Practices:
• Wind erosion can be reduced by maintaining plant cover, keeping mulch on the surface, keeping the surface of the soil rough, and limiting the width of strips of unprotected soil.

Building Site Development

General management considerations:
- This soil is highly susceptible to wind erosion.
- Surface disturbance and excavation increase the risk of erosion.
- Cutbanks are not stable and therefore are subject to caving.
- The quality of roadbeds can be adversely affected by limited soil strength.

Suitable management practices:
- Revegetate disturbed areas at construction sites as soon as possible to reduce the risk of wind erosion.
- Reduce the risk of erosion and maintenance cost by stabilizing areas that have been disturbed.
- Preserve the existing plant cover during construction to reduce the risk of erosion.
- To minimize subsidence, use the fill as a base for structures only after the material has been compacted.
- Construct special retaining walls in shallow excavations to prevent cutbanks from caving in.
- Offset the risk of corrosion to uncoated steel by using corrosion-resistant material or by using coatings and cathodic protectors.
- Design roads to control surface runoff and stabilize cut slopes.
- Stabilize disturbed areas to reduce the risk of erosion and the maintenance cost resulting from erosion.
- Seed road cuts and fills to permanent vegetation.

Wildlife Habitat

Suitability for herbaceous plants and shrubs: moderately suited
- Burrowing animals find this site suitable for digging.

Interpretive Groups

Land capability classification: IVe, irrigated, VIIe, nonirrigated
Range site: Sandy Upland 6-10" p.z.

45—Sheppard loamy fine sand, 5 to 15 percent slopes

Setting

Landform: plateaus (fig. 12)
Landscape position: old stabilized dunes
Flooding: none
Elevation: 3,600 to 4,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Sheppard soil and similar soils: 90 percent
Contrasting inclusions: 10 percent

Typical Profile

0 to 4 inches—yellowish red loamy fine sand
4 to 60 inches—reddish yellow fine sand

Soil Properties and Qualities

Parent material: eolian sand from sandstone
Depth class: very deep
Drainage class: excessively drained
Permeability: rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: very severe
Hazard of wind erosion: high

Inclusions

Contrasting inclusions:
- Areas of Pagina and Wahweap soils on higher convex slopes
- Areas having blackbrush as the major vegetation near the Utah boundary
- Areas of Rock outcrop
- Areas of coppice dunes
- Areas along the Paria River that are slightly warmer and subject to flooding
- Boulders along intermittent channels and near the Vermilion Cliffs
- Sandy soils that are high in lime
- Soils that have slopes of more than 15 percent

Similar inclusions:
- Soils that have slopes of less than 5 percent

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—Indian ricegrass, needleandthread, fourwing saltbush, Mormon tea
- Present plant community—sand sage, Indian ricegrass, galleta, squirreltail

Important forage species: Indian ricegrass, galleta, squirreltail, fourwing saltbush

Major management factors: Hazard of erosion by wind and water, limited available water capacity, seepage

General management considerations:
- Ground cover should be maintained or improved to reduce the erosion hazard.
- Earthen water impoundments are limited because of seepage potential.
- Readily responds to proper management.

Suitable management practices:
- Proper grazing use
- Planned grazing system
- Fencing

Building Site Development

General management considerations:
- This soil is highly susceptible to wind erosion.
- Surface disturbance and excavation increases the risk of erosion.
- Cutbanks are not stable and therefore are subject to caving.
- The quality of roadbeds can be adversely affected by limited soil strength.

Suitable management practices:
- Revegetate disturbed areas at construction sites as soon as possible to reduce the risk of wind erosion.
- Reduce the risk of erosion and maintenance cost by stabilizing areas that have been disturbed.
- Preserve the existing plant cover during construction to reduce the risk of erosion.
- To minimize subsidence, use the fill as a base for structures only after the material has been compacted.
- Construct special retaining walls in shallow excavations to prevent cutbanks from caving in.
- Offset the risk of corrosion to uncoated steel by

Figure 12.—Sheppard loamy fine sand, 5 to 15 percent slopes. The hazard of wind erosion and the sparse vegetation make proper management of this soil difficult.

using corrosion-resistant material or by using coatings and cathodic protectors.
- Design roads to control surface runoff and stabilize cut slopes.
- Stabilize disturbed areas to reduce the risk of erosion and the maintenance cost resulting from erosion.
- Seed road cuts and fills to permanent vegetation.

Wildlife Habitat

Suitability for herbaceous plants and shrubs: moderately suited
- Burrowing animals find this site suitable for digging.

Interpretive Groups

Land capability classification: VIIe, nonirrigated
Range site: Sandy Upland 6-10" p.z.

46—Strych loam, 1 to 4 percent slopes

Setting

Landform: fan terraces
Flooding: none
Elevation: 4,800 to 5,800 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Strych soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

Rock fragments on surface—10 percent gravel
0 to 2 inches—light reddish brown loam
2 to 14 inches—reddish yellow very gravelly loam and light brown extremely gravelly loam
14 to 32 inches—pinkish white, limy extremely gravelly loam
32 to 60 inches—pink, limy extremely gravelly sandy loam

Soil Properties and Qualities

Parent material: alluvium from limestone
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: low
Potential rooting depth: 60 or more inches
Runoff: medium
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Lime content: more than 15 percent between a depth of 8 and 16 inches

Inclusions

Contrasting inclusions:
- Soils that are very shallow and shallow to limestone on higher convex slopes
- Soils that have slopes of more than 4 percent

Similar inclusions:
- Soils that have a low content of lime
- Soils that have gravelly surfaces
- Deep soils that have less than 35 percent rock fragments

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—western wheatgrass, blue grama, big sagebrush, fourwing saltbush
- Present plant community—blue grama, western wheatgrass, sagebrush

Important forage species: western wheatgrass, squirreltail, galleta, fourwing saltbush

Major management factors: Limited available water capacity, hazard of erosion by wind

General management considerations:
- Overuse can occur because livestock prefer this site over others in adjacent areas.
- Readily responds to management.
- Brush management can be used when unpalatable species have increased significantly.
- Good livestock distribution is necessary to proper forage use.
- Ground cover should be maintained or improved to reduce erosion hazard.

Suitable management practices:
- Proper grazing use
- Planned grazing system
- Fencing
- Brush management
- Deferred grazing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: moderately suited
- A preferred site for open rangeland wildlife

Interpretive Groups

Land capability classification: VIs, nonirrigated
Range site: Loamy Upland 10-14" p.z.

47—Torriorthents, 3 to 50 percent slopes

Setting

Landform: hills
Flooding: none
Elevation: 3,500 to 5,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Torriorthents soil and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

These soils are highly variable in surface and subsurface textures and rock fragments; in depth to bedrock, cemented gypsum layers, or weathered bedrock. They have more than 30 percent gypsum crystals in some part of the profile.

Soil Properties and Qualities

Parent material: gypsiferous shales and mudstones
Depth class: shallow to deep
Drainage class: well drained
Permeability: variable
Available water capacity: very low to high
Potential rooting depth: 10 to more than 60 inches
Runoff: rapid or very rapid
Hazard of water erosion: very severe
Hazard of wind erosion: very slight
Corrosivity: concrete—high; steel—high
Gypsum content: high content of gypsum below the surface layer

Inclusions

Contrasting inclusions:
- Areas of exposed gypsum
- Areas of badland or severely eroded soils
- Soils that do not have gypsum in the profile
- Soils that have slopes of more than 50 percent

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—Indian ricegrass, galleta, needleandthread
- Present plant community—cliffrose, goldenweed, shadscale

Important forage species: Indian ricegrass, galleta, squirreltail

Major management factors: Slope, hazard of erosion by water, depth to bedrock or hard layers, gypsum content, subsidence

General management considerations:
- This site is fragile and adapts well only to light stocking rates.
- Management alternatives are very limited by steep slopes, low rainfall, low productivity and severe erosion hazard.
- Good livestock distribution is needed in order to use the forage properly.

Suitable management practices:
- Proper grazing use
- Planned grazing systems
- Fencing
- Deferred grazing

Building Site Development

General management considerations:
- Introduction of water in any amount will cause some degree of subsidence because of the gypsum content of the soil.
- Surface disturbance and excavation increase the risk of wind and water erosion.
- The deep cuts needed to level the road surface can expose soft bedrock; however, it can be easily excavated.
- Septic tank absorption fields may function poorly because of the limited soil depth.
- Some areas of this unit may be subject to salt heave because of the expansion of sodium sulfate salts. This action is likely to crack concrete slab floors, driveways, and sidewalks.
- Concrete placed in contact with this soil is subject to disintegration because of the chemical reaction of gypsum.

Suitable management practices:
- Rain gutters should be used to divert the rain at least 6 feet from the foundations.
- Revegetate disturbed areas at construction sites as soon as possible to reduce the risk of wind erosion.
- Preserve the existing plant cover during construction to reduce the risk of erosion.
- Offset the risk of corrosion to concrete and uncoated steel pipe by using sulfate-resistant cement and treated steel pipe with cathodic protectors.
- Stabilize disturbed areas to reduce the risk of

erosion and the maintenance cost resulting from erosion.
- Seed road cuts and fills to permanent vegetation.

Wildlife Habitat

Suitability for herbaceous plants and shrubs: poorly suited

Interpretive Groups

Land capability classification: VIIe, nonirrigated
Range site: Gypsum Hills 7-11" p.z.

48—Torriorthents-Rock outcrop complex, 25 to 65 percent slopes

Setting

Landform: hills (fig. 13)
Flooding: none
Elevation: 3,100 to 6,800 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 150 to 165 days

Composition

Torriorthents soil and similar soils: 55 percent
Rock outcrop and similar areas: 30 percent
Contrasting inclusions: 15 percent

Typical Profile

Torriorthents

Rock fragments on surface—variable, ranging from a trace to as much as 60 percent gravel and stones
These soils are highly variable in texture of the surface, but the major part of the profile is dominantly loamy
The depth of soil over bedrock varies from 4 inches to more than 60 inches

Rock Outcrop

Rock outcrop consists of exposed areas of sandstone, limestone, or shale.

Soil Properties and Qualities

Torriorthents

Parent material: colluvium and alluvium from mixed sources
Depth class: very shallow to deep
Drainage class: well drained to somewhat excessively drained
Permeability: very slow to rapid
Available water capacity: very low to high
Potential rooting depth: 4 inches to more than 60 inches
Runoff: very rapid
Hazard of water erosion: very severe
Hazard of wind erosion: slight to very high

Inclusions

Contrasting inclusions:
- Soils that have slopes of more than 65 percent
- Cliffs
- The Paria River, a perennial stream

Similar inclusions:
- Areas that have slopes of less than 25 percent
- Areas of lower precipitation (6- to 11-inch p.z.)

Use and Management

Rangeland

Dominant vegetation on the Torriorthents:
- Potential plant community—needleandthread, muttongrass, Indian ricegrass, juniper, big sagebrush
- Present plant community—blue grama, needlegrasses, Indian ricegrass, big sagebrush

Important forage species: muttongrass, Indian ricegrass, squirreltail, fourwing saltbush

Major management factors: Slope, depth to bedrock, limited available water capacity, and hazard of erosion by water and wind

General management considerations:
- Steep slopes and rock outcrops limit access by livestock and result in overgrazing of less sloping areas.
- Management alternatives are very limited by steep slopes and Rock outcrop.
- In areas of lower precipitation (6- to 11-inch p.z.), no big sagebrush occurs. Site guides for this precipitation zone better describe the plant community in this part of the unit.

Suitable management practices:
- Proper grazing use
- Planned grazing systems
- Fencing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: poorly suited

Interpretive Groups

Land capability classification: VIIe, nonirrigated

Figure 13.—Torriorthents-Rock outcrop complex, 25 to 65 percent slopes. The Vermilion Cliffs are in the background.

Range site: Breaks 10-14" p.z.
Rock outcrop is not assigned a capability subclass or range site.

49—Wahweap loamy sand, 0 to 5 percent slopes

Setting

Landform: plateaus (fig. 14)
Flooding: none
Elevation: 3,600 to 4,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Wahweap soil and similar soils: 90 percent
Contrasting inclusions: 10 percent

Typical Profile

Rock fragments on surface—5 percent gravel
0 to 1 inch—yellowish red loamy sand
1 to 12 inches—yellowish red gravelly loamy fine sand
12 to 19 inches—yellowish red limy very gravelly fine sandy loam
19 inches—partially weathered sandstone

Soil Properties and Qualities

Parent material: eolian sand and alluvium from sandstone
Depth class: shallow
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: very high
Depth to a limy layer: about 12 inches

Inclusions

Contrasting inclusions:
- Soils that are sandy, limy, and moderately deep to bedrock (Pagina)
- Soils that are sandy throughout and deep in convex positions (Sheppard)
- Soils that have slopes of more than 5 percent

Similar inclusions:
- Soils that are similar to Wahweap but have less than 35 percent fragments

Use and Management

Rangeland

Dominant vegetation:
- Potential plant community—Indian ricegrass, galleta, blackbrush, Mormon tea
- Present plant community—galleta, Indian ricegrass, Mormon tea, blackbrush

Important forage species: Indian ricegrass, galleta

Major management factors: Hazard or erosion by wind, limited available water capacity, depth to bedrock, seepage

General management considerations:
- Ground cover should be maintained or improved to reduce erosion hazard.
- Earthen water impoundments are limited by seepage potential and shallow depth to bedrock.
- Limited potential for range seeding because of very low available water capacity.
- Good livestock distribution needed in order to use the forage properly.

Suitable management practices:
- Proper grazing use
- Planned grazing systems
- Fencing

Building Site Development

General management considerations:
- This soil is highly susceptible to wind erosion.
- Surface disturbance and excavation increases the risk of erosion.
- The quality of roadbeds can be adversely affected by limited soil strength.
- Excavation is hampered by limited depth to bedrock.

Suitable management practices:
- Revegetate disturbed areas at construction sites as soon as possible to reduce the risk of wind erosion.
- Preserve the existing plant cover during construction to reduce the risk of erosion.
- Offset the risk of corrosion to uncoated steel by using corrosion-resistant material or by using coatings and cathodic protectors.
- Seed road cuts and fills to permanent vegetation.
- Septic tank absorption fields may function poorly because of the limited depth to bedrock.

Wildlife Habitat

Suitability for herbaceous plants: poorly suited
- Burrowing animals find this site suitable for digging.

Interpretive Groups

Land capability classification: VIIe, nonirrigated
Range site: Shallow Sandy Loam, Calcareous 6-10" p.z.

50—Wahweap-Rock outcrop complex, 1 to 15 percent slopes

Setting

Landform: plateaus
Flooding: none
Elevation: 3,800 to 4,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F
Frost-free period: 165 to 180 days

Composition

Wahweap soil and similar soils: 50 percent
Rock outcrop and similar areas: 35 percent
Contrasting inclusions: 15 percent

Typical Profile

Wahweap

Rock fragments on surface—20 percent gravel
0 to 1 inches—yellowish red gravelly sandy loam
1 to 12 inches—yellowish red gravelly loamy fine sand

12 to 19 inches—yellowish red limy very gravelly fine sandy loam
19 inches—partially weathered sandstone

Rock Outcrop

Rock outcrop consists of areas of exposed sandstone.

Soil Properties and Qualities

Wahweap

Parent material: eolian sands and alluvium from sandstone
Depth class: shallow
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: moderately high
Depth to a limy layer: about 12 inches

Inclusions

Contrasting inclusions:
- Soils that are sandy, limy, and moderately deep to bedrock (Pagina)
- Soils that have slopes of more than 15 percent

Similar inclusions:
- Soils that are similar to Wahweap but have less than 35 percent rock fragments
- Soils that are sandy and shallow to bedrock (Needle)

Use and Management

Rangeland

Dominant vegetation on the Wahweap soil:
- Potential plant community—Indian ricegrass, galleta, blackbrush, Mormon tea
- Present plant community—galleta, Indian ricegrass, Mormon tea, blackbrush

Important forage species: Indian ricegrass, galleta

Figure 14.—Wahweap loamy sand, 0 to 5 percent slopes, overlooking Lake Powell. This map unit is dominantly shallow soils over sandstone.

Major management factors: Hazard of erosion by wind and water, limited available water capacity, depth to bedrock, seepage

General management considerations:
- Ground cover should be maintained or improved to reduce erosion hazard.
- Earthen water impoundments are limited because of seepage potential and shallow soil depth to bedrock.
- Limited potential for range seeding because of very low available water capacity.
- Good livestock distribution is needed in order to use the forage properly.

Suitable management practices:
- Proper grazing use
- Planned grazing systems
- Fencing

Wildlife Habitat

Suitability for herbaceous plants and shrubs: poorly suited

Interpretive Groups

Land capability classification: VIIs, nonirrigated
Range site: Shallow Sandy Loam, Calcareous 6-10" p.z.
Rock outcrop is not assigned a capability subclass or range site.

51—Yumtheska very gravelly loam, 4 to 30 percent slopes

Setting

Landform: hills
Flooding: none
Elevation: 5,800 to 6,400 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 150 days

Composition

Yumtheska soil and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

Rock fragments on surface—35 percent gravel and 15 percent cobbles
0 to 2 inches—reddish brown very gravelly loam
2 to 19 inches—reddish brown and very pale brown very gravelly loam
19 inches—limestone

Soil Properties and Qualities

Parent material: alluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: severe
Hazard of wind erosion: very slight

Inclusions

Contrasting inclusions:
- Soils that have less than 35 percent rock fragments and are moderately deep; on toeslopes
- Soils that are similar to Yumtheska but are deep; on toeslopes
- Soils that are deep and have a clay subsoil; on toeslopes
- Soils that have slopes of more than 30 percent

Similar inclusions:
- Soils that have dark colored surfaces
- Soils that are similar to Yumtheska but contain less than 35 percent rock fragments

Use and Management

Grazeable Woodland

Dominant vegetation:
- Potential plant community—juniper, pinyon, needleandthread, big sagebrush
- Present plant community—juniper, pinyon, blue grama, cliffrose, snakeweed

Important forage species: blue grama, cliffrose

Major management factors: Depth to bedrock, limited available water capacity, slope and hazard of erosion by water

General management considerations:
- Brush management and range seeding are limited by shallow depth and very low available water capacity.
- Moderate to severe erosion hazard limits vehicle access, requiring the proper installation and maintenance of access roads.

• Earthen water impoundments are limited because of shallow depth.
• Overstory production of fuelwood is 3-5 cords per acre.

Suitable management practices:
• Proper woodland grazing
• Planned grazing systems
• Access roads
• Forest land erosion control system
• Fencing

Wildlife Habitat

Suitability for coniferous trees: moderately suited
• These woodlands of pinyon pine and juniper trees provide habitat for many species. Firewood gatherers should not disturb nest trees.

Interpretive Groups

Land capability classification: VIs, nonirrigated
Woodland site: Shallow Loamy 14-18" p.z.

52—Yumtheska-Houserock association, 4 to 20 percent slopes

Setting

Landform: plateaus and hills
Landscape position: Yumtheska soil—summits and shoulders; Houserock soil—footslopes, toeslopes, and lower rolling areas
Flooding: none
Elevation: 5,800 to 6,400 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 150 days

Composition

Yumtheska soil and similar soils: 55 percent
Houserock soil and similar soils: 30 percent
Contrasting inclusions: 15 percent

Typical Profile

Yumtheska

Rock fragments on surface—30 percent gravel and 5 percent cobbles
0 to 2 inches—reddish brown gravelly loam
2 to 19 inches—reddish brown and very pale brown, very gravelly loam
19 inches—limestone

Houserock

Rock fragments on surface—25 percent pebbles
0 to 3 inches—reddish brown gravelly loam
3 to 8 inches—reddish brown very gravelly clay loam
8 to 19 inches—red very gravelly clay
19 inches—limestone

Soil Properties and Qualities

Yumtheska

Parent material: alluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of water erosion: very severe
Hazard of wind erosion: moderate

Houserock

Parent material: alluvium from limestone
Depth class: shallow
Drainage class: well drained
Permeability: slow
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of water erosion: very severe
Hazard of wind erosion: moderate

Inclusions

Contrasting inclusions:
• Soils that have slopes of more than 20 percent
• Soils that are deep and have less than 35 percent rock fragments
• Soils that are deep and have a clay subsoil; on toeslopes
• Soils that are moderately deep; on toeslopes

Similar inclusions:
• Soils that have slopes less than 4 percent

Use and Management

Grazeable Woodland

Dominant vegetation on the Yumtheska soil:
• Potential plant community—juniper, pinyon, blue grama, needleandthread, big sagebrush
• Present plant community—juniper, pinyon, blue grama, cliffrose, snakeweed

Dominant vegetation on the Houserock soil:
- Potential plant community—juniper, pinyon, blue grama, big sagebrush
- Present plant community—pinyon, juniper, blue grama, snakeweed

Important forage species: blue grama, cliffrose

Major management factors: Depth to bedrock, limited available water capacity and hazard of erosion by wind and water

General management considerations on the Yumtheska-Houserock soils:
- Brush management and range seeding are limited by shallow depth and very low available water capacity.
- Moderate to severe erosion hazard limits vehicle access, requiring the proper installation and maintenance of access roads.
- Earthen water impoundments are limited because of shallow depth.
- Overstory production of fuelwood for Yumtheska is 3-5 cords/acre and for Houserock is 2-4 cords/acre.

Suitable management practices on the Yumtheska-Houserock soils:
- Proper woodland grazing
- Planned grazing systems
- Access roads
- Forest land erosion control system
- Fencing

Wildlife Habitat

Suitability of the Yumtheska-Houserock soils for coniferous trees: moderately suited
- Woodlands of pinyon and juniper provide habitat for many species.
- Firewood gatherers should not disturb nest trees.

Interpretive Groups

Land capability classification: Yumtheska-Houserock—VIs, nonirrigated

Woodland site: Yumtheska—Shallow Loamy 14-18" p.z.; Houserock—Shallow Loamy 14-18" p.z.

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 and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems; for 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 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

Steve Cassady, district conservationist, Natural Resources Conservation Service, prepared this section.

This section describes general management needed for crops and pasture. It identifies the crops or pasture plants best suited to the soils and explains the system of land capability classification used by the Natural Resources Conservation Service.

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 "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 900 acres of land in the survey area is used for irrigated farming. This land is found in the Fredonia area. The main crops grown are pasture grass, alfalfa hay, and small grains.

Irrigation water is diverted out of Kanab Creek. Flows in Kanab Creek are limited and vary greatly with the season. Greatest flows occur in the winter months. Summer flows are limited to infrequent storm runoff in excess of that diverted at the Kanab diversion.

Proper use and management of the irrigated soils of the area requires good land use. The aim of good land use is to produce the greatest amount of the most needed crops, while protecting and improving the soil. To achieve this aim, the land must be protected according to its needs and used within its capabilities by using plants that are well suited to the soil, applying soil management practices that protect the soil, and keeping the soil in good physical condition.

The following paragraphs 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. The exception is irrigation water management, which applies only to irrigated soils.

Conservation Cropping Sequence

A conservation cropping sequence is the growing of crops in combination with needed cultural and management measures. In a good conservation cropping sequence, the soil-improving crops and practices more than offset the soil-depleting crops and deteriorating practices.

Soil-improving practices in a conservation cropping sequence include the use of rotations that contain grasses and legumes, the return of crop residue to the soil, proper tillage, adequate fertilization, weed and pest control measures, and other good management practices.

A typical cropping sequence used in the survey area is growing alfalfa for 6 to 8 years, growing small grain or field corn for 2 years, and then planting alfalfa again. 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 management is done by incorporating plant residue into the soil or leaving it on the surface during that part of the year when erosion is likely to occur. Plant residue adds organic matter. A major benefit of organic matter in the soil is its influence on the development and stabilization of good soil structure and its relationship to the general physical environment of the soil, which influences crop growth. Organic matter functions mainly as it decomposes. Applying nitrogen fertilizer to the soil aids in the decomposition process.

It is particularly important that organic matter 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 begins, and slower water infiltration and poorer aeration result.

Conservation Tillage

Conservation tillage is a tillage and planting system where adequate crop residue is left to protect the soil surface from water or wind erosion.

To protect against water erosion, a minimum of 30 percent of the soil surface should be left covered by plant residue after planting. Where soil erosion by wind is the primary concern, at least 1,000 pounds per acre of flat small grain residue-equivalent should be left on the surface during the critical erosion period.

Irrigation Water Management

Irrigation water management requires regulating applications of irrigation water to insure 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 growing crops. A good distribution system has enough capacity to meet the needs of the crops irrigated and efficiently conveys water without causing excessive seepage and 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 one type of irrigation system used 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 efficiencies. On land that cannot be leveled because of high costs or soil limitations, sprinkler or drip irrigation systems can be used. Sprinkler and drip systems often have higher irrigation efficiencies than surface irrigation systems, but normally require a greater initial cost to install.

If water is to be applied efficiently, a farmer needs to give special attention 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. Forty-eight hours after irrigation, a soil check can be made to determine whether the desired moisture was added.

Pasture Management

Proper pasture management requires treating 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 with a rotation system that allows for controlled grazing periods and adequate rest periods in 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. If livestock are allowed to graze wet pastures, the soil is compacted, the water intake rate is decreased, and soil structure is destroyed.

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.

Suitable 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 wind erosion 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 depend 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 (USDA, 1961). 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, for woodland, and for engineering purposes.

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 I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main 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 I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of the components of each map unit is given in the section "Detailed Soil Map Units."

Range Management

Larry Ellicott, Range Conservationist, Natural Resources Conservation Service, prepared this section.

About 90 percent of the land in the survey area is rangeland. This section describes the principles of range management and defines range site and condition.

Production of high quality forage conserves and protects soil, moisture, and plant resources. A harvest of high quality forage can be insured by maintaining the native vegetation or by improving it to its highest potential. Grasses manufacture the food they need to grow, flower, and reproduce. If the plants are properly managed, they will remain healthy and vigorous for many years.

Effective management of rangeland depends on many factors. The season of use, intensity of use, kinds and distribution of grazing animals, and a knowledge of the resource capability are important management considerations.

The primary objective in range management is to control grazing so that the plants growing on a site are similar in kind and amount to the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, water conservation, and erosion control. Sometimes, however, a range condition somewhat below the maximum potential meets grazing needs, provides for wildlife habitat, and protects the soil and water resources.

The forage plants in many parts of the survey area have been depleted by excessive and untimely use. There has been a general reduction in cool-season grasses and a general increase in woody, non-forage plants. Productivity of forage plants generally is below the potential of the soils. Uneven livestock distribution has created localized overuse and underuse of forage. Gully erosion is extensive on some flood plain and stream terrace soils, and sheet erosion occurs on some of the upland soils.

Many areas that were once open grassland have been encroached upon by juniper trees. The number of herbaceous plants is now inadequate to provide fuel for the natural fires that once controlled the juniper. Broom snakeweed, a half-shrub, has also dramatically increased, particularly on the shallow soils. These woody plants compete for soil moisture with forage plants that should dominate the sites.

Abnormal amounts of woody plants, excessive erosion, and the abundance of toxic plants are all symptoms of a deteriorated range condition. However, a systematic range improvement program can help correct this situation.

Shrubs and trees can be managed in a number of ways. Several mechanical forms of brush management have been used in the survey area, and large areas of juniper have been mechanically treated. Chaining, cabling, or pushing of trees has met with mixed success. The use of herbicides, particularly on shrubby plants, is effective if soil moisture and other growing conditions are satisfactory. Seeding should be done after brush management in areas where understory vegetation is lacking.

Gully erosion has a profound effect on forage production of flood plain and stream terrace soils. These soils are potentially the most productive ones in the survey area. When the plant cover on these soils deteriorates, they are more susceptible to erosion. Some sites receive extra runoff from adjacent areas and readily respond to management. The best treatment of these sites is to allow them to be deferred from livestock grazing during the growing season of the important forage species. Other suitable treatment practices for these sites are water spreading and grade stabilization structures. Where these sites are in poor or fair condition the improvement can be accelerated by seeding locally adapted forage plants, except in areas where the average annual rainfall is less than 10 inches and soils are shallow. These factors, when combined, reduce the feasibility of seeding because of low availability of water for plants to establish and grow.

Gully erosion can be partially controlled by adequate treatment and management of the upland soils that contribute runoff to the lower lying areas. Severely depleted upland sites may require range seeding of adapted species to increase the ground cover. Increasing the plant cover slows water runoff, increases moisture infiltration, improves growing conditions, and reduces sheet erosion.

Management of the rangeland resources in this area should be directed toward meeting the native plant requirements. Critical growth stages in the native plant community must be recognized and considered when selecting a grazing management program. A systematic grazing program should include proper stocking levels and protection from continuous use. Livestock distribution can be improved by fencing and by developing additional water facilities. Priority should be given to permanent livestock water facilities; however, livestock watering ponds are not dependable and can cause grazing distribution problems. Wells, pipelines, storage tanks, and spring developments are much more dependable means of providing water. Fences should be used to divide pastures into manageable units. Fences and watering facilities can be used to force animals to use areas that might otherwise be underused.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 5 shows, for each soil that supports rangeland

vegetation suitable for grazing, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. 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.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre of air-dry vegetation. Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

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.

Woodland Management

Larry Ellicott, range conservationist, Natural Resources Conservation Service, prepared this section.

About 78,300 acres of juniper and pinyon pine woodland are in the survey area.

The juniper and pinyon pine woodland is found between the ponderosa pine forests (outside the survey area) and the cold desert grassland. This cold-adapted evergreen woodland is characterized by the unequal dominance of two conifers, juniper and pinyon. Structurally, these juniper-pinyon woodlands are among the simplest communities in the southwest. Juniper-pinyon woodland covers extensive areas between 4,000 and 7,500 feet. It reaches its greatest development on mesas, plateaus, piedmonts, slopes, and ridges. Juniper grows at lower elevations and on drier sites. Pinyon grows at higher elevations and in areas of higher precipitation. In the middle, juniper and pinyon are mixed. In the survey area, Utah juniper (Juniperous osteosperma) and two leaf pinyon (Pinus edulis) are the most common species.

Juniper and pinyon tend to grow on rocky habitats where shallow soils predominate. Stoniness or coarseness of the soil is a consistent indicator of a site on which the native potential plant community is juniper-pinyon. Soil moisture availability is the major factor controlling plant community patterns. Rapid infiltration, deep penetration, and low soil moisture tension will favor the dominance of woodland over grassland. The root systems of pinyon pine and juniper are well adapted to these sites.

The lower elevation side of this zone grades into grassland and savanna-like landscapes. Here the understory is typically composed of grasses such as blue grama and galleta and low shrubs such as groundsel and snakeweed. The overstory is dominated by juniper that is low in productivity. In the middle to upper parts of the juniper-pinyon zone, sagebrush is the major component of the understory. Other

understory components of general or regional importance are rabbitbrush, winterfat, black sage, blackbrush, cliffrose, and barberry along with some cacti such as hedgehogs, prickly pears, and chollas. The high elevation contact of the juniper-pinyon zone is the ponderosa pine forest at about 7,000 to 8,000 feet elevation. Here, the overstory is dominated by pinyon, and productivity of both species is at their highest.

Historically, stands of pinyon pine and juniper were restricted to certain sites. In the last 100 years, junipers have invaded many areas of former grassland. Some of the reasons for this are warmer temperature trends over the last 100 years or longer, wetter conditions in the last half of the 19th century, lack of wildfires as a result of fire prevention and suppression, and heavy grazing, which has reduced both fuel and plant competition. Young trees are very susceptible to grass fires until their crowns grow well above the grasses; consequently, fires normally eliminate or greatly thin tree seedlings on soils that produce good stands of grass. About 15 to 40 years is necessary for trees to grow tall enough to resist grass fires. Attempts to restore native habitat can be successful in deep, finer-textured soils where grasses are more productive.

Woodland Management and Productivity

Table 6 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce in a pure stand under natural conditions. The number 1 indicates low potential productivity; 2 or 3, moderate; 4 or 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *D*, restricted rooting depth; and *S*, sandy texture. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, D, and S.

In table 6, *slight* and *moderate* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are depth to the water table and the available water capacity. A rating of *slight* indicates that competition from

undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of *moderate* indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands. A rating of *severe* indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *productivity class* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Woodland Understory Vegetation

Understory vegetation consists of grasses, forbs, shrubs, and other plants. If well managed, some woodland can produce enough understory vegetation to support grazing of livestock or wildlife, or both, without damage to the trees.

The quantity and quality of understory vegetation vary with the kind of soil, the age and kind of trees in the canopy, the density of the canopy, and the depth and condition of the litter. The density of the canopy determines the amount of light that understory plants receive.

Table 7 shows, for each soil suitable for woodland, the potential for producing understory vegetation. The total production of understory vegetation includes the herbaceous plants and the leaves, twigs, and fruit of woody plants up to a height of 4.5 feet. It is expressed in pounds per acre of air-dry vegetation in favorable, normal, and unfavorable years. In a favorable year, soil moisture is above average during the optimum part of the growing season; in a normal year, soil moisture is average; and in an unfavorable year, it is below average.

Table 7 also lists the common names of the characteristic vegetation on each soil and the *composition*, by percentage of air-dry weight, of each kind of plant. The table shows the kind and percentage of understory plants expected under a canopy density that is most nearly typical of woodland in which the production of wood crops is highest.

Wildlife Habitat

David W. Seery, Area Biologist, Natural Resources Conservation Service, prepared this section.

Soils affect the kind and amount of vegetation available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants. There are several different types of vegetative areas that provide distinctive plant communities. These vegetative areas and their relationship to wildlife are described in the following paragraphs:

Desert Shrub

The shrub and mixed grassland plant communities support several important big game species, pronghorn antelope, mule deer, and Desert Bighorn sheep being the most notable. This community contains a variety of shrubs, grasses, and forbs which support many species of wildlife. The dry climate makes water a scarce resource for all wildlife.

Mixed Grass Plains

This grassland community is the main habitat of pronghorn antelope. The grass provides good cover for newborn kids. The potential for conflict between livestock and wildlife is high.

Cold Desert Shrub

The cool, dry climate of this area favors shrubs and drought-hearty grasses. Drinking water is limited. Pronghorn antelope use these areas extensively.

Woodland-Grassland

The bottom lands are generally dominated by grasses, and the uplands are dominated by juniper and pinyon pine. This creates a mosaic of woodland and

open grassland which allows wildlife species to travel between food and cover. The understory contains important browse, grasses, and forbs. Grazing has reduced the understory and allowed trees and brush to invade some grasslands. This loss of habitat for wildlife can be corrected through range management.

Sagebrush

The mixture of open grassland, sagebrush, and juniper woodlands makes the area productive for wildlife; however, water is limited. Mule deer and pronghorn occur in this area. The rodent and rabbit populations attract predators.

Cold Desert Grassland

Wildlife use this area less than other areas because of the low plant production potential. Very little protective cover exists for large game species. Historically, pronghorn antelope were found here, and a small herd has been reintroduced.

Breaks

These areas are rough, broken, and steep and contain a great mixture of plans. Breaks also provide cover and physical diversity, making them ideal places for a wide variety of wildlife. Although breaks often support less vegetation than do other sites, they are very important for wildlife. Mule deer are attracted by the preferred browse forage, cover, and isolation.

Rock outcrop

Although these areas produce very little vegetation, wildlife species use the rocks, cliffs, cracks, and ledges. Birds of prey use cliffs and ledges for nesting, roosting, and observation. Bighorn sheep use the cliffs and ledges for escape and resting areas. Overhangs provide protection from weather. Bats roost during the day in cracks and caves. Mountain lions ambush prey from rocks and rest under overhangs.

Wetlands

Small wetlands are found in the Rim area along the Colorado River, Paria River, Kanab Creek, and mountain meadows.

Each soil or map unit is rated for its ability to produce some or all of the following types of vegetation—herbaceous plants and shrubs; shrubs and vines; riparian herbaceous plants; riparian shrubs, trees and vines; and coniferous trees—and then placed into suitability groups. These suitability groups are also described.

Well suited means that soil properties are such that vegetation can be improved, managed, or created with a few or no soil limitations (suitability group 4).

Moderately well suited means that soil properties are such that vegetation can be improved, managed or created. Soil limitations are moderate, and management is necessary to maintain the habitat (suitability group 3).

Poorly suited means that soil limitations are severe. Management is possible, but creating or improving vegetation is difficult and success is questionable (suitability group 2).

Very poorly suited means that soil limitations are such that it is impractical to attempt to create or improve vegetation, and failure is highly probable (suitability group 1).

The suitabilities apply to this survey area and cannot be compared to any other area unless the precipitation, elevation, latitude, and other climatic factors are the same.

Representative wildlife species, by areas in which they occur

Desert shrub.—Desert Bighorn sheep, mule deer, kangaroo rat, woodrat, coyote, gray fox, golden eagle, red-tail hawk.

Mixed grass plains.—Pronghorn, horned lark, mourning dove, lark bunting, marsh hawk, burrowing owl, prairie dog, and kangaroo rat.

Cold desert shrub.—Mule deer, coyote, golden eagle, jackrabbit, and woodrat.

Woodland-grassland.—Mule deer, scrub jay, pronghorn, stellars jay, coyote, gray fox, cougar, black bear, woodrat, golden eagle, great horned owl, jackrabbit, cottontail rabbit, and ferruginas hawk.

Sagebrush-grasslands.—Pronghorn, mule deer, coyote, sage sparrow, woodrat, prairie falcon, kestrel, and raven.

Cold desert grasslands.—Lark bunting, horned lark, prairie falcon, jackrabbit, red-tail hawk, raven, kangaroo rat, badger, and coyote.

Breaks.—Mule deer, bighorn sheep, golden eagle, cougar, and cottontail rabbit.

Rock outcrop.—Bighorn sheep, golden eagle, prairie falcon, great horned owl, big brown bat, cougar, and violet green swallow.

Wetlands.—Kildeer, ducks, shore birds, muskrat, beaver, bald eagle, and peregrine falcon.

Recreation

The soils of the survey area are rated in table 8 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 8, 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 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 10 and interpretations for dwellings without basements and for local roads and streets in table 9.

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.

Most of the recreation in the area is asociated with the water-based activities on Lake Powell and the Colorado River. Fishing, boating, and water skiing are popular activities on Lake Powell. Raft runs are the principal activities on the Colorado River.

Hunting is another major activity throughout the survey area and draws visitors from Arizona, Utah, and Nevada.

Building Site Development

Table 9 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.

Sanitary Facilities

Table 10 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.

The table 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.

The table 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 the table 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 11 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 the table, 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 12 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, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a

depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

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.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 13.

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 13 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.

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 14 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 ERROR[Unused arguments - too many, or wrong type] in:<BF>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.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.
8. Soils that are not subject to wind erosion 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 14, 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 15 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.

If a soil is assigned to two hydrologic groups in table 15, the first letter is for drained areas and the second is for undrained areas.

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 15 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. About two-thirds to three-fourths of all flooding occurs during the stated period.

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.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

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.

A *cemented pan* is a cemented or indurated subsurface layer within a depth of 5 feet. Such a pan causes difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors 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 16 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 *Fluvent*, 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. The Clayhole and Jocity series in the survey area are members of this family.

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. 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 series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (1951). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (1975). Unless otherwise indicated, 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."

Aneth Series

Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: rapid
Landform: fan terraces
Parent material: alluvium derived dominantly from sandstone
Slope range: 2 to 16 percent

Elevation: 4,200 to 5,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: sandy, mixed, mesic Typic Torriorthents

Typical Pedon

Aneth fine sand, 2 to 16 percent slopes; about 11 miles west and 3.5 miles south of Cliff Dwellers Lodge; about 2,500 feet south and 1,500 feet west of the northeast corner of sec. 15, T. 38 N., R. 4 E.

A—0 to 2 inches; yellowish red (5YR 5/6) fine sand, yellowish red (5YR 4/6) moist; single grained; loose; few very fine roots; slightly effervescent; mildly alkaline; abrupt smooth boundary.
C1—2 to 26 inches; yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable; few very fine roots; few very fine tubular pores; slightly effervescent; mildly alkaline; abrupt smooth boundary.
2C2—26 to 40 inches; reddish brown (5YR 5/4) sandy loam, reddish brown (5YR 5/4) moist; massive; slightly hard, very friable; few very fine roots; common very fine tubular pores; stratified with loam, fine sandy loam and fine sand; slightly effervescent; moderately alkaline; abrupt smooth boundary.
3C3—40 to 60 inches; light reddish brown (5YR 6/4) loamy fine sand, reddish brown (5YR 5/4) moist; slightly hard, very friable; few very fine roots; common very fine tubular pores; stratified with loam, sandy loam and fine sand; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to the stratified horizon: 26 to 34 inches
Average content of rock fragments in the control section: 0 to 15 percent

Arches Series

Depth class: shallow
Drainage class: excessively drained
Permeability: rapid
Landform: dunes on plateaus
Parent material: eolian sand derived dominantly from sandstone
Slope range: 4 to 16 percent
Elevation: 5,200 to 7,100 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F.
Frost-free period: 150 to 165 days
Classification: Mixed, mesic Lithic Torripsamments

Typical Pedon

Typical pedon of Arches fine sand in an area of Arches-Pensom complex, 4 to 12 percent slopes; about 23 miles west and 3 miles north of Marble Canyon; about 1,950 feet north and 1,150 feet east of the southwest corner of sec. 13, T. 40N., R. 3 E.

A—0 to 1 inch; yellowish red (5YR 5/6) fine sand, reddish brown (5YR 4/4) moist; single grained with a 1/4-inch crust on the surface; loose; few very fine roots; many very fine irregular pores; mildly alkaline; abrupt smooth boundary.
C1—1 to 9 inches; yellowish red (5YR 5/6) fine sand, reddish brown (5YR 4/4) moist; massive; slightly hard, very friable; many very fine roots; common very fine tubular pores; mildly alkaline; clear wavy boundary.
C2—9 to 16 inches; yellowish red (5YR 5/6) fine sand, reddish brown (5YR 4/4) moist; massive; slightly hard, very friable; few very fine roots; common very fine tubular pores; moderately alkaline; abrupt smooth boundary.
2R—16 inches; sandstone

Range in Characteristics

Depth to bedrock: 10 to 20 inches. The bedrock is partially weathered as much as 2 inches in some pedons.
Control section texture: Fine sand or loamy fine sand with a relatively small percentage of medium sand or coarser.
Hue: 7.5YR through 2.5YR
A horizon texture: Fine sand or loamy fine sand

Barx Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 6 percent
Elevation: 5,000 to 5,500 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F.
Frost-free period: 150 to 165 days
Classification: Fine-loamy, mixed, mesic Ustollic Haplargids

Typical Pedon

Barx gravelly loam, 1 to 6 percent slopes; about 11 miles south of Fredonia; about 2,500 feet south and

1,000 feet west of the northeast corner of sec. 13, T. 39 N., R. 1 W.

A—0 to 3 inches; strong brown (7.5YR 4/6) gravelly loam, dark brown (7.5YR 4/4) moist; moderate medium granular structure; soft, friable, slightly sticky, slightly plastic; common very fine roots; common very fine tubular pores; 20 percent gravel; mildly alkaline; abrupt smooth boundary.

Bt1—3 to 18 inches; yellowish red (5YR 4/6) clay loam, reddish brown (5YR 4/4) moist; medium coarse prismatic structure parting to strong medium subangular blocky; slightly hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; many thin clay films in pores and on faces of peds; mildly alkaline; gradual smooth boundary.

Bt2—18 to 22 inches; yellowish red (5YR 4/6) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; many thin clay films in pores and on faces of peds; moderately alkaline; gradual wavy boundary.

Btk—22 to 29 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable, sticky and plastic; few very fine roots; common very fine tubular pores; common fine soft lime masses; slightly effervescent; moderately alkaline; clear smooth boundary.

Bk1—29 to 42 inches; pink (7.5YR 7/4) loam, reddish yellow (7.5YR 6/6) moist; massive; slightly hard, very friable, sticky and plastic; few very fine roots; common very fine tubular pores; common fine soft lime masses; violently effervescent; moderately alkaline; clear smooth boundary.

Bk2—42 to 60 inches; light brown (7.5YR 6/4) loam, strong brown (7.5YR 4/6) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; few fine soft lime masses; violently effervescent; moderately alkaline.

Range in Characteristics

Depth to a calcic horizon: 20 to 34 inches
Average content of rock fragments in the control section: typically less than 5 percent, but may be as much as 15 percent in any one horizon
Hue: 7.5YR or 5YR
A horizon texture: gravelly loam or fine sandy loam
Bt horizon texture: loam, clay loam or sandy clay loam

Bidonia Series

Depth class: shallow
Drainage class: well drained
Permeability: slow
Landform: plateaus
Parent material: alluvium from sandstone
Slope range: 1 to 15 percent
Elevation: 4,900 to 5,300 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F.
Frost-free period: 150 to 165 days
Classification: clayey, kaolinitic, mesic Lithic Ustollic Haplargids

Typical Pedon

Bidonia sandy loam, in an area of Bidonia-Rock outcrop complex, 1 to 15 percent slopes; about 2 miles north and 4 miles east of Fredonia; about 1,100 feet east and 250 feet north of the southwest corner of sec. 6, T. 41 N., R. 1 W.

A—0 to 2 inches; strong brown (7.5YR 5/6) sandy loam, dark brown (7.5YR 4/4) moist; moderate fine granular structure; slightly hard; very friable, few very fine roots; many very fine irregular pores; mildly alkaline; abrupt smooth boundary.

Bt1—2 to 6 inches; reddish brown (5YR 5/4) loam, yellowish red (5YR 4/6) moist, strong coarse granular structure; hard, firm, sticky and slightly plastic; few very fine roots; many very fine tubular pores; few thin clay films on faces of peds and in pores; 3 percent soft sandstone fragments; moderately alkaline; clear wavy boundary.

2Bt2—6 to 12 inches; yellowish red (5YR 5/6) sandy clay, yellowish red (5YR 4/6) moist; strong very fine subangular blocky structure; hard, firm, very sticky and very plastic; few very fine roots; many very fine tubular pores; many thick clay films on faces of peds and in pores; few pressure faces; 3 percent soft sandstone fragments; strongly effervescent; moderately alkaline; abrupt smooth boundary.

3R—12 inches; sandstone

Range in Characteristics

Depth to bedrock: 10 to 20 inches

Average content of rock fragments in the control section: 1 to 15 percent
Hue: 7.5YR through 2.5YR

Bison Series

Depth class: moderately deep to a petrocalcic horizon
Drainage class: well drained
Permeability: moderate
Landform: fan terraces
Parent material: alluvium from limestone
Slope range: 2 to 6 percent
Elevation: 4,800 to 5,200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: coarse-loamy, mixed, mesic Typic Paleorthids

Typical Pedon

Bison gravelly loam, in an area of Bison-Curob complex, 2 to 6 percent slopes; about 19 miles southwest of Marble Canyon; about 2,550 feet north and 1,300 feet west of the southeast corner of sec. 10, T. 37 N., R. 4 E.

A—0 to 4 inches; brown (7.5YR 5/4) gravelly loam, reddish brown (5YR 4/4) moist; weak thick platy structure; soft, very friable; few very fine roots; many very fine tubular pores; 15 percent gravel; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Bw—4 to 8 inches; brown (7.5YR 5/4) gravelly loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; soft, very friable; few very fine roots; many very fine tubular pores; 15 percent gravel with lime coating dominantly on the undersides; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk1—8 to 13 inches; yellowish red (5YR 5/6) gravelly loam, yellowish red (5YR 4/6) moist; weak, fine subangular blocky structure; soft, very friable, slightly sticky; few very fine roots; many very fine tubular pores; 20 percent gravel with lime coating dominantly on the undersides; many large irregularly shaped soft lime masses; violently effervescent; moderately alkaline; clear wavy boundary.

Bk2—13 to 26 inches; pink (7.5YR 8/4) gravelly loam, reddish yellow (5YR 6/6) moist; strong fine subangular blocky structure; soft, very friable, slightly sticky; few very fine roots; many very fine tubular pores; few fine soft lime masses; 20 percent gravel with lime coating dominantly on the undersides; violently effervescent; moderately alkaline; abrupt smooth boundary.

2Bkm—26 to 38 inches; pink (7.5YR 8/4) fractured indurated lime-cemented hardpan.

3Bk—38 to 60 inches; yellowish red (5YR 5/6) gravelly loam, yellowish red (5YR 4/6) moist; massive; slightly hard, friable, slightly sticky; slightly plastic; many very fine tubular pores; 25 percent lime-coated gravel; weakly lime cemented; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to hardpan: 20 to 40 inches
Average content of rock fragments in the control section: 5 to 35 percent
Cementation of the hardpan: weak to indurated
Hue: 5YR or 7.5YR

Clayhole Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: alluvial fans
Parent material: alluvium derived dominantly from gypsiferous shale
Slope range: 1 to 8 percent
Elevation: 4,300 to 5,500 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: fine-loamy, mixed (calcareous), mesic Typic Torrifluvents

Typical Pedon

Clayhole silty clay loam, 1 to 5 percent slopes; about 1 mile southeast of Fredonia; about 2,200 feet east and 1,700 feet south of the northwest corner of sec. 27, T. 41 N., R. 2 W.

A—0 to 3 inches; yellowish red (5YR 5/6) silty clay loam, reddish brown (5YR 4/4) moist; thin platy structure; slightly hard, friable, sticky and plastic; few very fine roots; common very fine tubular pores; 3 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

Cy1—3 to 12 inches; reddish yellow (5YR 6/6) silt loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; soft, very friable, sticky and plastic; common fine roots; common fine tubular pores; 3 percent gravel; common fine gypsum crystals; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Cy2—12 to 21 inches; reddish yellow (5YR 6/6) loam;

yellowish red (5YR 5/6) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; common very fine tubular pores; 3 percent gravel; common fine gypsum crystals; strongly effervescent; moderately alkaline; clear smooth boundary.

Cy3—21 to 44 inches; reddish yellow (5YR 6/6) silt loam, yellowish red (5YR 4/6) moist; strong medium subangular blocky structure; very firm, very sticky and plastic; few very fine roots; few very fine tubular pores; 3 percent gravel; many fine lime filaments; common fine gypsum crystals; strongly effervescent; moderately alkaline; clear wavy boundary.

Cy4—44 to 60 inches; yellowish red (5YR 5/6) silty clay loam, reddish brown (5YR 4/4) moist; massive; very hard, very firm, very sticky and very plastic; few very fine tubular pores; 3 percent gravel; many gypsum crystal masses; common clay lenses; moderately alkaline.

Range in Characteristics

Average content of rock fragments in the control section: 0 to 15 percent

Control section texture: contains thin ($^1/_4$-inch) discontinuous strata of silty clay loam, loam and silt loam

Content of gypsum: ranges from 35 to 40 percent below the surface layer but averages more than 40 percent in the control section.

Hue: 7.5YR or 5YR

Value: 5 or 6 dry, 3, 4 or 5 moist

Chroma: 4 through 6

A horizon texture: silty clay loam or loam

Curhollow Series

Depth class: shallow

Drainage class: well drained

Permeability: moderate

Landform: fan terraces

Parent material: alluvium from limestone

Slope range: 2 to 12 percent

Elevation: 4,800 to 5,800 feet

Mean annual precipitation: 10 to 14 inches

Mean annual air temperature: 52 to 55 degrees F.

Frost-free period: 150 to 165 days

Classification: loamy-skeletal, mixed, mesic, shallow Ustollic Paleorthids

Typical Pedon

Curhollow loam, in an area of Curhollow-Mellenthin complex, 2 to 12 percent slopes; about 9 miles southeast of Fredonia; 300 feet north and 900 feet west of the southeast corner of sec. 23, T.40 N., R. 1 W.

A—0 to 2 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; slightly hard, very friable, nonsticky and slightly plastic; common very fine roots; common fine tubular pores; 10 percent gravel; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Bk1—2 to 8 inches; reddish brown (5YR 5/4) very gravelly loam, dark reddish brown (5YR 3/4) moist; moderate fine and very fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; 35 percent gravel; strongly effervescent; lime accumulations as coatings on undersides of gravel; moderately alkaline; clear wavy boundary.

Bk2—8 to 13 inches; reddish brown (5YR 5/4) very gravelly loam, reddish brown (5YR 4/4) moist; weak very fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular pores; 40 percent gravel; violently effervescent; moderately alkaline; abrupt smooth boundary.

2Bkm—13 to 19 inches; pink (7.5YR 8/4) strongly lime cemented and fractured hardpan; trowelled laminar surface; violently effervescent; abrupt smooth boundary.

3R—19 inches; limestone.

Range in Characteristics

Average content of coarse fragments in the control section: 35 to 60 percent pan and limestone fragments

Depth to hardpan: 10 to 20 inches

Control section texture: loam or sandy loam

Reaction: mildly or moderately alkaline

Effervescence: slight to violent

Hue: 7.5YR through 5YR

Curob Series

Depth class: shallow to a petrocalcic horizon

Drainage class: well drained

Permeability: moderate to moderately rapid

Landform: fan terraces

Parent material: alluvium from limestone and sandstone

Slope range: 2 to 12 percent
Elevation: 3,600 to 5,200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: loamy-skeletal, mixed, mesic, shallow Typic Paleorthids

Typical Pedon

Curob very gravelly loam 2 to 12 percent slopes; about 19 miles southwest of Marble Canyon; about 1,600 feet east and 800 feet north of the southwest corner, sec. 15, T. 37 N., R. 4 E.

A—0 to 3 inches; light brown (7.5YR 6/4) very gravelly loam, dark brown (7.5YR 4/4) moist; moderate thin platy structure; slightly hard, very friable; few very fine roots; common very fine tubular pores; 40 percent gravel; violently effervescent; moderately alkaline; abrupt smooth boundary.

Bw1—3 to 7 inches; light brown (7.5YR 6/4) gravelly loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure parting to moderate fine granular; slightly hard, very friable; common very fine roots; many very fine tubular pores; 30 percent gravel; violently effervescent; moderately alkaline; abrupt smooth boundary.

Bw2—7 to 13 inches; brown (7.5YR 5/4) very gravelly loam, dark brown (7.5Y 4/4) moist; weak very fine subangular blocky structure; slightly hard, very friable; many very fine roots; many very fine tubular pores; 40 percent gravel; violently effervescent; moderately alkaline; abrupt smooth boundary.

2Bkm—13 to 19 inches; trowelled, laminated indurated calcium carbonate cemented pan with 1/8- to 1/2-inch calcium carbonate pendants on the bottom.

3C1—19 to 35 inches; light brown (7.5YR 6/4) extremely gravelly loamy coarse sand, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; few very fine roots; many very fine tubular pores; 80 percent gravel; discontinuous areas of indurated pan; violently effervescent; moderately alkaline; abrupt smooth boundary.

3C2—35 to 45 inches; light brown (7.5YR 6/4) extremely gravelly loamy coarse sand, brown (7.5YR 5/4) moist; massive; hard, very friable; few very fine roots; many fine irregular pores; 80 percent gravel; violently effervescent; moderately alkaline; abrupt smooth boundary.

3C3—45 to 60 inches; light brown (7.5YR 6/4) extremely gravelly loamy coarse sand, dark brown (7.5YR 4/4) moist; massive; slightly hard, very friable; few very fine roots; many very fine tubular pores; 60 percent gravel, 5 percent cobbles; violently effervescent; moderately alkaline.

Range in Characteristics

Average content of rock fragments in the control section: 35 to 65 percent
Depth to hardpan: 10 to 20 inches
Control section texture: loam or sandy loam
Hue: 7.5YR or 5YR
Chroma: 3 through 6
Value (A horizon): 5 or 6
Value (C horizon): 6 or 7
A horizon texture: loamy sand or very gravelly loam

The Curob soil in map unit 11, Curob loamy sand, 2 to 10 percent slopes, is a taxadjunct to the Curob series in that it has fewer rock fragments in the control section and the petrocalcic horizon is underlain by bedrock. However, this does not significantly affect its primary use and management.

Disterheff Series

Depth class: very deep
Drainage class: well drained
Permeability: slow
Landform: plateaus
Parent material: alluvium derived dominantly from cherty limestone
Slope range: 2 to 15 percent
Elevation: 6,000 to 6,600 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F.
Frost-free period: 135 to 150 days
Classification: fine, montmorillonitic, mesic Aridic Haplustalfs

Typical Pedon

Disterheff very gravelly loam, 2 to 15 percent slopes; about 21 miles east of Fredonia; about 1,500 feet south and 1,800 feet east of the northwest corner of sec. 35, T. 41 N., R. 2 E.

A—0 to 3 inches; brown (7.5YR 5/4) very gravelly loam, dark brown (7.5YR 3/4) moist; weak, thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; 40 percent gravel; mildly alkaline; clear smooth boundary.

Bt1—3 to 7 inches; reddish brown (5YR 5/3) clay loam, dark reddish brown (5YR 3/4) moist; moderate fine subangular blocky structure; hard, firm, sticky and

plastic; common fine roots; common fine tubular pores; 10 percent gravel; mildly alkaline; abrupt smooth boundary.

Bt2—7 to 22 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; strong, medium prismatic structure parting to strong medium subangular blocky; extremely hard, very firm, very sticky and very plastic; common fine roots; common fine tubular pores; 5 percent gravel; continuous thick clay films on faces of peds and in pores; many pressure faces; moderately alkaline; clear wavy boundary.

Btk1—22 to 37 inches; yellowish red (5YR 4/6) and pink (5YR 8/3) gravelly clay loam, yellowish red (5YR 5/6) moist; strong, fine medium subangular blocky structure; extremely hard, very firm, sticky and plastic; few fine and common fine roots; common fine tubular pores; 20 percent gravel; common moderately thick clay films on faces of peds and in pores; many lime masses; violently effervescent; moderately alkaline; abrupt wavy boundary.

Btk2—37 to 60 inches; yellowish red (5YR 4/6) and pink (5YR 8/3) very gravelly clay loam, yellowish red (5YR 5/6) moist; strong fine subangular blocky structure; hard, firm, sticky and plastic; few fine roots; common fine tubular pores; 40 percent gravel; common moderately thick clay films on faces of peds and in pores; few fine roots; common fine tubular pores; many lime masses; violently effervescent; moderately alkaline.

Range in Characteristics

Average content of rock fragments in the control section: commonly 5 to 20 percent but ranges to 35 percent
Depth to calcic horizon: 20 to 30 inches
Control section texture: clay loam or clay
Hue: 7.5YR through 2.5 YR
Value: (A and Bt horizons): 4 or 5 dry and 3 or 4 moist
Value: (Btk horizon): 4, 6, and 8 dry and 5 or 6 moist
Chroma: (A and Bt horizons): 3 to 6
A horizon texture: very gravelly loam or gravelly loam

Doak Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 6 percent
Elevation: 4,700 to 5,200 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: fine-loamy, mixed, mesic Typic Haplargids

Typical Pedon

Doak fine sandy loam, 1 to 6 percent slopes; about 1.5 miles south of Fredonia; about 2,000 feet west and 100 feet north of the southeast corner, sec. 29, T. 41 N., R. 2 W.

A—0 to 2 inches; brown (7.5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; weak fine granular structure; soft, very friable; many very fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Bt—2 to 8 inches; strong brown (7.5YR 5/6) loam, reddish brown (5YR 4/4) moist; weak very fine subangular blocky structure; slightly hard, very friable, slightly sticky; few very fine roots; common very fine tubular pores; few thin clay films on ped faces and in pores; strongly effervescent; moderately alkaline; clear wavy boundary.

Btk—8 to 22 inches; strong brown (7.5YR 5/6) clay loam, reddish brown (5YR 4/4) moist; medium fine subangular blocky structure; slightly hard, friable, sticky and slightly plastic; few very fine roots; common very fine tubular pores; common thin clay films on ped surfaces and in pores; strongly effervescent; common medium soft lime masses; moderately alkaline; gradual wavy boundary.

Bk1—22 to 40 inches; reddish yellow (5YR 6/6) sandy clay loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common very fine tubular pores; violently effervescent; few common soft lime masses; moderately alkaline; gradual wavy boundary.

Bk2—40 to 60 inches; reddish yellow (5YR 6/6) sandy clay loam, reddish brown (5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky; strongly effervescent; moderately alkaline.

Range in Characteristics

Depth to calcareous material: 8 to 23 inches
Average content of rock fragments in the control section: less than 10 percent
Calcium carbonate equivalent: 5 to 12 percent

A horizon:
Value—4 through 6
Chroma—3 or 4

Bt horizon:
Hue—5YR or 7.5YR
Chroma—4 through 6

Bk horizon:
Hue: 5YR or 7.5YR
Value: 5 through 7
Chroma: 4 through 6

Glenyon Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: low stream terraces
Parent material: mixed alluvium
Slope range: 0 to 2 percent
Elevation: 4,700 to 5,000 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: clayey over sandy or sandy skeletal, mixed (calcareous), mesic Typic Torriorthents

Typical Pedon

Glenyon silty clay loam, 0 to 2 percent slopes; about 1/4 mile north of Fredonia; about 2,000 feet west and 50 feet north of the southeast corner of sec. 8, T. 41 N., R. 2 W.

A—0 to 2 inches; yellowish red (5YR 5/6) silty clay loam, reddish brown (5YR 4/4) moist; moderate medium platy structure; soft, friable, slightly sticky and plastic; common very fine roots; few very fine tubular pores; slightly effervescent; strongly alkaline; abrupt smooth boundary.

By—2 to 11 inches; strong brown (7.5YR 5/6) silty clay loam, dark brown (7.5YR 4/4) moist; weak coarse subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; strongly effervescent; few gypsum crystals; strongly alkaline; gradual smooth boundary.

Cy—11 to 34 inches; light brown (7.5YR 6/4) silty clay loam, dark brown (7.5YR 4/4) moist; massive; hard, firm, very sticky and very plastic; few very fine roots; few very fine tubular pores; few gypsum crystals; strongly effervescent; strongly alkaline; clear smooth boundary.

2C1—34 to 45 inches; light brown (7.5YR 6/4) loamy sand, strong brown (7.5YR 5/6) moist; single grained; loose; slightly effervescent; moderately alkaline; clear smooth boundary.

2C2—45 to 60 inches; light brown (7.5YR 6/4) loamy fine sand, strong brown (7.5YR 5/6) moist; massive; slightly hard, very friable; slightly effervescent; moderately alkaline.

Range in Characteristics

Depth to sandy substratum : 30 to 36 inches
Average content of rock fragments in the control section: 0 to 5 percent
Content of gypsum: less than 1 percent to 3 percent
Hue: 7.5YR or 5YR
Salinity: ranges to 7 dS/m

Houserock Series

Depth class: shallow
Drainage class: well drained
Permeability: slow
Landform: plateaus and hills
Parent material: alluvium from cherty limestone
Slope range: 3 to 20 percent
Elevation: 5,800 to 6,600 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F.
Frost-free period: 135 to 150 days
Classification: clayey-skeletal, montmorillonitic, mesic Lithic Haplustalfs

Typical Pedon

Houserock gravelly loam in an area of Disterheff-Houserock complex, 3 to 15 percent slopes; about 18 miles east of Fredonia; 500 feet south and 1,350 feet west of the northeast corner of sec. 33, T. 41 N., R. 2 E.

A—0 to 3 inches; reddish brown (5YR 5/3) gravelly loam, dark reddish brown (5YR 3/3) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky and plastic; common fine roots; common, very fine tubular pores; 30 percent gravel; mildly alkaline; abrupt smooth boundary.

Bt1—3 to 8 inches; reddish brown (2.5YR 4/4) very gravelly clay loam, dark reddish brown (2.5YR 3/4) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; common fine roots; common fine tubular pores; 35 percent gravel; mildly alkaline; clear wavy boundary.

Bt2—8 to 15 inches; red (2.5YR 4/6) very gravelly clay, dark red (2.5YR 3/6) moist; strong, medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots; common very fine tubular pores; 35 percent gravel;

many thick clay films; common pressure faces; moderately alkaline; clear wavy boundary.

Bt3—15 to 19 inches; red (2.5YR 4/6) extremely gravelly clay, dark red (2.5YR 3/6) moist; moderate medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots; common fine tubular pores; 60 percent gravel; moderately alkaline; abrupt smooth boundary.

2R—19 inches; fractured cherty limestone with reddish brown (2.5YR 4/4) clay films in the joints.

Range in Characteristics

Depth to bedrock: 10 to 20 inches
Average content of rock fragments in the control section: 35 to 55 percent
Control section texture: clay loam or clay (35 to 55 percent clay)
Hue: 7.5YR, 5YR or 2.5YR
Chroma (A horizon): 3 or 4 moist
Value (B horizon): 4 or 5 dry and 3 or 4 moist

Jocity Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: stream terraces, flood plains, and alluvial fans
Parent material: Mixed alluvium
Slope range: 1 to 3 percent
Elevation: 4,400 to 5,300 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: fine-loamy, mixed (calcareous), mesic Typic Torrifluvents

Typical Pedon

Jocity clay loam, 1 to 3 percent slopes; about 21 miles southwest of Marble Canyon; about 1,500 feet west and 2,200 feet south of the northeast corner of sec. 7, T. 37 N., R. 5 E.

A—0 to 4 inches; brown (7.5YR 5/4) clay loam, reddish brown (5YR 4/3) moist; strong thin platy structure; slightly hard, very friable, sticky and plastic; common very fine roots; many fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C1—4 to 13 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; slightly hard, very friable, sticky and plastic; common very fine roots; common fine tubular pores; slightly effervescent; 5 percent fine gravel; moderately alkaline; abrupt smooth boundary.

C2—13 to 21 inches; yellowish red (5YR 4/6) silt loam, dark reddish brown (5YR 3/4) moist; massive; slightly hard, very friable, sticky and plastic; common very fine roots; many fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C3—21 to 32 inches; strong brown (7.5YR 5/6) silt loam, reddish brown (5YR 4/4) moist; massive; slightly hard, very friable, sticky and plastic; common very fine roots; many fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C4—32 to 40 inches; strong brown (7.5YR 5/6) loam, reddish brown (5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; many fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C5—40 to 51 inches; yellowish red (5YR 5/6) silt loam, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; many fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

5C6—51 to 60 inches; yellowish red (5YR 4/6) loam, reddish brown (5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; many fine tubular pores; slightly effervescent; moderately alkaline.

Range in Characteristics

Gypsum content: less than 1 percent to 10 percent. Some horizons below 30 inches have as much as 30 percent gypsum
Reaction: mildly alkaline to strongly alkaline
Hue: 7.5YR or 5YR
A horizon texture: clay loam or silty clay loam

Keeseha Series

Depth class: very deep
Drainage class: well drained
Permeability: slow
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 6 percent
Elevation: 4,800 to 5,400 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F.

Frost-free period: 150 to 165 days
Classification: fine, mixed, mesic Ustollic Haplargids

Typical Pedon

Keeseha loam, 1 to 6 percent slopes; about 3 miles north of Fredonia; about 2,300 feet west and 1,500 feet north of the southeast corner of sec. 33, T. 42 N., R. 2W.

A—0 to 1 inch; yellowish red (5YR 5/6) loam, dark reddish brown (5YR 3/4) moist; weak thin platy structure; soft, friable, slightly sticky and slightly plastic; common fine roots; common very fine irregular pores; 10 percent gravel; mildly alkaline; abrupt smooth boundary.

Bt1—1 to 2 inches; red (2.5YR 5/6) clay loam, dark reddish brown (2.5YR 3/4) moist; moderate fine subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; few fine tubular pores; 10 percent gravel; moderately alkaline; clear smooth boundary.

Bt2—2 to 14 inches; red (2.5YR 4/6) clay, dark red (2.5YR 3/6) moist; strong medium prismatic structure parting to strong medium subangular blocky; very hard, very firm, very sticky and very plastic; many fine roots; common fine tubular pores; 10 percent gravel; many moderately thick clay films on faces of peds; many strong pressure faces; moderately alkaline; abrupt smooth boundary.

2Btk—14 to 19 inches; pink (5YR 7/4) gravelly clay loam, yellowish red (5YR 5/6) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; few fine roots; few very fine tubular pores; 28 percent gravel; few fine soft lime masses; violently effervescent; moderately alkaline; clear wavy boundary.

3Bk—19 to 60 inches; pinkish white (7.5YR 8/2) gravelly sandy loam, pinkish gray (7.5YR 6/2) moist; weak fine subangular blocky structure; hard, friable, sticky and slightly plastic; few fine roots; few fine tubular pores; 25 percent gravel; weakly lime cemented; violently effervescent; moderately alkaline.

Range in Characteristics

Depth to calcic horizon: 8 to 20 inches
Average content of rock fragments in the control section: 10 to 35 percent
Hue (A and Bk horizons): 7.5YR or 5YR
Hue (Bt horizon): 5YR or 2.5 YR

Kinan Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Landform: plateaus
Parent material: alluvium from limestone
Slope range: 4 to 15 percent
Elevation: 3,500 to 5,000 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: coarse-loamy, mixed, mesic Typic Calciorthids

Typical Pedon

Kinan gravelly sandy loam, in an area of Kinan-Pennell complex, 4 to 15 percent slopes; about 10 miles southwest of Marble Canyon; about 2,000 feet north and 300 feet east of the southwest corner of sec. 15, T. 38 N., R. 6 E.

A1—0 to 1 inch; yellowish red (5YR 5/6) gravelly sandy loam, reddish brown (5YR 4/4) moist; weak thin platy structure parting to weak fine granular; slightly hard, very friable, few very fine roots; common very fine tubular pores; 20 percent gravel; moderately alkaline; slightly effervescent; abrupt smooth boundary.

A2—1 to 4 inches; yellowish red (5YR 4/6) sandy loam, reddish brown (5YR 4/4) moist; weak very thick platy structure parting to weak fine granular; slightly hard, very friable; few very fine roots; common very fine tubular pores; 2 percent gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bw1—4 to 10 inches; yellowish red (5YR 5/6) sandy loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable; common very fine roots; common very fine tubular pores; 2 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

Bw2—10 to 13 inches; yellowish red (5YR 5/6) sandy loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable; common very fine roots; common very fine tubular pores; 2 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

2Bk1—13 to 17 inches; yellowish red (5YR 5/6) very

gravelly sandy loam, yellowish red (5YR 5/6) moist; weak fine subangular blocky structure; slightly hard, very friable, common very fine roots; common very fine tubular pores; 40 percent gravel with thin lime coatings on the underside; violently effervescent; moderately alkaline; clear wavy boundary.

2Bk2—17 to 27 inches; pinkish white (7.5YR 8/2) very gravelly sandy loam, pink (5YR 7/4) moist; massive; slightly hard, very friable; few very fine roots; common very fine tubular pores; 40 percent lime-coated gravel; violently effervescent; strongly alkaline; clear wavy boundary.

3Bk3—27 to 39 inches; pinkish white (7.5YR 8/2) loam; pink (5YR 7/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine tubular pores; 5 percent lime-coated gravel; violently effervescent; strongly alkaline; abrupt smooth boundary.

3Bk4—39 to 60 inches; very pale brown (10YR 8/3) loam, light yellowish brown (10YR 6/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common very fine tubular pores; few fine soft lime masses; violently effervescent.

Range in Characteristics

Depth to calcic horizon: 13 to 25 inches
Average content of rock fragments in the control section: 5 to 35 percent
Control section texture: sandy loam or loam

A and B Horizons:
Hue—5YR or 2.5YR
Value—5 or 6 dry and 4 or 5 moist
Chroma—4 through 6

Bk horizon:
Hue—7.5YR or 5YR
Value—6 through 8 dry and 5 or 6 moist
Chroma—2 through 4

Klondike Series

Depth class: shallow
Drainage class: well drained
Permeability: moderately slow
Landform: hills
Parent material: alluvium derived dominantly from sandstone, siltstone and shale
Slope range: 2 to 15 percent
Elevation: 4,800 to 5,400 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F.
Frost-free period: 150 to 165 days
Classification: loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents

Typical Pedon

Klondike sandy clay loam, 2 to 15 percent slopes; about 3.5 miles southeast of Fredonia; about 2,000 feet south and 300 feet west of the northeast corner of sec. 3, T. 40 N., R. 2 W.

A—0 to 1 inch; reddish brown (5YR 5/4) sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; common irregular pores; 10 percent gravel; strongly effervescent; mildly alkaline; abrupt smooth boundary.

Bw—1 to 5 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; moderate very fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; thin clay films on faces of peds and in pores; 10 percent gravel; strongly effervescent; mildly alkaline; clear wavy boundary.

Bky—5 to 11 inches; yellowish red (5YR 5/6) loam, reddish brown (5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many very fine tubular pores; 10 percent gravel with thick lime coatings on the underside; common gypsum crystals; violently effervescent; moderately alkaline; abrupt smooth boundary.

2Cr—11 inches; thin bedded, fractured calcareous sandstone; many thick dark reddish brown (5YR 3/4) clay films; common lime coatings and few gypsum crystals in fractures.

Range in Characteristics

Depth to paralithic contact: 10 to 20 inches
Gypsum content: 0.5 to 5 percent
Average content of rock fragments in the control section: 1 to 35 percent
Calcium carbonate equivalent: less than 15 percent
Hue: 5YR or 2.5YR
Value: 4 or 5 dry, 3 or 4 moist
Chroma: 4 through 6

Manikan Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow

Landform: stream terraces
Parent material: mixed alluvium
Slope range: 1 to 3 percent
Elevation: 4,700 to 5,400 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F.
Frost-free period: 150 to 165 days
Classification: fine-loamy, mixed (calcareous), mesic Ustic Torrifluvents

Typical Pedon

Manikan silty clay loam, 1 to 3 percent slopes; about 8 miles northeast of Fredonia; about 1,700 feet east and 300 feet north of the southwest corner of sec. 35, T. 42 N., R. 1 E.

A—0 to 3 inches; yellowish red (5YR 5/6) silty clay loam, reddish brown (5YR 4/4) moist; weak fine granular structure; slightly hard, very friable; many very fine roots; common very fine tubular pores; slightly effervescent; mildly alkaline; abrupt smooth boundary.

Bw1—3 to 16 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable; many very fine roots; common very fine tubular pores; slightly effervescent; mildly alkaline; abrupt smooth boundary.

Bw2—16 to 30 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky; many very fine roots; common very fine tubular pores; slightly effervescent; mildly alkaline; abrupt smooth boundary.

2Bw3—30 to 42 inches; light brown (7.5YR 6/4) silty clay loam, brown (7.5YR 5/4) moist; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

3C—42 to 60 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, slightly sticky; many very fine roots; common very fine tubular pores; slightly effervescent; moderately alkaline.

Range in Characteristics

Average content of rock fragments in the control section: less than 5 percent
Gypsum content: some pedons have a few gypsum crystals below 10 inches and some have many gypsum crystals below 30 inches.
Hue: 7.5YR or 5YR
Value: 5 or 6
Chroma: 3 through 6

Mellenthin Series

Depth class: shallow
Drainage class: well drained
Permeability: moderate
Landform: hills
Parent material: alluvium and colluvium from limestone
Slope range: 1 to 60 percent
Elevation: 4,800 to 6,200 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F.
Frost-free period: 150 to 165 days
Classification: loamy-skeletal, mixed, mesic Lithic Ustollic Calciorthids

Typical Pedon

Mellenthin very gravelly loam, 1 to 25 percent slopes; about 8 miles east of Fredonia; about 2,100 feet south and 2,250 feet east of the northwest corner of sec. 22, T. 41 N., R. 1 E.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly loam, dark brown (7.5YR 3/4) moist; weak thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; 55 percent gravel, of which 10 percent are pan fragments; strongly effervescent; mildly alkaline; clear wavy boundary.

Bw—2 to 8 inches; strong brown (7.5YR 5/6) very gravelly loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; 40 percent gravel of which 20 percent are pan fragments; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk—8 to 13 inches; strong brown (7.5YR 5/6) extremely gravelly sandy loam, dark brown (7.5YR 4/4) moist; massive, slightly hard, friable, slightly sticky and slightly plastic; common fine roots; common fine tubular pores; 75 percent lime-coated gravel, which includes 35 percent pan fragments; common lime masses and nodules; violently effervescent; moderately alkaline; abrupt smooth boundary.

2R—13 inches; fractured limestone. 1/8- to 3/8-inch lime pendants on the bottom sides of the joints.

Range in Characteristics

Depth to calcic horizon: 4 to 14 inches

Depth to bedrock: 10 to 20 inches
Average content of rock fragments in the control section: 35 to 70 percent
Hue: 7.5YR or 5YR
Value: 5 or 6 dry and 3 or 4 moist
Chroma: 4 through 6

Monierco Series

Depth class: shallow
Drainage class: well drained
Permeability: moderately slow
Landform: hills
Parent material: alluvium from sandstone and shale
Slope range: 2 to 15 percent
Elevation: 4,800 to 5,000 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: loamy, mixed, mesic, shallow Typic Haplargids

Typical Pedon

Monierco clay loam, 2 to 15 percent slopes; about 19 miles southwest of Marble Canyon; about 1,800 feet south and 1,200 feet east of the northwest corner of sec. 25, T. 37 N., R. 4 E.

A—0 to 1 inch; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; moderate medium platy structure; slightly hard, friable, sticky and plastic; common fine roots; common very fine pores; 10 percent gravel; strongly effervescent; mildly alkaline; clear smooth boundary.

Bt—1 to 10 inches; red (2.5YR 4/6) clay loam, dark red (2.5YR 3/6) moist; weak medium subangular blocky structure parting to strong medium granular; slightly hard, firm, sticky and plastic; common very fine tubular pores; common very fine roots; clay films in pores and as bridges between mineral grains; strongly effervescent; moderately alkaline; clear wavy boundary.

BC—10 to 19 inches; reddish brown (5YR 4/4) gravelly loam, dark reddish brown (2.5YR 3/4) moist; moderate; very fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; 20 percent shale fragments; strongly effervescent; moderately alkaline; abrupt smooth boundary.

2Cr—19 inches; thin bedded fractured siltstone with occasional clay films in the fractures.

Range in Characteristics

Depth to paralithic contact: 10 to 20 inches
Average content of rock fragments in the control section: 5 percent
Hue: 7.5YR through 2.5YR
BC Horizon: absent in some pedons

Monue Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid, (upper part); moderately slow, (lower part)
Landform: fan terraces
Parent material: alluvium from sandstone
Slope range: 1 to 6 percent
Elevation: 5,000 to 5,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: coarse-loamy, mixed, mesic Typic Camborthids

Typical Pedon

Monue sandy loam, 1 to 6 percent slopes; about 19 miles west southwest of Marble Canyon; about 2,100 feet south and 1,500 feet west of the northeast corner of sec. 9, T. 38 N., R. 4 E.

A1—0 to 1 inch; yellowish red (5YR 5/6) sandy loam, yellowish red (5YR 4/6) moist; single grained; loose, few very fine roots; many very fine irregular pores; few pebbles; slightly effervescent; mildly alkaline; abrupt smooth boundary.

A2—1 to 4 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak thin platy structure; slightly hard, very friable; common very fine roots; many very fine tubular pores; 3 percent gravel, strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bw1—4 to 12 inches; yellowish red (5YR 5/6) fine sandy loam, reddish brown (2.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable; many very fine roots; many very fine tubular pores, 3 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

Bw2—12 to 18 inches; yellowish red (5YR 5/6) fine sandy loam, reddish brown (2.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable; common very fine roots; many very fine tubular pores; 3 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

Bw3—18 to 43 inches; yellowish red (5YR 5/6) fine sandy loam, reddish brown (2.5YR 4/4) moist; weak fine subangular blocky structure; slightly

hard, very friable; few very fine roots; many very fine tubular pores; 3 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.
2C—43 to 60 inches; yellowish red (5YR 5/6) silty clay loam, yellowish red (5YR 5/6) moist; strong fine subangular blocky structure; hard, firm, sticky and plastic; few very fine roots; many very fine tubular pores; 3 percent gravel; strongly effervescent; strongly alkaline.

Range in Characteristics

Average content of rock fragments in the control section: 0 to 5 percent
Hue: 5YR or 2.5YR
Value: 5 or 6 dry and 4 or 5 moist
Chroma: 5 or 6
A horizon texture: fine sandy loam or sandy loam
Texture below 40 inches: silty clay loam to loamy fine sand

Needle Series

Depth class: shallow
Drainage class: excessively drained
Permeability: very rapid
Landform: hills and plateaus
Parent material: eolian sand and alluvium from sandstone
Slope range: 2 to 35 percent
Elevation: 3,800 to 5,600 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: mixed, mesic Lithic Torripsamments

Typical Pedon

Needle fine sand in an area of Needle-Rock outcrop complex, 4 to 15 percent slopes; about 2 miles west and 1 mile north of Page; about 1,100 feet north and 100 feet west of the southeast corner of sec. 14, T. 41 N., R. 8 E.

A—0 to 2 inches; reddish yellow (5YR 6/6) fine sand, red (2.5YR 5/6) moist; single grained; loose; common very fine roots; many fine irregular pores; 1 percent fine gravel; mildly alkaline; abrupt smooth boundary.
C1—2 to 10 inches; reddish yellow (5YR 6/6) fine sand, red (2.5YR 5/6) moist; single grained; loose; many very fine roots; many irregular pores; 1 percent fine gravel; mildly alkaline; clear wavy boundary.
C2—10 to 11 inches; red (2.5YR 4/6) fine sand, red (2.5YR 4/6) moist; massive; slightly hard, very friable; common very fine roots; common irregular pores; mildly alkaline; abrupt smooth boundary.
2R—11 inches; sandstone, partially weathered in the upper 2 inches.

Range in Characteristics

Depth to bedrock: 10 to 20 inches
Control section texture: fine sand or loamy fine sand with a small percentage of medium or coarser sand
Hue: 5YR or 2.5YR
Value: 5 or 6
Chroma: 4 through 6
2R Horizon: The weathered portion is absent in some pedons

Pagina Series

Depth class: moderately deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Landform: plateaus
Parent material: eolian sand and alluvium from sandstone
Slope range: 1 to 16 percent
Elevation: 3,600 to 4,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: coarse-loamy, mixed, mesic Typic Calciorthids

Typical Pedon

Pagina fine sand in an area of Pagina-Wahweap complex, 3 to 16 percent slopes; about 7 miles northwest of Page; about 1,470 feet north and 150 feet east of the southwest corner of sec. 7, T. 41 N., R. 8 E.

A—0 to 2 inches; yellowish red (5YR 5/8) fine sand, yellowish red (5YR 4/6) moist; single grained; loose; common very fine roots; many very fine irregular pores; 5 percent gravel; moderately alkaline; abrupt smooth boundary.
Bk1—2 to 13 inches; yellowish red (5YR 5/8) loamy fine sand, yellowish red (5YR 4/6) moist; massive; soft, very friable; common very fine roots; common very fine tubular pores; 5 percent lime-coated gravel, with thicker lime coatings on the bottom than on the top; strongly effervescent; moderately alkaline; clear wavy boundary.
Bk2—13 to 22 inches; reddish yellow (5YR 6/6) loamy fine sand, yellowish red (5YR 5/6) moist; massive; soft, very friable; common very fine roots; common very fine tubular pores; 10 percent lime-coated gravel; with thicker lime coatings on the

bottom than on the top; violently effervescent; moderately alkaline; clear wavy boundary.

Bk3—22 to 38 inches; pinkish white (5YR 8/2) sandy loam, pinkish gray (5YR 7/2) moist; massive; slightly hard, very friable; few very fine roots; common very fine tubular pores; 10 percent gravel; common fine soft lime masses; violently effervescent; moderately alkaline; clear wavy boundary.

2Cr—38 inches; partially weathered calcareous sandstone.

Range in Characteristics

Depth to the paralithic contact: 20 to 40 inches
Depth to the calcic horizon: 2 to 25 inches
Average content of rock fragments in the control section: less than 1 percent to 15 percent
Hue: 7.5YR or 5YR
Value (A horizon): 5 or 6 dry and 4 or 5 moist
Value (Bk horizons): 5 through 8 dry and 4 through 7 moist
Chroma (A horizon): 6 or 8 dry
Chroma (Bk horizons): 2 through 8, dry or moist
A horizon texture: loamy sand or fine sand

Pennell Series

Depth class: shallow
Drainage class: well drained
Permeability: moderately rapid
Landform: plateaus and hills
Parent material: alluvium derived dominantly from limestone
Slope range: 3 to 45 percent
Elevation: 3,500 to 5,000 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: loamy, mixed, mesic Lithic Calciorthids

Typical Pedon

Pennell gravelly sandy loam in an area of Kinan-Pennell complex, 4 to 15 percent slopes; about 10 miles southwest of Marble Canyon; about 2,200 feet north and 500 feet east of the SW corner of sec. 15, T. 38 N., R. 6 E.

A1—0 to 1 inch; yellowish red (5YR 4/6) gravelly sandy loam reddish brown (5YR 4/4) moist; weak thin platy structure; soft, very friable; few very fine roots; many medium irregular pores; 20 percent gravel; slightly effervescent; moderately alkaline; abrupt smooth boundary.

A2—1 to 4 inches; yellowish red (5YR 4/6) gravelly sandy loam; reddish brown (5YR 4/4) moist; weak thin platy structure; soft, very friable; few very fine roots; many very fine tubular pores; 15 percent gravel; slightly effervescent; moderately alkaline; abrupt smooth boundary.

Bw—4 to 7 inches; yellowish red (5YR 5/6) sandy loam; yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; soft, very friable; few very fine roots; common very fine tubular pores; 10 percent gravel; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk1—7 to 10 inches; yellowish red (5YR 5/6) very gravelly sandy loam; yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; soft, very friable; few very fine roots; common very fine tubular pores; 40 percent gravel with 2 to 5 millimeter long lime pendants on underside; violently effervescent; moderately alkaline; clear wavy boundary.

Bk2—10 to 14 inches; yellowish red (5YR 5/6) very gravelly sandy loam; yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; soft, very friable; few very fine roots; common very fine tubular pores; 40 percent gravel with 3 to 5 millimeter long lime pendants on underside, common fine soft lime masses; violently effervescent; moderately alkaline; clear wavy boundary.

2Bk3—14 to 19 inches; pink (5YR 7/4) sandy loam; light reddish brown (5YR 6/4) moist; massive; soft, very friable; few very fine roots; common very fine tubular pores; 10 percent lime-coated gravel with thicker lime coatings on the bottom than on the top; violently effervescent; moderately alkaline; abrupt smooth boundary.

3R—19 inches; limestone with 2 millimeter thick indurated lime coating the surface.

Range in Characteristics

Depth to bedrock: 10 to 20 inches
Average content of rock fragments in the control section: 0 to 40 percent but averages less than 35 percent

A horizon:
Texture—Sandy loam, gravelly sandy loam or cobbly loam
Hue—7.5YR or 5YR

Value—4 through 6, dry or moist
Chroma—3 through 6

B horizon:
Hue—7.5YR or 5YR
Value—5 through 8, dry and 4 through 7, moist
Chroma—4 through 6

Pensom Series

Depth class: deep
Drainage class: excessively drained
Permeability: very rapid
Landform: dunes on plateaus
Parent material: eolian sand from sandstone
Slope range: 1 to 16 percent
Elevation: 5,000 to 7,100 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F.
Frost-free period: 150 to 165 days
Classification: mixed, mesic Ustic Torripsamments

Typical Pedon

Pensom fine sand in an area of Arches-Pensom complex, 4 to 12 percent slopes; about 23 miles west and 3 miles north of Marble Canyon; about 1,800 feet north and 750 feet east of the southwest corner of sec. 13, T. 40 N., R. 3 E.

A—0 to 2 inches; reddish yellow (7.5YR 6/6) fine sand, yellowish red (5YR 4/6) moist; single grained; loose; few very fine roots; few very fine irregular pores; moderately alkaline; abrupt smooth boundary.

C1—2 to 6 inches; brown (7.5YR 5/4) fine sand, yellowish red (5YR 4/6) moist; massive; soft, very friable; common very fine roots; few very fine tubular pores; moderately alkaline; clear wavy boundary.

C2—6 to 21 inches; strong brown (7.5YR 5/6) fine sand, yellowish red (5YR 4/6) moist; massive; soft, very friable; few very fine roots; few very fine tubular pores; moderately alkaline; clear wavy boundary.

C3—21 to 55 inches; yellowish red (5YR 5/6) fine sand, yellowish red (5YR 4/6) moist; massive, loose, few very fine roots; few very fine tubular pores; moderately alkaline; abrupt smooth boundary.

2R—55 to 60 inches; sandstone, partially weathered in the upper 3 inches.

Range in Characteristics

Depth to bedrock: 40 to 60 inches. The upper part of the bedrock is not weathered in some pedons.

Control section texture: Dominantly fine sand but ranges to loamy fine sand
Hue: 7.5YR or 5YR
Value: 5 through 7 dry and 4 or 5 moist
Chroma: 3 through 6
A horizon texture: fine sand or loamy fine sand

Seeg Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terraces
Parent material: mixed alluvium
Slope range: 1 to 6 percent
Elevation: 5,000 to 5,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: loamy-skeletal, mixed, mesic Typic Calciorthids

Typical Pedon

Seeg fine sandy loam, in an area of Monue-Seeg complex, 1 to 6 percent slopes; about 22 miles southwest of Marble Canyon; about 900 feet west and 600 feet north of the southeast corner of sec. 19, T. 38 N., R. 4 E.

A—0 to 3 inches; yellowish red (5YR 5/6) fine sandy loam; yellowish red (5YR 4/6) moist; weak fine granular structure; slightly hard, very friable; many very fine roots; common very fine tubular pores; 5 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

Bw—3 to 10 inches; yellowish red (5YR 5/6) gravelly fine sandy loam; yellowish red (5YR 4/6) moist; medium coarse subangular blocky structure; slightly hard, very friable and slightly sticky; many very fine roots; common very fine tubular pores; 30 percent gravel; strongly effervescent; moderately alkaline; clear smooth boundary.

2Bk—10 to 18 inches; reddish yellow (5YR 6/6) and pink (5YR 7/4) gravelly fine sandy loam; yellowish red (5YR 4/6) moist; medium coarse subangular blocky structure; slightly hard, very friable, slightly sticky; common very fine roots; common very fine tubular pores; 30 percent gravel, 5 percent cobbles; violently effervescent; common medium soft lime masses; moderately alkaline; gradual wavy boundary.

2C—18 to 26 inches; pink (5YR 7/4) very gravelly loam; reddish yellow (5YR 6/6) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine roots; common very fine tubular

pores; 40 percent gravel; violently effervescent; lime disseminated; weakly cemented; moderately alkaline; abrupt smooth boundary.

2Ck—26 to 46 inches; pink (5YR 7/4) very gravelly loam; reddish yellow (5YR 6/6) moist; massive; very hard, friable, slightly sticky and slightly plastic; few very fine roots; 40 percent gravel; violently effervescent; many medium soft lime masses; moderately alkaline; abrupt smooth boundary.

3C—46 to 60 inches; reddish yellow (5YR 6/6) and pink (5YR 7/4) fine sandy loam; yellowish red (5YR 5/6) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; 5 percent gravel; violently effervescent; lime disseminated; moderately alkaline.

Range in Characteristics

Depth to a calcic horizon: 6 to 22 inches
Average content of rock fragments in the control section: more than 35 percent
Hue: 5YR or 7.5YR
Value (A horizon): 5 or 6
Value (Bk horizon): 6 through 8
Chroma: 3 through 6

Sheppard Series

Depth class: very deep
Drainage class: excessively drained
Permeability: rapid
Landform: dunes on plateaus
Parent material: eolian sand from sandstone
Slope range: 1 to 15 percent
Elevation: 3,600 to 5,600 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: mixed, mesic Typic Torripsamments

Typical Pedon

Sheppard loamy fine sand, 5 to 15 percent slopes; about 7 miles west of Page; about 960 feet south and 120 feet west of the northeast corner of sec. 23, T. 41 N., R. 7 E.

A—0 to 4 inches; yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/8) moist; massive; soft, slightly hard; common very fine roots; few very fine irregular pores; 2 to 3 percent fine gravel; mildly alkaline; clear wavy boundary.

C1—4 to 39 inches; reddish yellow (5YR 6/8) fine sand, yellowish red (5YR 5/8) moist; massive, soft, slightly hard; few very fine roots; many very fine tubular pores; 3 percent fine gravel; mildly alkaline; gradual wavy boundary.

C2—39 to 60 inches; reddish yellow (5YR 6/8) fine sand, yellowish red (5YR 5/8); massive; soft; slightly hard; few very fine roots; many very fine tubular pores; 3 percent fine gravel; mildly alkaline.

Range in Characteristics

Control section texture: fine sand or loamy fine sand with a small percentage of medium or coarser sand.
Hue: 7.5YR through 2.5YR
Value: 5 or 6 dry and 4 or 5 moist
Chroma: 6 through 8
A horizon texture: loamy fine sand or fine sand

Strych Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terraces
Parent material: alluvium from limestone
Slope range: 1 to 4 percent
Elevation: 4,800 to 5,800 feet
Mean annual precipitation: 10 to 14 inches
Mean annual air temperature: 52 to 55 degrees F.
Frost-free period: 150 to 165 days
Classification: loamy-skeletal, mixed, mesic Ustollic Calciorthids

Typical Pedon

Strych loam, 1 to 4 percent slopes, about 15 miles east and 1 mile north of Fredonia; about 1,250 feet west and 300 feet south of the northeast corner of sec. 14, T. 41 N., R. 1 E.

A—0 to 2 inches; light reddish brown (5YR 6/4) loam, dark reddish brown (5YR 3/3) moist, weak thin platy structure; slightly hard, friable, sticky and plastic; common fine roots; common very fine tubular pores; 10 percent gravel, 5 percent cobbles; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk1—2 to 8 inches; reddish yellow (5YR 6/6) very gravelly loam, reddish brown (5YR 4/4) moist; weak very fine subangular blocky structure; slightly hard, very friable, sticky and plastic; many fine roots; common fine tubular pores; 45 percent gravel, 5 percent cobbles with thin lime coatings and small pendants on the undersides; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk2—8 to 14 inches; light brown (7.5YR 6/4) extremely

gravelly loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; sticky and plastic; many very fine roots; common fine tubular pores; 55 percent gravel, 5 percent cobbles; thick lime coatings on all surfaces of rock fragments; common soft lime masses and nodules; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk3—14 to 32 inches; pinkish white (7.5YR 8/2) extremely gravelly loam, light brown (7.5YR 6/4) moist; moderate fine subangular blocky structure; very hard, firm, slightly sticky and slightly plastic; few very fine roots; few fine tubular pores; 75 percent gravel, 5 percent cobbles; weakly cemented; thick lime coatings on all surfaces of rock fragments; violently effervescent; moderately alkaline; clear wavy boundary.

Bk4—32 to 60 inches; pink (7.5YR 7/4) extremely gravelly sandy loam, strong brown (7.5YR 5/6) moist; moderate, fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; common fine irregular pores; 70 percent gravel, 5 percent cobbles; thin lime coatings on underside of rock fragments; weakly cemented; violently effervescent; moderately alkaline.

Range in Characteristics

Depth to calcic horizon: 11 to 32 inches
Average content of rock fragments in the control section: 35 to 75 percent

A horizon:
Hue—7.5YR or 5YR
Value—5 or 6 dry and 3 or 4 moist
Chroma—3 or 4

Bk horizon:
Value—6 or 7 dry and 4 through 6 moist

Torriorthents

Depth class: very shallow to very deep
Drainage class: well drained and somewhat excessively drained
Permeability: very slow to very rapid
Landform: hills and canyon walls
Parent material: colluvium and alluvium from mixed sources including gypsiferous shales
Slope range: 3 to 65 percent
Elevation: 2,900 to 6,800 feet
Mean annual precipitation: 6 to 14 inches
Mean annual air temperature: 52 to 59 degrees F.
Frost-free period: 150 to 200 days
Classification: Torriorthents

Reference Pedon

Torriorthents, 3 to 50 percent slopes; 2,200 feet north, 2,800 feet west of the SE corner, sec. 5, T. 39 N., R 7 E.

A—0 to 1 inch; reddish brown (2.5YR 4/4) very channery sandy loam; dark reddish brown (2.5YR 3/4) moist; weak fine granular structure; soft, non-sticky and non-plastic; few very fine roots; few very fine tubular pores; slightly effervescent; 50 percent shale channers; moderately alkaline; abrupt smooth boundary.

C—1 to 11 inches; reddish brown (2.5YR 4/4) extremely channery sandy loam; dark reddish brown (2.5YR 3/4) moist; massive; soft, non-sticky and non-plastic; few very fine roots; many fine irregular pores; slightly effervescent; few fine gypsum crystals; 80 percent shale channers; moderately alkaline; abrupt smooth boundary.

2Cr—11 to 21 inches; decomposing interbedded shale and mudstone with 10 percent gypsum between some flagstones.

Range in Characteristics

Torriorthents are variable in depth to sedimentary bedrock, and in soil thickness, color, and texture.
Gypsum content: 0 to 20 percent

Wahweap Series

Depth class: shallow
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Landform: plateaus
Parent material: eolian sand and alluvium derived dominantly from sandstone.
Slope range: 0 to 16 percent
Elevation: 3,600 to 4,400 feet
Mean annual precipitation: 6 to 10 inches
Mean annual air temperature: 55 to 57 degrees F.
Frost-free period: 165 to 180 days
Classification: loamy-skeletal, mixed, mesic, shallow Typic Calciothids

Typical Pedon

Wahweap fine sand in an area of Pagina-Wahweap complex, 3 to 16 percent slopes; about 7 miles northwest of Page; about 1,200 feet north and 500 feet east of the southwest corner of sec. 7, T. 41 N., R. 8 E.

A—0 to 1 inch; yellowish red (5YR 5/8) fine sand, yellowish red (5YR 4/6) moist; massive; slightly

hard, very friable; many very fine roots; many very fine interstitial pores; 5 percent gravel; moderately alkaline; abrupt smooth boundary.

Bk1—1 to 12 inches; yellowish red (5YR 5/8) gravelly loamy fine sand, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable; common very fine roots; common very fine tubular pores; 30 percent lime-coated gravel with thicker coatings on the bottom than on the top; slightly effervescent; 10 percent calcium carbonate equivalent; moderately alkaline; clear wavy boundary.

Bk2—12 to 19 inches; yellowish red (5YR 5/6) extremely gravelly fine sandy loam, yellowish red (5YR 5/6) moist; moderate fine subangular blocky structure; slightly hard, very friable; common very fine roots; common very fine tubular pores; 60 percent lime-coated gravel with thicker coatings on the bottom than on the top; common fine lime occurring as filaments or threads; 10 percent calcium carbonate equivalent; violently effervescent; moderately alkaline; clear wavy boundary.

2Cr—19 inches; pinkish white (5YR 8/2) partially weathered sandstone.

Range in Characteristics

Depth to a paralithic contact: 10 to 20 inches
Depth to calcic horizon: 1 to 13 inches
Average content of rock fragments in the control section: 35 to 65 percent
Hue: 7.5YR or 5YR
Value: 5 or 6 dry and 4 or 5 moist
Chroma: 6 or 8 dry
A horizon texture: gravelly sandy loam, loamy sand or fine sand

Yumtheska Series

Depth class: shallow
Drainage class: well drained
Permeability: moderate
Landform: plateaus and hills
Parent material: alluvium from limestone
Slope range: 4 to 30 percent
Elevation: 5,800 to 6,400 feet
Mean annual precipitation: 14 to 18 inches
Mean annual air temperature: 48 to 52 degrees F.
Frost-free period: 135 to 150 days
Classification: loamy-skeletal, mixed, mesic Lithic Calciustolls

Typical Pedon

Yumtheska very gravelly loam, 4 to 30 percent slopes, about 17 miles southeast of Fredonia; about 1,300 feet west and 1,700 feet south of the northeast corner of sec. 25, T. 39 N., R. 1 W.

A—0 to 2 inches; reddish brown (5YR 5/3) very gravelly loam, dark reddish brown (5YR 3/3) moist; weak thin platy structure; slightly hard, friable, sticky and plastic; few very fine roots; common very fine irregular pores; 55 percent gravel; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk1—2 to 12 inches; reddish brown (5YR 5/4) very gravelly loam, dark reddish brown (5YR 3/3) moist; moderate fine subangular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; 45 percent lime-coated gravel and 5 percent cobbles; few fine soft lime masses; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Bk2—12 to 19 inches; very pale brown (10YR 8/4) very gravelly loam, very pale brown (10YR 7/4) moist; strong fine subangular blocky structure; very hard, very firm, sticky and plastic; few fine roots; common very fine irregular pores; 35 percent lime-coated gravel, 10 percent flagstones; weakly cemented; violently effervescent; moderately alkaline; abrupt smooth boundary.

2R—19 inches; lime-coated limestone, partially weathered in the upper 2 inches.

Range in Characteristics

Depth to bedrock: 10 to 20 inches
Average content of rock fragments in the control section: 35 to 65 percent
Control section texture: loam or clay loam
A horizon texture: gravelly loam or very gravelly loam

A and Bk1 horizons:
Hue—7.5YR or 5YR
Value—4 or 5 dry and 3 or 4 moist
Chroma—3 or 4

Bk2 horizon:
Hue—10YR through 5YR
Value—5 through 8 dry and 3 through 7 moist
Chroma—3 or 4

Formation of the Soils

Edward R. Fenn, Mark H. Clark, and Richard C. Herriman, soil scientists, Natural Resources Conservation Service, prepared this section.

Soil is a complex, natural, three-dimensional body on the earth's surface. It consists of inorganic and organic material. The nature and properties of soil have been determined by the physical, chemical, and biological processes that result from the interaction of five factors - climate, living organisms, parent material, topography, and time. The influence of any one of these factors varies from one location to another, but the interaction of all the factors determines the kind of soil that forms.

During the last million years or so, the soils in this survey area have undergone dynamic changes. Volcanos have erupted, streams have eroded the earth's surface and transported sediment to low-lying areas, eolian sediment has been deposited, climate changes have occurred, and the kinds of living organisms that inhabit the area have changed. These events have greatly influenced the properties of the soils in the area (Hawley, 1975).

Factors of Soil Formation

This section describes the five factors that affect soil formation in the survey area and discusses the major soil-forming processes: climate, living organisms, parent material, topography, and time.

Climate

Climate has a profound influence on soil formation. Moisture and temperature directly affect the kind of vegetation that can grow, the rate at which organic matter accumulates and decomposes, and the rates at which minerals weather. Moisture and temperature also affect the rate at which the weathered minerals accumulate in, or are removed from, some soil horizons.

Precipitation is distributed in winter snow and rain and in high-intensity summer thunderstorms that move in from the Pacific or Gulf of California, usually in July, August and September. Winters in most of the survey area are cold and receive a moderate amount of precipitation, especially snow at the higher elevations (Green and Sellars, 1964). The lower elevations, such as the Colorado River gorge and the lower House Rock Valley and Page areas, are cool in the winters and receive less rainfall and snow. Summers are warm, especially in the lower elevations. Spring is usually the driest season, and strong winds may occur from March through June. The relative humidity generally is low in the summer and moderate in the winter (Cooley, 1962). All the soils in the survey area have a mesic soil temperature regime (USDA, 1975).

The survey area has four major climatic zones that influence soil formation and vegetation type: (a) areas that have an average annual precipitation of 6 to 10 inches, an average annual air temperature of 55 to 57 degrees F., a frost-free period of 165 to 180 days, elevations of 3,600 to 4,400 feet, and sparse desert shrub-grassland-cacti vegetation; (b) areas that have an average annual precipitation of 7 to 11 inches, an average annual air temperature of 55 to 57 degrees F., a frost-free period of about 164 to 180 days, elevations of 3,500 to 5,500 feet, and sparse desert shrub-grassland-cacti vegetation; (c) areas that have an average annual precipitation of 10 to 14 inches, an average annual air temperature of 52 to 55 degrees F., a frost-free period of about 150 to 165 days, elevations of 4,000 to 6,600 feet, and pinyon-juniper and grassland vegetation; and (d) areas that have an average annual precipitation of 14 to 18 inches, an average annual air temperature of 48 to 52 degrees F., a frost-free period of 135 to 150 days, elevations of 5,800 to 6,600 feet, and pinyon-juniper woodland vegetation (Green and Sellars, 1964; Lowe, 1980).

The 6- to 10-inch precipitation zone includes the Page area and the lower Paria River gorge and the Colorado River gorge. Soils in this zone have a Typic Aridic soil moisture regime and have less than 1 percent organic matter. Examples of soils that formed in this zone are the Pagina and Wahweap.

The 7- to 11-inch precipitation zone includes the lower House Rock Valley and the Fredonia-Johnson Wash area. Soils in this zone have an aridic or torric soil moisture regime and are low in organic matter content. The surface layer of these soils is influenced

by some eolian deposition. Examples of soils that formed in this zone are the Jocity, Glenyon, and Monue.

The 10- to 14-inch precipitation zone is characterized by soils that have an ustic aridic moisture regime (an aridic or torric soil moisture regime that borders on an ustic moisture regime). The organic matter is usually more than 1 percent in the thin A horizon of these grassland soils. The soils in this zone are usually on older surfaces that have argillic, cambic, or calcic horizons. Examples are Curhollow, Keeseha, Mellenthin, and Strych soils.

The 14- to 18-inch precipitation zone has an ustic soil moisture regime. Because of the increased precipitation, the plant community of the soils in this zone is composed mostly of pinyon, Utah juniper, and grasses. Examples of soils in this zone are Disterheff, Houserock, and Yumtheska soils.

Living Organisms

Living organisms, particularly plants, have a significant influence on soil formation and soil surface stability and influence physical and chemical soil properties. Decaying plant material, such as fibrous grass roots, is the main source of organic matter in soils. Other contributors include surface litter and dieback of annual plant growth. Root activity increases the porosity and structure of the soil, directly affecting the movement of water down through the profile. Dieback of large plants that have tap roots, such as pinyon-Utah juniper or big sagebrush, promotes deep penetration of water. Plants of all sizes intercept precipitation, reduce soil erosion, trap sediment, and help to aerate the soils. Soil-stabilizing algae, mosses, and lichens (cryptogams) can protect the soil surface from wind and water erosion by providing a protective cover. This cover, however, is easily damaged by off-road vehicles and other surface disturbances, leading to rapid erosion (Anderson, et. al., 1982).

Roots and surface litter affect the movement of minerals and nutrients into the soil. For example, precipitation moving through pinyon-juniper litter is slightly more acidic than precipitation infiltrating a grassland or sagebrush cover. Temperatures below a shady juniper or pinyon tree are markedly lower than in an open grassland, decreasing the rate of evaporation. This vegetative-induced microclimate in areas having the pinyon and Utah juniper tree canopy also reduces raindrop impact, thus promoting soil surface structure and development (Anderson, et. al., 1982).

Animals influence soil formation by contributing and synthesizing organic matter. Vertebrate animals, such as rodents, gophers, ground squirrels, and badgers, turn and mix the soil material while feeding and foraging. Invertebrates, such as insects, earthworms, and micro-organisms, synthesize organic matter. The number of invertebrates in the soil depends on the content of organic matter and moisture. Earthworms and other fauna are scarce in this area because low organic matter content, low soil moisture, and abundant carbonates and gypsum do not support their populations (Alexander, 1962).

Accumulated plant remains and organic matter in alluvial deposits provide soils with varying amounts of organic matter. In the 6- to 10-inch and 7- to 11-inch precipitation zones, plant residues have accumulated slowly and dissipated rapidly because of warm soil temperatures. The 10- to 14-inch precipitation zone, which is higher in elevation, has a denser vegetative cover and is cooler and wetter during the growing season, thus producing more surface organic material.

The Mellenthin soils southeast of Fredonia have a light-colored surface horizon and are low in organic matter. However, further upslope on the Buckskin Mountains, precipitation and vegetation increase. Mellenthin soils grade into Yumtheska soils which have a higher, darker, and richer organic matter content in the surface horizon.

Coppice dunes are common in level areas where vegetation is sparse and winds are strong. These dunes are eolian deposits that have accumulated and stabilized around the base of shrubs and grasses because of their tenacious roots and the protective plant cover they provide (Hawley, 1975).

Parent Material

This section describes the ancestral drainage patterns and the paleoclimate in the survey area. It also discusses soil parent material sources (geologic formations) and the mechanisms for sediment transportation (Cooley, 1962; Hamblin and Best, 1970).

The Colorado River serves as the local base level for the survey area. Kanab Creek is the major tributary and drainageway for the western part of the survey area. Permian, Triassic, and Jurassic marine regressions and transgressions caused major sedimentary and some eolian deposition and varied erosional dissection 140 to 330 million years ago. Later, (Laramide Orogeny or Cretaceous-Early Tertiary age) according to local theory and geologic evidence, the "mountain building" Colorado Plateau Uplift occurred. The folding and faulting associated with it created such features as the Kaibab Plateau Uplift. An ancestral river east of the Kaibab uplift

flowed in a south-southeasterly direction on a gentle gradient from Utah through northwestern Arizona into New Mexico, roughly along the present-day northwardly flow of the Little Colorado River. According to historical geologists the flow filled a large lake in late Tertiary called Bidahochi, finally spilling into the Rio Grande system and into the Gulf of Mexico (Cooley, 1969; Hamblin and Best, 1970; McKee, 1967).

On the west side of the Kaibab Plateau Uplift, another lower ancestral drainage system called the Hualapai drained to the Pacific (Gulf of California). It follows roughly the route of today's Colorado River along the western Arizona state line. Geologic evidence indicates that the Gulf of California extended as far north as Lake Mead in Miocene time and certainly extended north to Bullhead City as late as Pliocene time (Nations and Stump, 1981).

In late Tertiary time, some 10 million years ago, the ancestral Hualapai Drainage (or present-day Colorado River) began gradually to cut its canyon eastward into the Kaibab Uplift by headward erosion (today's Grand Canyon). The process continued until finally, 6 to 8 million years ago, the Hualapai Drainage captured the Little Colorado River, which was flowing southward on the east side of the Kaibab Uplift, and reversed its flow to northward at that nick point junction after the headward erosion was completed. The base level of the Little Colorado River was lowered at this nick point, causing later headward erosion seen today in the Little Colorado River Drainage System and upper Colorado River Drainage System. Base level may be lowered by a change in the drainage pattern as a result of erosion through a barrier (lava flow, landslide, drainage divide). When rejuvenation occurs, the stream pattern often remains the same, except that the canyons become narrow, steep walled, and V-shaped again (Gregory, 1947; Hamblin and Best, 1970).

Other geologic studies have helped support the argument that the Colorado Plateau and such features on it as the Kaibab Uplift were there since at least Oligocene time (some 50 million years ago), prior to the drastic and rapid downcutting of the Grand Canyon. The rate of incision has slowed substantially during the last million years (Nations and Stump, 1981). When the Little Colorado River reversed its direction, it drained Lake Bidahochi, leaving behind swampy areas and deposits of Pliocene lacustrine sediments called the Bidahochi Formation. These can be seen in the Hopi Buttes area north of Winslow and Holbrook (Cooley, 1962; Cooley, 1969). Other substantiating evidence supporting the relative youth of the Colorado River includes the occurrence of middle and late Tertiary fluvial and lacustrine sediments in the Colorado River drainage systems in the Western Grand Canyon area known as the Muddy Creek Formation. The absence of Laramide-age sediments seems to indicate that the Colorado River was not flowing there until after the Kaibab Uplift occurred (Nations and Stump, 1981).

Tectonics and volcanism have been major factors influencing erosion and deposition on a regional scale. However, cyclic change in the paleoclimate, affected by Quaternary glaciations and interglaciations in adjacent mountains, has been the main factor controlling depositional processes in individual basins and river valley segments. These alluvial deposits reflect cyclic shifts in hydrologic regimes and related changes in vegetation caused by the sudden changes in climate (Howard, 1968).

Glacial melting corresponds with episodes of increased river discharge, entrenchment of major valleys, and flooding. Aridity increased during the transition from glacial to interglacial periods. This resulted in less plant cover and in widespread erosion and sedimentation during infrequent thunderstorm-runoff events (Hack, 1941). Aerial deflation and subsequent eolian deposition affected large areas, particularly those areas lacking good plant cover. Calcareous dust was blown about freely throughout the area. (USDA, 1983).

The survey area is within the Grand Canyon section of the Colorado Plateau physiographic and geologic province. Included on the Colorado Plateau in this survey are several geographic landform breaks: the Paria Plateau and Page area, House Rock Valley-Marble Canyon area, north part of the Kaibab Plateau Uplift (Buckskin Mountain area), and the Fredonia area. The entire survey area is generally a stepped-plateau landform made up of escarpments, monoclines, structural benches, and bedrock-controlled pediment slopes, all having a mostly thin-mantle of soil alluvium over bedrock of varying types.

The geologic history of the survey area is recorded by outcropping of rocks that span an interval of about 140 to 330 million years. The oldest rocks are of Mississipian age and are of minor extent in the area (Redwall Limestone) located in the bottom of the Colorado River gorge. The Supai, Hermit, Coconino, Toroweap, and Kaibab Formations (Permian age) are found mostly in the Colorado River, Kanab Creek, and their tributary gorges and canyons. During the Permian time, the sea covered much of Arizona, with numerous regressions and transgressions of alternating marine and non-marine formations. Depositional phases include fossiliferous limestones, fine marine lacustrine shales and

siltstones, eolian sands, and evaporites (Gregory, 1947; Moore, et. al., 1960). The Kaibab Limestone is a significant formation in the survey area. Formation began during an early marine transgression and then stopped in the late Permian time when the regional uplift began (Christensen and Dean, 1983). Calciorthids and Calciustolls, such as the Mellenthin, Strych, and Yumtheska soil series, formed in Kaibab Limestone alluvium (USDA, 1975). An unknown thickness of post-Kaibab sedimentary strata (since eroded away) has left thin deposits of chert and limestone-sandstone-pebble conglomerates in erosion-low areas (Christensen and Dean, 1983). Other evidence consists of Permian fusulinids (fossils) in detrial chert of the Triassic age conglomerates resting on the uplifted and eroded surface of the Kaibab Limestone Monocline Uplift (Nations and Stump, 1981).

During the Triassic Period, sediment was deposited under the influence of a near-shore continental environment. The Moenkopi Formation, which consists of locally gypsiferous mudstone, shale, siltstone, sandstone, and subordinate amounts of limestone, is common in the Fredonia and House Rock Valley-Marble Canyon-Vermilion Cliffs areas (Lynch, 1982). It must be noted that a major Pre-Moenkopi and a Post-Moenkopi unconformity existed. The Pre-Moenkopi unconformity hiatus represents tens of millions of years, marking the break between two eras which separate the Moenkopi Formation and the underlying Kaibab Limestone by expressed irregular surface erosion developed on top of the Kaibab. The Post Moenkopi unconformity hiatus is also a wavy irregular erosional surface (exact age unknown), of regional extent between the Chinle (above) and the weak Upper Red Member of the Moenkopi Formation. The Moenkopi Formation consists of six major members: (a) the older Timpoweap, (b) Lower Red, (c) Virgin Limestone, (d) Middle Red, (e) Shnabkaib, and (f) the youngest Upper Red Members. Erosion subsequently removed the Moenkopi Formation in some parts of the survey area (Buckskin Mountain on the Kaibab Plateau) (Hamblin and Best, 1970).

The main soils found in the Moenkopi alluvium are Torrifluvents (USDA, 1975), such as the Clayhole soils.

The erosion-resistant Shinarump Conglomerate Member is usually the distinctive caprock unit resting over the Moenkopi Formation. This unit consists of fine-grained sandstone and has some well rounded, well sorted quartz pebbles that average less than 1 inch in diameter and locally abundant petrified wood mineralized with yellow carnotite and other uranium minerals. The thickness generally ranges from 5 to 160 feet (Hintze, n.d.). Bidonia soils are formed in alluvium from this unit.

The Petrified Forest Member (sometimes referred to as the "Chinle" or "Painted Desert" formation) is a member of the Chinle Formation and is composed of distinct and varied claystones, shales, and minor interbedded sandstones, conglomerates, and finely fractured bentonitic material which weathers quite rapidly. Its most distinctive characteristic is its variable colors of green, blue, gray, pink, and brown as evidenced in the Painted Desert-Petrified Forest National Park area of northern Arizona. Portions of the Keeseha soils are derived from this geologic member (Hamblin and Best, 1970).

The Kayenta, Navajo, and Moenave formations are the younger Triassic sediments of the Glen Canyon Group. The Navajo Sandstone of the late Jurassic is the predominant formation of the Paria Plateau top. The Arches and Pensom series are soils formed on the Paria Plateau from the Navajo Sandstone. In parts of the Paria Plateau and Page area are the predominant Carmel Formation and the Entrada Sandstone of the San Raphail Group of the mid Jurassic Period (Alberding, n.d.; Moore, et. al., 1960). Soil formed in the alluvium are the Needle, Pagina, Sheppard, and Wahweap series.

Virtually no Cretaceous-age or younger geologic units occur in the survey area because long-term erosion has removed it. No volcanics or associated alluvium occur in this survey area (Lynch, 1982). Only sedimentary rock from marine and non-marine transgressions and regressions of the late Palezoic and Mesozoic era age mentioned above occur in this survey area. The geomorphic surfaces of the weathered alluvium are mainly of Quaternary age.

Topography and Time

Each major landform in the survey area represents an episode of landscape development in terms of geomorphic surface age and soil development. These landforms and their associated soils on each surface are described in the following paragraphs.

Floodplains

These Holocene landforms developed in alluvial material from varying parent materials deposited by graded channels of small drainageways (washes, arroyos, and creeks) to large drainages such as the Colorado and Paria Rivers and their major tributaries. Floodplains are characterized by low, undulating bar and channel topography that resulted from periodic floods. Each flood caused rapid changes in the

landscape. New channels were cut as older channels were abandoned, and new stratified alluvium was deposited as floodwaters receded (Hawley and Parsons, 1984). The extensive watershed is capable of supplying large amounts of high velocity floodwater sometimes called "flash floods," especially in the "slick rock" country where rock outcrop and low soil density areas produce extra runoff in the narrow canyons and gorges. Some small areas have been partially abandoned as a floodplain but are still subject to rare flooding. Soils formed in the stream deposits on the floodplain include Torrifulvents. A typical soil on floodplains is Jocity. These young soils formed in loamy sediment. They have an irregular decrease in organic carbon content as depth increases. As long as soils on floodplains continue to receive fresh alluvium, soil formation is inhibited.

Stream Terraces

These Holocene landforms are abandoned floodplains that were formed before downward head-cutting erosion (channelization) probably within the last several thousand years in most areas such as the Johnson Wash area (fig. 15). Stream terraces are no longer subject to normal overflow but may flood in rare 50- or 100-year floods (Hawley and Parsons, 1984). Stream terraces may still receive some increments of fresh alluvium if intense and continuous rainfall causes sheet flooding or surface ponding. The alluvial deposits in these areas commonly are stratified. A typical soil on stream terraces is the Manikan soil.

Alluvial Fans

These Holocene landforms are part of broad (but mostly small scale) coalescent plains or fans covered by alluvial material. Alluvial deposits consist of diverse combinations of sand, silt, clay, and rock fragments, depending on the parent material of the nearby geologic sedimentary rock formations, such as the Moenkopi Shale, Kaibab Limestone, or Navajo Sandstone. The topography of this active landscape is characterized by numerous braided streams and shallow channels. During periods of flooding, the mostly small, shallow channels do not have the capacity to carry the runoff; consequently, the excess water overflows the channels and alluvium is spread across the surface (Hawley and Parsons, 1984). Periods of flooding are rare, but they are sometimes violent. In some areas, such as around Fredonia, leveling for irrigated farming and urban development has modified the original topography. Because soil

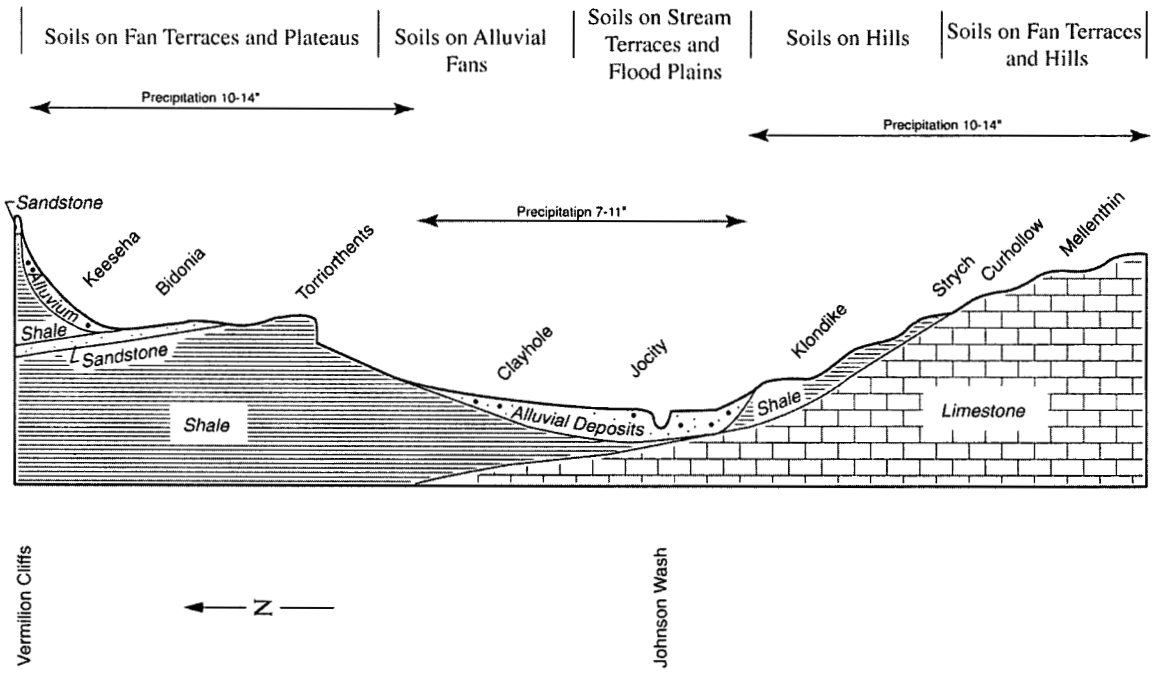

Figure 15.—Idealized soil landscape profile of the Johnson Wash area.

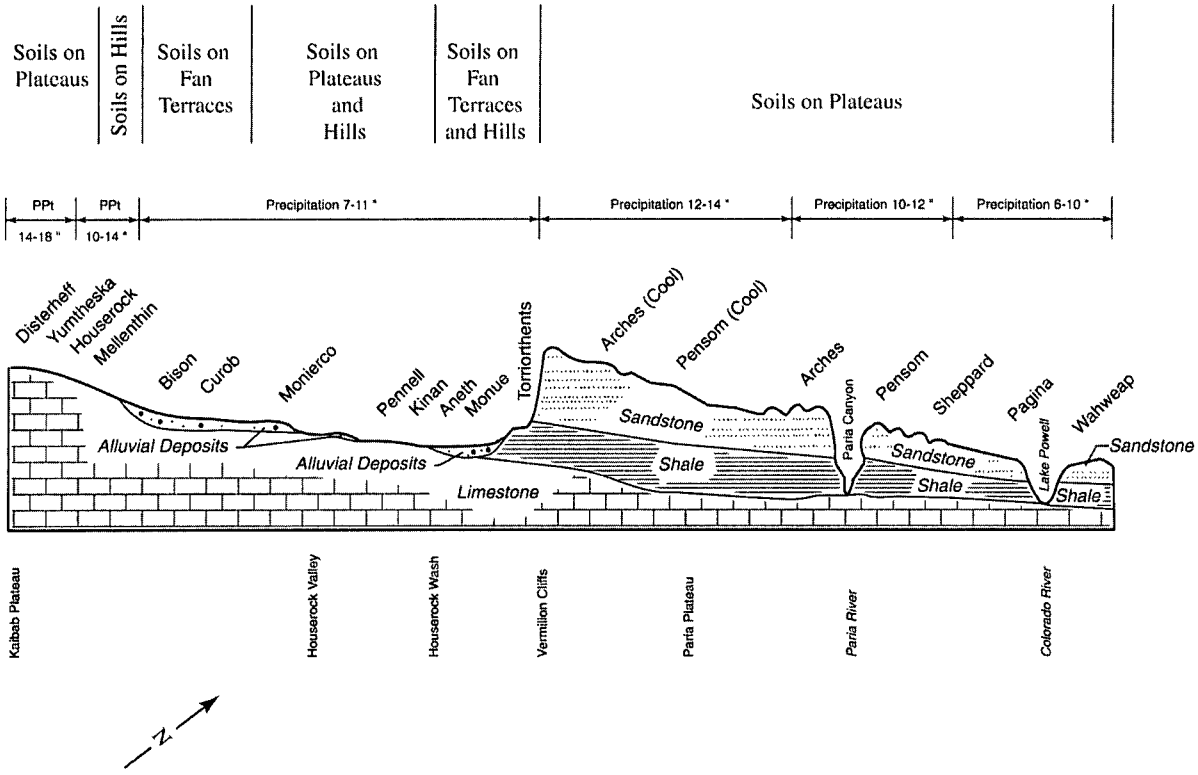

Figure 16.—Idealized soil landscape profile of the Houserock Valley-Paria Plateau area.

formation has not begun, only a limited amount of carbonates and gypsum (soluble salts), has been transferred within the calcareous or gypsiferous parent material. In areas adjacent to major drainages, such as Johnson Wash, White Sage Wash, House Rock Wash, or Emmeth Wash, the alluvial fans grade to stream terraces and floodplains of similar Holocene age. The Clayhole series is representative of soils on alluvial fans. These soils are usually highly stratified, calcareous, and gypsiferous throughout indicating lack of soil development. The organic matter content decreases irregularly with depth in these soils. They are classified as Torrifluvents.

Fan Terraces

These landforms are characterized by broad coalescent plains that have been incised by streams (Hawley and Parsons, 1984). They are late Pleistocene or older. Local relief and the amount of dissection are variable. These surfaces were formed during multiple episodes of incision and backfilling. The particle-size distribution and mineralogy of the alluvial deposits are diverse. The lithology of the hills and varying erodibility of geologic rock outcrop areas above the valley influence the original nature of the soil parent material.

The kinds of soils that formed on fan terraces are related to the amount of clay-sized particles, rock fragments, and secondary carbonates, gypsum, and some silica inherited from alluvial and eolian deposits. In the Kaibab Limestone alluvium, where cementing agents such as carbonates and some silica are abundant, sufficient time has elapsed for cemented pans to have developed.

Representative soils on the younger geomorphic fan terrace surfaces are the Aneth and Monue soils usually associated with Holocene and late Pleistocene entrenchment. Higher and older terraces are associated with episodes that are at least as old as mid-Pleistocene or slightly older. Typically, incision

of the higher fan terraces produces undulating, sometimes steep side slopes that are as young as the stream channel truncating them. Most fan terraces in the survey area are over bedrock within a depth of 6 feet. Geomorphic surfaces tend to converge toward the center of the valley. The result is diminishing and less prominent escarpments between the lower fan terraces near the alluvial source (plateau escarpments and exposed rock outcrops). Typically, these soils have a more developed, clayey argillic horizon, or have a strongly cemented and continuous petrocalcic horizon. Kaibab Limestone is the main source of alluvium for some of these older soils, such as Curhollow and Strych, on the higher fan terraces. The accumulation of some soluble silica combined with the high amount of carbonates has resulted in the development of indurated, lime-cemented pan in some of these soils, usually within 6 feet of some type of bedrock, particularly Kaibab Limestone. Soils that have a moderate to strongly lime-cemented hardpan are usually on the stable top or upper part of these fan terrace landforms.

Plateaus and Mesas

Plateaus are extensive, gently sloping to undulating plains. Mesas are isolated tablelands. More specifically, a plateau is an extensive upland mass having a relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands, and is separated from them on one or more sides by escarpments. A comparatively large part of a plateau surface is near summit level (Hawley and Parsons, 1984). A classic example is the Paria Plateau, which is relatively flat but does have a slight downward dip to the north (fig. 16). The scenic Vermilion Cliffs is the escarpment around the plateau. Mesas are broad, nearly flat-topped upland masses that have summit widths less than the escarpment height. All of these landforms have a resistant cap rock that is essentially horizontal. Most areas consist of old erosional surfaces that have a thin mantle of alluvial and eolian deposits over bedrock, such as the sand on the Paria Plateau, which is weathered from the Navajo Sandstone cap rock. Examples of these landforms can be found on the Paria Plateau and Page areas. Age is mid-Pleistocene or older. Representative soils on these landforms are the Arches, Pensom, Needle, and Sheppard.

Hills

These landforms are characterized by undulating to moderately steep Pleistocene landscapes with occasional steep Holocene landforms. These landforms are remnants of formerly extensive plains, plateaus, or geologic formations (sedimentary) that have been dissected to form narrow, stable summits and steep hills. Hills consist of the area below the summit and include the moderately steep backslopes typically less than 30 percent, but can be as much as 90 percent (Hawley and Parsons, 1984). Representative hill landforms are at the base of the Vermilion Cliffs in House Rock Valley and east of Fredonia. Most soils on hills are less than 40 inches deep to bedrock. The parent material includes limestone, shales and claystones, sandstone, and sandstone conglomerates of varying composition and fragment sizes. Typical soils on hills include Mellenthin and Pennell series. The series are less than 20 inches to bedrock, and the parent material is from the Kaibab limestone.

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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 cone. The material washed down the sides of mountains and hills by ephemeral streams and deposited at the mouth of gorges in the form of a moderately steep, conical mass descending equally in all directions from the point of issue.

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.

Alpha,alpha-dipyridyl. A dye that when dissolved in 1N ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction indicates a type of redoximorphic feature.

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.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

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.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Arroyo. The flat-floored channel of an ephemeral stream, commonly with very steep to vertical banks cut in alluvium.

Aspect. The direction in which a slope faces.

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 2.5
Low	2.5 to 5.0
Moderate	5.0 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.

Bajada. A broad alluvial slope extending from the base of a mountain range out into a basin and formed by coalescence of separate alluvial fans.

Basal area. The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

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.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bedrock-controlled topography. A landscape where the configuration and relief of the landforms are determined or strongly influenced by the underlying bedrock.

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.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Blowout. A shallow depression from which all or most of the soil material has been removed by 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.

Broad-base terrace. A ridge-type terrace built to control erosion by diverting runoff along the contour at a nonscouring velocity. The terrace is 10 to 20 inches high and 15 to 30 feet wide and has gently sloping sides, a rounded crown, and a dish-shaped channel along the upper side. It may be nearly level or have a grade toward one or both ends.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Breast height. An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or 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.

Cable yarding. A method of moving felled trees to a nearby central area for transport to a processing facility. Most cable yarding systems involve use of a drum, a pole, and wire cables in an arrangement similar to that of a rod and reel used for fishing. To reduce friction and soil disturbance, felled trees generally are reeled in while one end is lifted or the entire log is suspended.

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 directly beneath the solum, or it is exposed at the surface by erosion.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

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.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent

material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Channery soil material. Soil material that is, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) 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.

Cirque. A semicircular, concave, bowllike area that has steep faces primarily resulting from glacial ice and snow abrasion.

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 depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse 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.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

Colluvium. Soil material or 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.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

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 effects of 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. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

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.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

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.

Cropping system. Growing crops according to a planned system of rotation and management practices.

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.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cuesta. A hill or ridge that has a gentle slope on one side and a steep slope on the other; specifically, an asymmetric, homoclinal ridge capped by resistant rock layers of slight or moderate dip.

Culmination of the mean annual increment (CMAI). The average annual increase per acre in the volume of a stand. Computed by dividing the total volume of the stand by its age. As the stand increases in age, the mean annual increment continues to increase until mortality begins to reduce the rate of increase. The point where the stand reaches its maximum annual rate of growth is called the culmination of the mean annual increment.

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.

Delta. A body of alluvium having a surface that is nearly flat and fan shaped; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

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 sediments or that remains after finer particles have been removed by running water or the wind.

Dip slope. A slope of the land surface, roughly determined by and approximately conforming to the dip of the underlying bedrock.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming. A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human

activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained.* These classes are defined in the "Soil Survey Manual."

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.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Dune. A mound, ridge, or hill of loose, windblown granular material (generally sand), either bare or covered with vegetation.

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.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

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.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of 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.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

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.

Esker. A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess sulfur (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

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.*

Fill slope. A sloping surface consisting of excavated

soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, or clay.

Firebreak. Area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has 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.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (300 meters) and fringes a mountain range or high-plateau escarpment.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

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.

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 35 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. Water filling all the unblocked pores of the 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 bedrock. Bedrock 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.

Head out. To form a flower head.

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 potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

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.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

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.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

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.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

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.

Marl. An earthy, unconsolidated deposit consisting chiefly of calcium carbonate mixed with clay in approximately equal amounts.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

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.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

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. 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. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

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 that has hue of 10YR, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

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.

Observed rooting depth. Depth to which roots have been observed to penetrate.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

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.*

Paralithic contact. A boundary between soil and continuous coherent underlying material. Partially weathered bedrock.

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.

Pedisediment. A thin layer of alluvial material that mantles an erosion surface and has been transported to its present position from higher lying areas of the erosion surface.

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 affects the specified use.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as "saturated hydraulic conductivity," which is defined in the "Soil Survey Manual." In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms describing

permeability, measured in inches per hour, are as follows:

Extremely slow	0.0 to 0.01 inch
Very slow	0.01 to 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 flooding.

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 or very rapid permeability, 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.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Potential native plant community. See Climax plant community.

Potential 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.

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. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

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.

P.z. Abbreviation for "precipitation zone" used in range site names.

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.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a

soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
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

Red beds. Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

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 growth of plants. A saline soil does not contain excess exchangeable sodium.

Salinity. The degree to which a soil is affected by soluble salt, measured in decisiemens per meter (dS/M), which means the same as millimhos per centimeter (mmhos/cm).

Nonsaline	0 to 2
Very slight or very slightly saline	2 to 4
Slight or slightly saline	4 to 8
Moderate or moderately saline	8 to16
Strong or strongly saline	more than 16

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.

Saprolite. Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

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. 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.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Sinkhole. A depression in the landscape where limestone has been dissolved.

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 high in soluble salts and sodium. The surface is impermeable to moisture and subject to ponding for short periods.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use. In this survey, the following classes are recognized:

Nearly level	0 to 3 percent
Gently sloping or undulating	3 to 7 percent
Strongly sloping or rolling	7 to 15 percent
Moderately steep or hilly	15 to 25 percent
Steep	25 to 55 percent
Very steep	55 percent and higher

Sloughed till. Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.

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

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

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, in millimeters, of separates 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 material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of rock 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.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind 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. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus. Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes.

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. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material 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.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Tuff. A compacted deposit that is 50 percent or more volcanic ash and dust.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland. 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.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

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.

Windthrow. The uprooting and tipping over of trees by the wind.

Tables

Table 1.--Temperature and Precipitation

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average daily	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	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
Recorded in the period 1951-75 at Fredonia Station, Arizona											
January----	46.4	18.4	32.4	66	-8	21	1.15	0.24	1.86	3	7.1
February---	52.7	20.9	36.8	71	0	59	.83	---	1.42	2	2.5
March------	59.0	25.3	42.2	78	8	134	.91	.05	1.56	2	4.5
April------	67.2	31.1	49.2	84	17	287	.61	.05	1.03	2	1.3
May--------	77.5	38.1	57.8	93	22	552	.49	.04	.82	2	.0
June-------	87.4	45.9	66.7	102	31	801	.33	---	.57	1	.0
July-------	93.7	54.7	74.2	102	41	1,060	.78	.23	1.21	3	.0
August-----	90.8	53.8	72.3	101	39	1,001	1.24	.42	1.90	4	.0
September--	84.3	44.7	64.5	96	29	735	.73	---	1.25	2	.0
October----	73.1	34.8	54.0	88	18	434	.76	.06	1.28	2	.1
November---	57.9	25.8	41.9	73	9	117	.94	.44	1.37	3	1.4
December---	47.5	18.9	33.2	64	-7	32	.88	.21	1.41	3	4.8
Yearly:											
Average--	69.8	34.4	52.1	---	---	---	---	---	---	---	---
Extreme--	---	---	---	104	-9	---	---	---	---	---	---
Total----	---	---	---	---	---	5,233	9.65	7.03	12.05	29	21.7
Recorded in the period 1958-81 at Page Station, Arizona											
January----	42.3	23.7	33.0	61	7	51	0.47	0.02	0.81	2	2.1
February---	50.8	30.2	40.5	68	16	109	.45	.07	.74	2	.8
March------	58.6	35.9	47.3	78	22	256	.71	.15	1.15	2	.1
April------	68.7	43.5	56.1	86	29	483	.33	.05	.53	1	.0
May--------	79.6	52.8	66.2	95	36	812	.45	.02	.75	1	.0
June-------	91.0	62.6	76.8	104	48	1,104	.19	---	.34	1	.0
July-------	96.8	69.3	83.1	105	60	1,336	.43	.12	.67	1	.0
August-----	93.8	66.9	80.4	104	56	1,252	.62	.19	.98	2	.0
September--	84.9	58.5	71.7	98	44	951	.56	.12	.91	2	.0
October----	71.4	46.9	59.2	89	29	595	.79	.09	1.32	2	.0
November---	55.6	35.1	45.4	72	21	176	.55	.15	.87	2	.6
December---	44.2	25.7	35.0	61	11	78	.64	---	1.10	2	2.4
Yearly:											
Average--	69.8	45.9	57.9	---	---	---	---	---	---	---	---
Extreme--	---	---	---	106	5	---	---	---	---	---	---
Total----	---	---	---	---	---	7,205	6.19	4.36	7.88	20	6.0

* 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

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Recorded in the period 1951-75 at Fredonia Station, Arizona			
Last freezing temperature in spring:			
1 year in 10 later than--	May 16	May 28	June 10
2 years in 10 later than--	May 9	May 22	June 4
5 years in 10 later than--	Apr. 26	May 11	May 24
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 9	Sept. 27	Sept. 14
2 years in 10 earlier than--	Oct. 14	Oct. 3	Sept. 20
5 years in 10 earlier than--	Oct. 23	Oct. 14	Oct. 1
Recorded in the period 1958-81 at Page Station, Arizona			
Last freezing temperature in spring:			
1 year in 10 later than--	Mar. 23	Apr. 11	Apr. 30
2 years in 10 later than--	Mar. 12	Apr. 2	Apr. 22
5 years in 10 later than--	Feb. 20	Mar. 17	Apr. 7
First freezing temperature in fall:			
1 year in 10 earlier than--	Nov. 15	Nov. 4	Oct. 24
2 years in 10 earlier than--	Nov. 20	Nov. 10	Oct. 30
5 years in 10 earlier than--	Nov. 29	Nov. 20	Nov. 9

Table 3.--Growing Season

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
Recorded in the period 1956-78 at Fredonia Station, Arizona			
9 years in 10	154	135	105
8 years in 10	163	142	113
5 years in 10	180	155	129
2 years in 10	197	169	145
1 year in 10	206	176	154
Recorded in the period 1958-81 at Page Station. Arizona			
9 years in 10	243	218	183
8 years in 10	256	228	194
5 years in 10	282	247	215
2 years in 10	313	265	236
1 year in 10	341	275	247

Table 4.--Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
1	Aneth fine sand, 2 to 16 percent slopes	22,135	3.0
2	Arches-Pensom complex, 4 to 12 percent slopes	141,883	19.2
3	Arches-Pensom complex, cool, 4 to 12 percent slopes	30,736	4.2
4	Barx gravelly loam, 1 to 6 percent slopes	13,080	1.8
5	Barx-Pensom complex, 1 to 6 percent slopes	1,300	0.2
6	Bidonia-Rock outcrop complex, 1 to 15 percent slopes	3,094	0.4
7	Bison-Curob complex, 2 to 6 percent slopes	10,176	1.4
8	Clayhole silty clay loam, 1 to 5 percent slopes	9,479	1.3
9	Clayhole-Torriorthents complex, 2 to 25 percent slopes	4,481	0.6
10	Curhollow-Mellenthin complex, 2 to 12 percent slopes	81,935	11.1
11	Curob loamy sand, 2 to 10 percent slopes	304	*
12	Curob very gravelly loam, 2 to 12 percent slopes	12,539	1.7
13	Disterheff very gravelly loam, 2 to 15 percent slopes	4,025	0.5
14	Disterheff-Houserock complex, 3 to 15 percent slopes	2,120	0.3
15	Doak fine sandy loam, 1 to 6 percent slopes	204	*
16	Glenyon silty clay loam, 0 to 2 percent slopes	3,502	0.5
17	Houserock-Disterheff complex, 3 to 15 percent slopes	2,753	0.4
18	Jocity clay loam, 1 to 3 percent slopes	1,099	0.1
19	Jocity silty clay loam, 1 to 3 percent slopes	10,599	1.4
20	Keeseha loam, 1 to 6 percent slopes	1,297	0.2
21	Kinan-Pennell complex, 4 to 15 percent slopes	30,723	4.2
22	Kinan-Pennell complex, dry, 4 to 15 percent slopes	1,020	0.1
23	Klondike sandy clay loam, 2 to 15 percent slopes	11,389	1.5
24	Manikan silty clay loam, 1 to 3 percent slopes	3,500	0.5
25	Mellenthin very gravelly loam, 1 to 25 percent slopes	28,138	3.8
26	Mellenthin very gravelly loam, 30 to 60 percent slopes	15,113	2.0
27	Monierco clay loam, 2 to 15 percent slopes	1,682	0.2
28	Monue sandy loam, 1 to 6 percent slopes	3,596	0.5
29	Monue-Seeg complex, 1 to 6 percent slopes	13,543	1.8
30	Needle-Rock outcrop complex, 4 to 15 percent slopes	1,960	0.3
31	Needle-Sheppard complex, 2 to 12 percent slopes	6,541	0.9
32	Pagina loamy sand, 1 to 3 percent slopes	464	0.1
33	Pagina-Wahweap complex, 3 to 16 percent slopes	28,270	3.8
34	Pennell cobbly loam, 3 to 10 percent slopes	9,459	1.3
35	Pennell gravelly sandy loam, 20 to 45 percent slopes	5,753	0.8
36	Pennell sandy loam, 20 to 45 percent slopes	670	0.1
37	Pensom fine sand, 2 to 16 percent slopes	19,988	2.7
38	Pensom-Arches complex, 4 to 12 percent slopes	3,600	0.5
39	Pensom-Arches complex, moist, 4 to 16 percent slopes	4,990	0.7
40	Pits, borrow	1,138	0.2
41	Rock outcrop	33,380	4.5
42	Rock outcrop-Needle complex, 4 to 50 percent slopes	9,740	1.3
43	Rock outcrop-Torriorthents complex, warm, 25 to 65 percent slopes	20,939	2.8
44	Sheppard loamy fine sand, 1 to 5 percent slopes	2,186	0.3
45	Sheppard loamy fine sand, 5 to 15 percent slopes	15,235	2.1
46	Strych loam, 1 to 4 percent slopes	15,192	2.1
47	Torriorthents, 3 to 50 percent slopes	10,261	1.4
48	Torriorthents-Rock outcrop complex, 25 to 65 percent slopes	47,234	6.4
49	Wahweap loamy sand, 0 to 5 percent slopes	1,805	0.2
50	Wahweap-Rock outcrop complex, 1 to 15 percent slopes	361	*
51	Yumtheska very gravelly loam, 4 to 30 percent slopes	22,975	3.1
52	Yumtheska-Houserock association, 4 to 20 percent slopes	5,391	0.7
w	Water	6,073	0.8
	Total	739,050	100.0

* Less than 0.1 percent.

Table 5.--Rangeland Productivity and Characteristic Plant Communities

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
1---------- Aneth	Sandy Upland 7-11" p.z.-------	Favorable	700	Bottlebrush squirreltail------	10
		Normal	500	Galleta----------	5
		Unfavorable	300	Indian ricegrass----------	25
				Fourwing saltbush----------	5
				Mormon tea----------	10
				Sand sagebrush----------	10
				Other perennial grasses-------	15
				Other perennial forbs---------	5
				Needlegrass----------	15
2* 3*: Arches.					
Pensom----------	Sandy Upland 10-14" p.z.------	Favorable	700	Black grama----------	10
		Normal	500	Needleandthread----------	10
		Unfavorable	300	Dropseed----------	5
				Galleta----------	5
				Indian ricegrass----------	20
				Blue grama----------	5
				Other perennial grasses-------	5
				Other perennial forbs---------	5
				Sand sagebrush----------	5
				Fourwing saltbush----------	5
				Winterfat----------	5
				Mormon tea----------	5
				Other shrubs----------	10
4---------- Barx	Loamy Upland 10-14" p.z.------	Favorable	1000	Blue grama----------	20
		Normal	750	Galleta----------	10
		Unfavorable	500	Indian ricegrass----------	10
				Other grasses----------	5
				Other shrubs----------	5
				Needleandthread----------	5
				Wyoming big sagebrush---------	10
				Fourwing saltbush----------	5
				Bottlebrush squirreltail------	5
				Western wheatgrass----------	25
5*:					
Barx----------	Sandy Loam Upland 10-14" p.z.	Favorable	1000	Indian ricegrass----------	25
		Normal	650	Galleta----------	10
		Unfavorable	350	Needleandthread----------	15
				Wyoming big sagebrush---------	5
				Other shrubs----------	10
				Blue grama----------	30
				Fourwing saltbush----------	5

See footnote at end of table.

Table 5.--Rangeland Productivity and Characteristic Plant Communities--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
5*:					
Pensom	Sandy Upland 10-14" p.z.	Favorable	700	Black grama	10
		Normal	500	Needleandthread	10
		Unfavorable	300	Dropseed	5
				Galleta	5
				Indian ricegrass	20
				Blue grama	5
				Other perennial grasses	5
				Other perennial forbs	5
				Sand sagebrush	5
				Fourwing saltbush	5
				Winterfat	5
				Mormon tea	5
				Other shrubs	10
7*:					
Bison	Loamy Upland 7-11" p.z.	Favorable	900	Indian ricegrass	15
		Normal	750	Needleandthread	15
		Unfavorable	600	Desert needlegrass	10
				Bottlebrush squirreltail	10
				Black grama	10
				Blue grama	20
				Sand dropseed	5
				Fourwing saltbush	10
				Mormon tea	5
Curob	Shallow Loamy 7-11 p.z.	Favorable	800	Black grama	10
		Normal	650	Desert needlegrass	10
		Unfavorable	550	Galleta	15
				Indian ricegrass	15
				Needleandthread	10
				Winterfat	5
				Other shrubs	10
				Bottlebrush squirreltail	10
				Blue grama	10
8--- Clayhole	Gypsum Upland 7-11" p.z.	Favorable	650	Indian ricegrass	15
		Normal	550	Bottlebrush squirreltail	5
		Unfavorable	450	Galleta	25
				Gyp dropseed	10
				Black grama	5
				Shadscale	15
				Fourwing saltbush	10
				Mormon tea	5
				Other perennial grasses	10
9*:					
Clayhole	Gypsum Upland 7-11" p.z.	Favorable	650	Indian ricegrass	15
		Normal	550	Bottlebrush squirreltail	5
		Unfavorable	450	Galleta	25
				Gyp dropseed	10
				Black grama	5
				Shadscale	15
				Fourwing saltbush	10
				Mormon tea	5
				Other perennial grasses	10

See footnote at end of table.

Table 5.--Rangeland Productivity and Characteristic Plant Communities--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
9*:					
Torriorthents	Gypsum Hills 7-11" p.z.	Favorable	450	Indian ricegrass	10
		Normal	350	Needleandthread	10
		Unfavorable	250	Galleta	10
				Bottlebrush squirreltail	5
				Black grama	5
				Gyp dropseed	5
				Shadscale	5
				Fourwing saltbush	7
				Mormon tea	8
				Other perennial forbs	5
				Shrubby buckwheat	10
				Utah serviceberry	10
10*:					
Curhollow	Shallow Loamy 10-14" p.z.	Favorable	800	Needleandthread	15
		Normal	650	New Mexico needlegrass	10
		Unfavorable	400	Bottlebrush squirreltail	5
				Black grama	10
				Sideoats grama	5
				Galleta	10
				Fourwing saltbush	5
				Mexican cliffrose	5
				Fernbush	5
				Blue grama	10
				Big sagebrush	15
Mellenthin	Shallow Loamy 10-14" p.z.	Favorable	800	Black grama	15
		Normal	650	Western wheatgrass	15
		Unfavorable	400	Blue grama	10
				Galleta	10
				Needleandthread	5
				Desert needlegrass	5
				New Mexico needlegrass	5
				Big sagebrush	15
				Fourwing saltbush	5
				Winterfat	5
11 Curob	Sandstone Upland 7-11" p.z.	Favorable	500	Indian ricegrass	15
		Normal	350	Needleandthread	10
		Unfavorable	200	Desert needlegrass	10
				Bottlebrush squirreltail	5
				Galleta	5
				Sand dropseed	5
				Sandhill muhly	5
				Blue grama	10
				Other perennial forbs	10
				Mormon tea	10
				Fourwing saltbush	10
				Other shrubs	5
12 Curob	Shallow Loamy 7-11" p.z.	Favorable	800	Black grama	10
		Normal	650	Desert needlegrass	10
		Unfavorable	550	Galleta	15
				Indian ricegrass	15
				Needleandthread	10
				Winterfat	5
				Other shrubs	10
				Bottlebrush squirreltail	10
				Blue grama	10

See footnote at end of table.

Table 5.--Rangeland Productivity and Characteristic Plant Communities--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
15---------- Doak	Sandy Loam Upland 7-11" p.z.	Favorable	950	Blue grama----------	10
		Normal	800	Fourwing saltbush----------	5
		Unfavorable	600	Galleta----------	5
				Indian ricegrass----------	25
				Needleandthread----------	10
				Bottlebrush squirreltail------	5
				Other perennial forbs---------	5
				Other shrubs----------	10
				Black grama----------	10
				Dropseed----------	5
16---------- Glenyon	Saline Upland, Loamy 7-11" p.z.	Favorable	1000	Indian ricegrass----------	15
		Normal	800	Fourwing saltbush----------	15
		Unfavorable	650	Blue grama----------	10
				Needleandthread----------	10
				Bottlebrush squirreltail------	5
				Other perennial grasses-------	5
				Black greasewood----------	10
				Bluebunch wheatgrass----------	5
				Inland saltgrass----------	15
18---------- Jocity	Clayey Bottom 7-11" p.z.------	Favorable	1200	Alkali sacaton----------	20
		Normal	1000	Western wheatgrass----------	15
		Unfavorable	700	Blue grama----------	15
				Galleta----------	10
				Other perennial grasses-------	15
				Fourwing saltbush----------	15
				Other shrubs----------	5
				Rubber rabbitbrush----------	2
				Other shrubs----------	3
19---------- Jocity	Clayey Upland 7-11" p.z.------	Favorable	950	Bottlebrush squirreltail------	5
		Normal	700	Other perennial forbs---------	5
		Unfavorable	500	Other perennial grasses-------	15
				Rubber rabbitbrush----------	10
				Fourwing saltbush----------	10
				Other shrubs----------	15
				Blue grama----------	15
				Western wheatgrass----------	10
				Black grama----------	5
				Galleta----------	10
20---------- Keeseha	Clay Loam Upland 10-14" p.z.	Favorable	1000	Black grama----------	10
		Normal	650	Needleandthread----------	5
		Unfavorable	300	Sideoats grama----------	10
				Galleta----------	10
				Blue grama----------	15
				Western wheatgrass----------	10
				Bottlebrush squirreltail------	5
				Fourwing saltbush----------	5
				Winterfat----------	5
				Other annual grasses----------	5
				Other shrubs----------	5
				Big sagebrush----------	10
				Other perennial grasses-------	5

See footnote at end of table.

Table 5.--Rangeland Productivity and Characteristic Plant Communities--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
21*:					
Kinan	Gravelly Upland 6-10" p.z.	Favorable	600	Galleta	10
		Normal	400	Indian ricegrass	20
		Unfavorable	250	Black grama	15
				Cutler Mormon tea	5
				Other perennial grasses	5
				Other perennial forbs	5
				Other shrubs	5
				Fourwing saltbush	5
				Burrograss	5
				Sand dropseed	20
21*:					
Pennell	Gravelly Upland 6-10" p.z.	Favorable	600	Galleta	10
		Normal	400	Indian ricegrass	20
		Unfavorable	250	Winterfat	5
				Fourwing saltbush	5
				Black grama	15
				Sideoats grama	5
				Bottlebrush squirreltail	10
				Other perennial grasses	5
				Other perennial forbs	5
				Other shrubs	5
				Cutler Mormon tea	5
				Sand dropseed	20
22*:					
Kinan	Gravelly Upland, Alkaline 6-10" p.z.	Favorable	550	Galleta	10
		Normal	350	Indian ricegrass	15
		Unfavorable	200	Black grama	10
				Other perennial grasses	5
				Other perennial forbs	5
				Other shrubs	10
				Shadscale	25
				Sand dropseed	15
Pennell	Gravelly Upland, Alkaline 6-10" p.z.	Favorable	550	Galleta	10
		Normal	350	Indian ricegrass	15
		Unfavorable	200	Black grama	10
				Other perennial grasses	5
				Other perennial forbs	5
				Other shrubs	10
				Shadscale	25
				Sand dropseed	15
23 Klondike	Shallow Loamy 10-14" p.z.	Favorable	800	Indian ricegrass	10
		Normal	600	Winterfat	10
		Unfavorable	400	Blue grama	15
				Galleta	10
				Mormon tea	10
				Big sagebrush	10
				Needleandthread	15
				Bottlebrush squirreltail	5
				Other perennial grasses	10
				Other perennial forbs	5
				Black grama	10

See footnote at end of table.

Table 5.--Rangeland Productivity and Characteristic Plant Communities--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
24---------- Manikan	Clayey Upland 10-14" p.z.-----	Favorable	1000	Blue grama----------	25
		Normal	750	Galleta----------	10
		Unfavorable	400	Western wheatgrass----------	15
				Winterfat----------	5
				Fourwing saltbush----------	10
				Indian ricegrass----------	5
				Needleandthread----------	5
				Bottlebrush squirreltail------	10
				Big sagebrush----------	5
				Black grama----------	10
25---------- Mellenthin	Shallow Loamy 10-14" p.z.-----	Favorable	800	Black grama----------	15
		Normal	650	Western wheatgrass----------	15
		Unfavorable	400	Blue grama----------	10
				Galleta----------	10
				Needleandthread----------	5
				Desert needlegrass----------	5
				New Mexico needlegrass--------	5
				Big sagebrush----------	15
				Fourwing saltbush----------	5
				Winterfat----------	5
26---------- Mellenthin	Limestone Breaks 10-14" p.z.	Favorable	550	Blue grama----------	5
		Normal	450	Needleandthread----------	5
		Unfavorable	350	Desert needlegrass----------	5
				Big sagebrush----------	20
				Fourwing saltbush----------	5
				Muttongrass----------	15
				Other perennial grasses-------	5
27---------- Monierco	Shallow Loamy 7-11" p.z.------	Favorable	800	Galleta----------	10
		Normal	650	Blue grama----------	10
		Unfavorable	550	Needleandthread----------	10
				Indian ricegrass----------	15
				Winterfat----------	5
				Mormon tea----------	5
				Other shrubs----------	10
				Other perennial forbs---------	5
				Other perennial grasses-------	10
28---------- Monue	Sandy Loam Upland 7-11" p.z.	Favorable	950	Galleta----------	5
		Normal	800	Indian ricegrass----------	30
		Unfavorable	600	Sand dropseed----------	5
				Mesa dropseed----------	5
				Other perennial grasses-------	10
				Other perennial forbs---------	5
				Fourwing saltbush----------	10
				Other shrubs----------	10
				Black grama----------	5
				Needleandthread----------	10
				Blue grama----------	5

See footnote at end of table.

Table 5.--Rangeland Productivity and Characteristic Plant Communities--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
29*:					
Monue	Sandy Loam Upland 7-11" p.z.	Favorable	950	Galleta	5
		Normal	800	Indian ricegrass	30
		Unfavorable	600	Sand dropseed	5
				Mesa dropseed	5
				Other perennial grasses	10
				Other perennial forbs	5
				Fourwing saltbush	10
				Other shrubs	10
				Black grama	5
				Needleandthread	10
				Blue grama	5
Seeg	Sandy Loam Upland 7-11" p.z.	Favorable	950	Indian ricegrass	30
		Normal	800	Needleandthread	10
		Unfavorable	600	Desert needlegrass	15
				Blue grama	10
				Galleta	5
				Fourwing saltbush	10
				Black grama	10
30*:					
Needle	Sandstone Upland 6-10" p.z.	Favorable	450	Galleta	5
		Normal	350	Needleandthread	2
		Unfavorable	250	Other perennial grasses	10
				Fourwing saltbush	15
				Mormon tea	5
				Other shrubs	5
				Sideoats grama	10
				Black grama	10
				Blue grama	10
				Indian ricegrass	10
Rock outcrop.					
31*:					
Needle	Sandstone Upland 6-10" p.z.	Favorable	450	Galleta	5
		Normal	350	Needleandthread	2
		Unfavorable	250	Other perennial grasses	10
				Fourwing saltbush	15
				Mormon tea	5
				Other shrubs	5
				Sideoats grama	10
				Black grama	10
				Blue grama	10
				Indian ricegrass	10
Sheppard	Sandy Upland 6-10" p.z.	Favorable	700	Indian ricegrass	25
		Normal	500	Mormon tea	5
		Unfavorable	300	Sand dropseed	10
				Blue grama	5
				Fourwing saltbush	10
				Sand sagebrush	10
				Galleta	10
				Black grama	5
				Needleandthread	10

See footnote at end of table.

Table 5.--Rangeland Productivity and Characteristic Plant Communities--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
32---------- Pagina	Sandy Loam Upland, Calcareous 6-10" p.z.	Favorable	500	Indian ricegrass----------	15
		Normal	400	Needleandthread----------	10
		Unfavorable	250	Bottlebrush squirreltail------	5
				Galleta----------	5
				Other perennial grasses-------	10
				Other perennial forbs---------	5
				Mormon tea----------	5
				Fourwing saltbush----------	5
				Other shrubs----------	5
				Blackbrush----------	25
33*: Pagina----------	Sandy Loam Upland, Calcareous 6-10" p.z.	Favorable	500	Indian ricegrass----------	15
		Normal	400	Needleandthread----------	10
		Unfavorable	250	Bottlebrush squirreltail------	5
				Galleta----------	5
				Other perennial grasses-------	10
				Other perennial forbs---------	5
				Mormon tea----------	5
				Fourwing saltbush----------	5
				Other shrubs----------	5
				Blackbrush----------	25
33*: Wahweap----------	Shallow Sandy Loam, Calcareous 6-10" p.z.	Favorable	400	Indian ricegrass----------	10
		Normal	300	Bottlebrush squirreltail------	5
		Unfavorable	200	Galleta----------	5
				Mormon tea----------	5
				Other shrubs----------	5
				Blackbrush----------	50
34---------- Pennell	Shallow Loamy 7-11" p.z.------	Favorable	700	Galleta----------	10
		Normal	500	Indian ricegrass----------	15
		Unfavorable	300	Winterfat----------	5
				Fourwing saltbush----------	5
				Blue grama----------	10
				Black grama----------	10
				Sideoats grama----------	5
				Bottlebrush squirreltail------	10
				Other perennial grasses-------	15
				Other perennial forbs---------	5
				Other shrubs----------	5
				Cutler Mormon tea----------	5
35---------- Pennell	Gravelly Upland 6-10" p.z.----	Favorable	600	Galleta----------	10
		Normal	400	Indian ricegrass----------	20
		Unfavorable	250	Winterfat----------	5
				Fourwing saltbush----------	5
				Black grama----------	15
				Sideoats grama----------	5
				Bottlebrush squirreltail------	10
				Other perennial grasses-------	5
				Other perennial forbs---------	5
				Other shrubs----------	5
				Cutler Mormon tea----------	5
				Sand dropseed----------	20

See footnote at end of table.

Table 5.--Rangeland Productivity and Characteristic Plant Communities--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
36---------- Pennell	Gravelly Upland, Alkaline 6-10" p.z.	Favorable	550	Other shrubs----------	10
		Normal	350	Galleta----------	10
		Unfavorable	200	Indian ricegrass----------	15
				Other perennial forbs---------	5
				Shadscale----------	25
				Black grama----------	10
				Other perennial grasses-------	5
				Sand dropseed----------	15
37---------- Pensom	Sandy Upland 10-14" p.z.------	Favorable	700	Black grama----------	10
		Normal	500	Needleandthread----------	10
		Unfavorable	300	Dropseed----------	5
				Galleta----------	5
				Indian ricegrass----------	20
				Blue grama----------	5
				Other perennial grasses-------	5
				Other perennial forbs---------	5
				Sand sagebrush----------	5
				Fourwing saltbush----------	5
				Winterfat----------	5
				Mormon tea----------	5
				Other shrubs----------	10
38*:					
Pensom----------	Sandy Upland 10-14" p.z.------	Favorable	700	Black grama----------	10
		Normal	500	Needleandthread----------	10
		Unfavorable	300	Dropseed----------	5
				Galleta----------	5
				Indian ricegrass----------	20
				Blue grama----------	5
				Other perennial grasses-------	5
				Other perennial forbs---------	5
				Sand sagebrush----------	5
				Fourwing saltbush----------	5
				Winterfat----------	5
				Mormon tea----------	5
				Other shrubs----------	10
Arches----------	Sandstone Upland, Calcareous 10-14" p.z.	Favorable	350	Dropseed----------	5
		Normal	200	Galleta----------	10
		Unfavorable	100	Indian ricegrass----------	10
				Other annual forbs----------	2
				Blackbrush----------	30
				Fourwing saltbush----------	5
				Mormon tea----------	5
				Bigelow sagebrush----------	5
				Needleandthread----------	5
39*:					
Pensom----------	Sandy Upland 10-14" p.z.------	Favorable	700	Black grama----------	10
		Normal	500	Needleandthread----------	10
		Unfavorable	300	Dropseed----------	5
				Galleta----------	5
				Indian ricegrass----------	20
				Blue grama----------	5
				Other perennial grasses-------	5
				Other perennial forbs---------	5
				Sand sagebrush----------	5
				Fourwing saltbush----------	5
				Winterfat----------	5
				Mormon tea----------	5
				Other shrubs----------	10

See footnote at end of table.

Table 5.--Rangeland Productivity and Characteristic Plant Communities--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
39*:					
Arches.					
42*:					
Rock outcrop.					
Needle	Sandstone Upland 6-10" p.z.	Favorable	450	Galleta	5
		Normal	350	Needleandthread	2
		Unfavorable	250	Other perennial grasses	10
				Fourwing saltbush	15
				Mormon tea	5
				Other shrubs	5
				Sideoats grama	10
				Black grama	10
				Blue grama	10
				Indian ricegrass	10
43*:					
Rock outcrop.					
Torriorthents	Breaks 6-10" p.z.	Favorable	500	Desert needlegrass	5
		Normal	350	Sideoats grama	5
		Unfavorable	200	Black grama	5
				Galleta	5
				Bush muhly	5
				Threeawn	5
				Other perennial forbs	5
				Cactus	5
				Indian ricegrass	15
				Bigelow sagebrush	5
44 45	Sandy Upland 6-10" p.z.	Favorable	700	Indian ricegrass	25
Sheppard		Normal	500	Mormon tea	5
		Unfavorable	300	Sand dropseed	10
				Fourwing saltbush	10
				Sand sagebrush	10
				Galleta	10
				Black grama	5
				Needleandthread	10
46	Loamy Upland 10-14" p.z.	Favorable	1000	Western wheatgrass	20
Strych		Normal	750	Blue grama	15
		Unfavorable	500	Indian ricegrass	10
				Galleta	10
				Muttongrass	5
				Big sagebrush	10
				Fourwing saltbush	10
47	Gypsum Hills 7-11" p.z.	Favorable	450	Indian ricegrass	10
Torriorthents		Normal	350	Needleandthread	10
		Unfavorable	250	Galleta	10
				Bottlebrush squirreltail	5
				Black grama	5
				Gyp dropseed	5
				Shadscale	5
				Fourwing saltbush	7
				Mormon tea	8
				Other perennial forbs	5
				Shrubby buckwheat	10
				Utah serviceberry	10

See footnote at end of table.

Table 5.--Rangeland Productivity and Characteristic Plant Communities--Continued

Soil name and map symbol	Range site	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
48*:					
Torriorthents-----	Breaks, Calcareous 10-14" p.z.	Favorable	800	Muttongrass----------	15
		Normal	600	Needleandthread----------	15
		Unfavorable	400	Indian ricegrass----------	10
				Blue grama----------	10
				Galleta----------	5
				Bottlebrush squirreltail------	5
				Threeawn----------	5
				Utah juniper----------	15
				Colorado pinyon----------	5
				Big sagebrush----------	10
				Snakeweed----------	5
Rock outcrop.					
49----------	Shallow Sandy Loam,	Favorable	400	Indian ricegrass----------	10
Wahweap	Calcareous 6-10" p.z.	Normal	300	Bottlebrush squirreltail------	5
		Unfavorable	200	Galleta----------	5
				Mormon tea----------	5
				Other shrubs----------	5
				Blackbrush----------	50
50*:					
Wahweap----------	Shallow Sandy Loam,	Favorable	400	Indian ricegrass----------	10
	Calcareous 6-10" p.z.	Normal	300	Bottlebrush squirreltail------	5
		Unfavorable	200	Galleta----------	5
				Mormon tea----------	5
				Other shrubs----------	5
				Blackbrush----------	50
Rock outcrop.					

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 6.--Woodland Management and Productivity

(Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available)

Soil name and map symbol	Management concerns					Potential productivity			
	Ordination symbol	Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	Productivity class*	Trees to plant
2**:									
Arches	2A	Slight	Slight	Slight	Slight	Utah juniper	51	2	Pinyon.
						Pinyon	---	--	
Pensom.									
3**:									
Arches	2A	Slight	Slight	Slight	Slight	Utah juniper	49	2	Pinyon.
						Pinyon	---	--	
Pensom.									
6**:									
Bidonia	1D	Slight	Slight	Slight	Slight	Utah juniper	28	1	Pinyon.
						Pinyon	---	--	
Rock outcrop.									
13	2A	Slight	Slight	Slight	Slight	Utah juniper	56	2	Pinyon.
Disterheff						Pinyon	---	--	
14**:									
Disterheff	2A	Slight	Slight	Slight	Slight	Utah juniper	54	2	Pinyon.
						Pinyon	---	--	
Houserock	3S	Slight	Slight	Moderate	Moderate	Pinyon	45	3	Pinyon.
						Utah juniper	---	--	
17**:									
Houserock	2R	Moderate	Moderate	Moderate	Moderate	Pinyon	52	2	Pinyon.
						Utah juniper	---	--	
Disterheff	2A	Slight	Slight	Slight	Slight	Utah juniper	56	2	Pinyon.
						Pinyon	---	--	

See footnote at end of table.

Table 6.--Woodland Management and Productivity--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity			Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Plant competition	Common trees	Site index	Productivity class*	
38**:									
Pensom.									
Arches	1D	Moderate	Slight	Moderate	Moderate	Juniper	40	1	
						Pinyon	40	1	
39**:									
Pensom.									
Arches	2A	Slight	Slight	Slight	Slight	Utah juniper	51	2	Pinyon.
						Pinyon	---	--	
51	1D	Moderate	Moderate	Severe	Moderate	Pinyon	41	1	Pinyon.
Yumtheska						Utah juniper	---	--	
52**:									
Yumtheska	1D	Moderate	Moderate	Moderate	Moderate	Pinyon	46	1	Pinyon.
						Utah juniper	---	--	
Houserock	2R	Moderate	Moderate	Moderate	Moderate	Pinyon	51	2	Pinyon.
						Utah juniper	---	--	

* Productivity class is the yield in cubic meters per hectare per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

** See description of the map unit for composition and behavior characteristics of the map unit.

Table 7.--Woodland Understory Vegetation

(Only the soils suitable for production of commercial trees are listed)

Soil name and map symbol	Total production		Characteristic vegetation	Composition
	Kind of year	Dry weight		
		Lb/acre		Pct
2*:				
Arches	Favorable	600	Indian ricegrass	20
	Normal	450	Galleta	10
	Unfavorable	300	Bigelow sagebrush	10
			Needleandthread	10
			Fourwing saltbush	5
			Mormon tea	5
Pensom.				
3*:				
Arches	Favorable	600	Indian ricegrass	15
	Normal	450	Bigelow sagebrush	10
	Unfavorable	300	Galleta	5
			Fourwing saltbush	5
			Mormon tea	5
Pensom.				
6*:				
Bidonia	Favorable	600	Big sagebrush	20
	Normal	450	Indian ricegrass	15
	Unfavorable	300	Utah juniper	15
			Needleandthread	10
			Blue grama	10
			Colorado pinyon	10
			Stansbury cliffrose	5
Rock outcrop.				
13	Favorable	900	Blue grama	25
Disterheff	Normal	650	Needleandthread	15
	Unfavorable	550	Utah juniper	15
			Galleta	10
			Black grama	5
			Winterfat	5
			Fourwing saltbush	5
			Colorado pinyon	5
14*:				
Disterheff	Favorable	1,100	Blue grama	30
	Normal	900	Needleandthread	20
	Unfavorable	700	Galleta	10
			Utah juniper	10
			Winterfat	5
			Fourwing saltbush	5
			Colorado pinyon	5
Houserock	Favorable	950	Blue grama	25
	Normal	700	Needleandthread	15
	Unfavorable	600	Juniper	10
			Bottlebrush squirreltail	5
			Galleta	5
			Winterfat	5
			Colorado pinyon	5
			Sideoats grama	5
			Big sagebrush	5

See footnote at end of table.

Table 7.--Woodland Understory Vegetation--Continued

Soil name and map symbol	Total production		Characteristic vegetation	Composition
	Kind of year	Dry weight		
		Lb/acre		Pct
17*:				
Houserock	Favorable	950	Blue grama	25
	Normal	700	Needleandthread	15
	Unfavorable	600	Juniper	10
			Bottlebrush squirreltail	5
			Galleta	5
			Winterfat	5
			Colorado pinyon	5
			Sideoats grama	5
			Big sagebrush	5
Disterheff	Favorable	1,100	Blue grama	30
	Normal	900	Needleandthread	20
	Unfavorable	700	Galleta	10
			Utah juniper	10
			Winterfat	5
			Fourwing saltbush	5
			Colorado pinyon	5
39*:				
Pensom.				
Arches	Favorable	600	Indian ricegrass	20
	Normal	450	Galleta	10
	Unfavorable	300	Bigelow sagebrush	10
			Needleandthread	10
			Fourwing saltbush	5
			Mormon tea	5
51	Favorable	800	Sideoats grama	15
Yumtheska	Normal	600	Needleandthread	10
	Unfavorable	400	Blue grama	10
			Bottlebrush squirreltail	5
			Big sagebrush	5
			Juniper	5
			Fourwing saltbush	5
52*:				
Yumtheska	Favorable	800	Sideoats grama	15
	Normal	600	Needleandthread	10
	Unfavorable	400	Blue grama	10
			Bottlebrush squirreltail	5
			Big sagebrush	5
			Juniper	5
			Fourwing saltbush	5

See footnote at end of table.

Table 7.--Woodland Understory Vegetation--Continued

Soil name and map symbol	Total production		Characteristic vegetation	Composition
	Kind of year	Dry weight		
		Lb/acre		Pct
52*:				
Houserock---------	Favorable	950	Blue grama----------	25
	Normal	700	Needleandthread----------	15
	Unfavorable	600	Juniper----------	10
			Bottlebrush squirreltail----------	5
			Galleta----------	5
			Winterfat----------	5
			Colorado pinyon----------	5
			Sideoats grama----------	5
			Big sagebrush----------	5

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 8.--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 Aneth	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
2*, 3*: Arches	Severe: too sandy, depth to rock.	Severe: too sandy, depth to rock.	Severe: slope, too sandy, depth to rock.	Severe: too sandy.
Pensom	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
4 Barx	Moderate: small stones, dusty.	Moderate: small stones, dusty.	Severe: small stones.	Moderate: dusty.
5*: Barx	Slight	Slight	Moderate: slope.	Severe: erodes easily.
Pensom	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
6*: Bidonia	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
Rock outcrop.				
7*: Bison	Moderate: small stones, dusty.	Moderate: small stones, dusty.	Severe: small stones.	Moderate: dusty.
Curob	Severe: small stones, cemented pan.	Severe: small stones, cemented pan.	Severe: small stones, cemented pan.	Moderate: dusty.
8 Clayhole	Severe: flooding.	Slight	Moderate: slope, small stones.	Slight.
9*: Clayhole	Severe: flooding.	Moderate: dusty.	Moderate: slope, small stones, dusty.	Moderate: dusty.
Torriorthents	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.

See footnote at end of table.

Table 8.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
10*:				
Curhollow	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan.	Severe: slope, depth to rock, cemented pan.	Moderate: dusty.
Mellenthin	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: small stones.
11 Curob	Severe: cemented pan.	Severe: cemented pan.	Severe: slope, cemented pan.	Slight.
12 Curob	Severe: small stones, cemented pan.	Severe: small stones, cemented pan.	Severe: slope, small stones, cemented pan.	Moderate: dusty.
13 Disterheff	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.
14*:				
Disterheff	Moderate: slope, small stones, dusty.	Moderate: slope, small stones, dusty.	Severe: slope, small stones.	Moderate: dusty.
Houserock	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
15 Doak	Slight	Slight	Moderate: slope.	Slight.
16 Glenyon	Moderate: excess salt.	Moderate: excess salt.	Moderate: excess salt.	Slight.
17*:				
Houserock	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
Disterheff	Moderate: slope, small stones, dusty.	Moderate: slope, small stones, dusty.	Severe: slope, small stones.	Moderate: dusty.
18 Jocity	Severe: flooding.	Slight	Moderate: slope, flooding.	Slight.
19 Jocity	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

Table 8.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
20--- Keeseha	Moderate: dusty.	Moderate: dusty.	Moderate: slope, small stones, dusty.	Moderate: dusty.
21*, 22*:				
Kinan---	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight.
Pennell---	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
23--- Klondike	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
24--- Manikan	Slight---	Slight---	Moderate: slope.	Slight.
25--- Mellenthin	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: small stones.
26--- Mellenthin	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones.
27--- Monierco	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight.
28--- Monue	Slight---	Slight---	Moderate: slope.	Slight.
29*:				
Monue---	Slight---	Slight---	Moderate: slope.	Slight.
Seeg---	Slight---	Slight---	Moderate: slope, small stones.	Slight.
30*:				
Needle---	Severe: too sandy, depth to rock.	Severe: too sandy, depth to rock.	Severe: slope, too sandy, depth to rock.	Severe: too sandy.
Rock outcrop.				
31*:				
Needle---	Severe: too sandy, depth to rock.	Severe: too sandy, depth to rock.	Severe: slope, too sandy, depth to rock.	Severe: too sandy.

See footnote at end of table.

Table 8.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
31*:				
Sheppard	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
32	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, small stones.	Moderate: too sandy.
33*:				
Pagina	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Wahweap	Severe: too sandy, depth to rock.	Severe: too sandy, depth to rock.	Severe: slope, depth to rock.	Severe: too sandy.
34	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Moderate: large stones.
35	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.
36	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.
37	Severe: too sandy.	Severe: too sandy.	Severe: slope, too sandy.	Severe: too sandy.
38*, 39*:				
Pensom	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
Arches	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Moderate: too sandy.
40*. Pits, borrow				
41*. Rock outcrop				
42*: Rock outcrop.				
Needle	Severe: slope, too sandy, depth to rock.	Severe: slope, too sandy, depth to rock.	Severe: slope, too sandy, depth to rock.	Severe: too sandy.
43*: Rock outcrop.				

See footnote at end of table.

Table 8.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
43*: Torriorthents				
44--Sheppard	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.
45--Sheppard	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.
46--Strych	Moderate: dusty.	Moderate: dusty.	Moderate: slope, small stones, dusty.	Moderate: dusty.
47--Torriorthents				
48*: Torriorthents				
Rock outcrop.				
49--Wahweap	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
50*: Wahweap	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
Rock outcrop.				
51--Yumtheska	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: small stones.
52*: Yumtheska	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
Houserock	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 9.--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---------- Aneth	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
2*, 3*: Arches----------	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.
Pensom----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
4---------- Barx	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: small stones.
5*: Barx----------	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Slight.
Pensom----------	Severe: cutbanks cave.	Slight---------	Moderate: depth to rock.	Slight---------	Slight---------	Moderate: droughty.
6*: Bidonia----------	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.						
7*: Bison----------	Moderate: cemented pan.	Slight---------	Moderate: cemented pan.	Moderate: slope.	Slight---------	Moderate: small stones, cemented pan.
Curob----------	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: small stones, cemented pan.
8---------- Clayhole	Slight---------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
9*: Clayhole---------	Slight---------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.	Slight.
Torriorthents----	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.

See footnote at end of table.

Table 9.--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
10*:						
Curhollow	Severe: depth to rock, cemented pan.	Severe: depth to rock.	Severe: depth to rock, cemented pan.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Mellenthin	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, droughty.
11 Curob	Severe: depth to rock, cemented pan.	Severe: cemented pan.	Severe: depth to rock, cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.
12 Curob	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Severe: small stones, cemented pan.
13 Disterheff	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, slope.	Severe: small stones.
14*:						
Disterheff	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, slope.	Moderate: small stones, slope.
Houserock	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, slope, depth to rock.	Severe: depth to rock, shrink-swell, low strength.	Severe: depth to rock.
15 Doak	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
16 Glenyon	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.	Moderate: excess salt.
17*:						
Houserock	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, slope, depth to rock.	Severe: depth to rock, shrink-swell, low strength.	Severe: depth to rock.
Disterheff	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: shrink-swell, slope.	Moderate: small stones, slope.
18 Jocity	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.	Moderate: flooding.
19 Jocity	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.	Slight.
20 Keeseha	Slight	Slight	Slight	Slight	Slight	Slight.

See footnote at end of table.

Table 9.--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
21*, 22*:						
Kinan	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: small stones, droughty, slope.
Pennell	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.
23--Klondike	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: depth to rock.
24--Manikan	Slight	Slight	Slight	Slight	Moderate: frost action.	Slight.
25--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, droughty.
26--Mellenthin	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: small stones, droughty, slope.
27--Monierco	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: depth to rock.
28--Monue	Slight	Slight	Slight	Slight	Slight	Slight.
29*:						
Monue	Slight	Slight	Slight	Slight	Slight	Slight.
Seeg	Slight	Slight	Slight	Slight	Slight	Moderate: droughty.
30*:						
Needle	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.						
31*:						
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.
Sheppard	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
32--Pagina	Severe: cutbanks cave.	Slight	Moderate: depth to rock.	Slight	Slight	Moderate: droughty, depth to rock.
33*:						
Pagina	Severe: cutbanks cave.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope, depth to rock.

See footnote at end of table.

Table 9.--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
33*:						
Wahweap	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: depth to rock.
34--- Pennell	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: large stones, depth to rock.
35, 36--- Pennell	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.
37--- Pensom	Severe: cutbanks cave.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
38*, 39*:						
Pensom	Severe: cutbanks cave.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Arches	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.
40*. Pits, borrow						
41*. Rock outcrop						
42*: Rock outcrop.						
Needle	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.
43*: Rock outcrop.						
Torriorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
44--- Sheppard	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
45--- Sheppard	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
46--- Strych	Slight	Slight	Slight	Slight	Slight	Severe: droughty.
47--- Torriorthents	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.

See footnote at end of table.

Table 9.--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
48*:						
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.						
49--- Wahweap	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.
50*:						
Wahweap	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.	Severe: depth to rock.
Rock outcrop.						
51--- Yumtheska	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: small stones, slope, depth to rock.
52*:						
Yumtheska	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.
Houserock	Severe: depth to rock.	Severe: shrink-swell, depth to rock.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell, slope, depth to rock.	Severe: depth to rock, shrink-swell, low strength.	Severe: depth to rock.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 10.--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--- Aneth	Severe: poor filter.	Severe: seepage, slope.	Moderate: slope, too sandy.	Moderate: slope.	Fair: too sandy, slope.
2*, 3*:					
Arches---	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, too sandy.	Moderate: slope.	Poor: depth to rock, too sandy.
Penson---	Severe: poor filter.	Severe: seepage, slope.	Severe: depth to rock, too sandy.	Moderate: slope.	Poor: too sandy.
4--- Barx	Moderate: percs slowly.	Severe: seepage.	Slight---	Slight---	Good.
5*:					
Barx---	Moderate: percs slowly.	Moderate: seepage.	Slight---	Slight---	Good.
Pensom---	Severe: poor filter.	Severe: seepage.	Severe: depth to rock, too sandy.	Slight---	Poor: too sandy.
6*:					
Bidonia---	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
Rock outcrop.					
7*:					
Bison---	Severe: cemented pan, percs slowly.	Severe: cemented pan.	Moderate: cemented pan.	Slight---	Poor: cemented pan, small stones.
Curob---	Severe: cemented pan.	Severe: cemented pan.	Severe: cemented pan.	Slight---	Poor: cemented pan, seepage, small stones.
8--- Clayhole	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: flooding.	Moderate: flooding.	Good.
9*:					
Clayhole---	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: flooding.	Moderate: flooding.	Good.
Torriorthents---	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.

See footnote at end of table.

Table 10.--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
10*:					
Curhollow	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan, slope.	Severe: depth to rock.	Slight	Poor: depth to rock, small stones.
Mellenthin	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock.	Slight	Poor: depth to rock, seepage, small stones.
11 Curob	Severe: depth to rock, cemented pan.	Severe: seepage, depth to rock, cemented pan.	Severe: depth to rock, cemented pan, seepage.	Severe: depth to rock, cemented pan.	Poor: depth to rock.
12 Curob	Severe: cemented pan.	Severe: cemented pan, slope.	Severe: cemented pan.	Slight	Poor: cemented pan, seepage, small stones.
13 Disterheff	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
14*:					
Disterheff	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
Houserock	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
15 Doak	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Good.
16 Glenyon	Severe: percs slowly, poor filter.	Severe: seepage.	Moderate: too sandy.	Slight	Fair: too sandy.
17*:					
Houserock	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Disterheff	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
18 Jocity	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
19 Jocity	Severe: percs slowly.	Severe: seepage.	Slight	Slight	Good.
20 Keeseha	Slight	Severe: seepage.	Slight	Slight	Fair: small stones.

See footnote at end of table.

Table 10.--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
10*:					
Curhollow	Severe: depth to rock, cemented pan.	Severe: depth to rock, cemented pan, slope.	Severe: depth to rock.	Slight	Poor: depth to rock, small stones.
Mellenthin	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock.	Slight	Poor: depth to rock, seepage, small stones.
11 Curob	Severe: depth to rock, cemented pan.	Severe: seepage, depth to rock, cemented pan.	Severe: depth to rock, cemented pan, seepage.	Severe: depth to rock, cemented pan.	Poor: depth to rock.
12 Curob	Severe: cemented pan.	Severe: cemented pan, slope.	Severe: cemented pan.	Slight	Poor: cemented pan, seepage, small stones.
13 Disterheff	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
14*:					
Disterheff	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
Houserock	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
15 Doak	Severe: percs slowly.	Moderate: slope.	Slight	Slight	Good.
16 Glenyon	Severe: percs slowly, poor filter.	Severe: seepage.	Moderate: too sandy.	Slight	Fair: too sandy.
17*:					
Houserock	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.
Disterheff	Severe: percs slowly.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: small stones.
18 Jocity	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
19 Jocity	Severe: percs slowly.	Severe: seepage.	Slight	Slight	Good.
20 Keeseha	Slight	Severe: seepage.	Slight	Slight	Fair: small stones.

See footnote at end of table.

Table 10.--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
21*, 22*:					
Kinan	Moderate: slope.	Severe: seepage, slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Pennell	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
23--Klondike	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
24--Manikan	Severe: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
25--Mellenthin	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock, seepage, small stones.
26--Mellenthin	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, seepage, small stones.
27--Monierco	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
28--Monue	Severe: percs slowly.	Severe: seepage.	Slight	Slight	Good.
29*:					
Monue	Severe: percs slowly.	Severe: seepage.	Slight	Slight	Good.
Seeg	Moderate: percs slowly.	Severe: seepage.	Slight	Slight	Poor: small stones.
30*:					
Needle	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too sandy.	Moderate: slope.	Poor: depth to rock, too sandy.
Rock outcrop.					
31*:					
Needle	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too sandy.	Slight	Poor: depth to rock, too sandy.
Sheppard	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy.	Slight	Poor: too sandy.
32--Pagina	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock.	Slight	Poor: depth to rock.

See footnote at end of table.

Table 10.--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
33*:					
Pagina	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock.
Wahweap	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock, seepage, small stones.
34 Pennell	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock.	Slight	Poor: depth to rock.
35, 36 Pennell	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: depth to rock, slope.
37 Pensom	Severe: poor filter.	Severe: seepage, slope.	Severe: depth to rock, too sandy.	Moderate: slope.	Poor: too sandy.
38*, 39*:					
Pensom	Severe: poor filter.	Severe: seepage, slope.	Severe: depth to rock, too sandy.	Moderate: slope.	Poor: too sandy.
Arches	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, too sandy.	Moderate: slope.	Poor: depth to rock, too sandy.
40*. Pits, borrow					
41*. Rock outcrop					
42*: Rock outcrop.					
Needle	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too sandy.	Severe: slope.	Poor: depth to rock, too sandy, slope.
43*: Rock outcrop. Torriorthents					
44 Sheppard	Severe: poor filter.	Severe: seepage.	Severe: too sandy.	Slight	Poor: too sandy.
45 Sheppard	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy.	Moderate: slope.	Poor: too sandy.

See footnote at end of table.

Table 10.--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
46--- Strych	Moderate: percs slowly.	Severe: seepage.	Slight	Slight	Poor: seepage, small stones.
47--- Torriorthents					
48*: Torriorthents					
Rock outcrop.					
49--- Wahweap	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock.	Slight	Poor: depth to rock, seepage, small stones.
50*: Wahweap	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock.	Moderate: slope.	Poor: depth to rock, seepage, small stones.
Rock outcrop.					
51--- Yumtheska	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.
52*: Yumtheska	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: depth to rock, small stones.
Houserock	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: depth to rock, too clayey, hard to pack.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 11.--Construction Materials

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," 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	Roadfill	Sand	Gravel	Topsoil
1 Aneth	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones, slope.
2*, 3*: Arches	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too sandy.
Pensom	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
4 Barx	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
5*: Barx	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Pensom	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
6*: Bidonia	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, small stones.
Rock outcrop.				
7*: Bison	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Curob	Poor: cemented pan.	Improbable: small stones.	Probable	Poor: cemented pan, small stones, area reclaim.
8 Clayhole	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
9*: Clayhole	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Torriorthents	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, slope.

See footnote at end of table.

Table 11.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
10*:				
Curhollow	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, cemented pan, small stones.
Mellenthin	Poor: depth to rock.	Improbable: small stones.	Improbable: thin layer.	Poor: depth to rock, small stones.
11 Curob	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: cemented pan, small stones.
12 Curob	Poor: cemented pan.	Improbable: small stones.	Probable	Poor: cemented pan, small stones, area reclaim.
13 Disterheff	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, area reclaim.
14*:				
Disterheff	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, area reclaim.
Houserock	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, small stones.
15 Doak	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
16 Glenyon	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, excess salt.
17*:				
Houserock	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, small stones.
Disterheff	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, small stones, area reclaim.
18 Jocity	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
19 Jocity	Fair: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

See footnote at end of table.

Table 11.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
20--Keeseha	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
21*, 22*:				
Kinan	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Pennell	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
23--Klondike	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
24--Manikan	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
25--Mellenthin	Poor: depth to rock.	Improbable: small stones.	Improbable: thin layer.	Poor: depth to rock, small stones.
26--Mellenthin	Poor: depth to rock, slope.	Improbable: small stones.	Improbable: thin layer.	Poor: depth to rock, small stones, slope.
27--Monierco	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock.
28--Monue	Fair: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Good.
29*:				
Monue	Fair: thin layer.	Improbable: excess fines.	Improbable: excess fines.	Good.
Seeg	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
30*:				
Needle	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too sandy.
Rock outcrop.				
31*:				
Needle	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too sandy.
Sheppard	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
32--Pagina	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too sandy.

See footnote at end of table.

Table 11.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
33*:				
Pagina	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too sandy, slope.
Wahweap	Poor: depth to rock.	Improbable: thin layer.	Improbable: thin layer.	Poor: depth to rock, too sandy, small stones.
34 Pennell	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
35, 36 Pennell	Poor: depth to rock, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
37 Pensom	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
38*, 39*:				
Pensom	Fair: depth to rock, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
Arches	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too sandy.
40*. Pits, borrow				
41*. Rock outcrop				
42*: Rock outcrop.				
Needle	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too sandy, slope.
43*: Rock outcrop.				
Torriorthents				
44, 45 Sheppard	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too sandy.
46 Strych	Good	Improbable: small stones.	Probable	Poor: small stones, area reclaim.

See footnote at end of table.

Table 11.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
47---------- Torriorthents				
48*: Torriorthents--------				
Rock outcrop.				
49---------- Wahweap	Poor: depth to rock.	Improbable: thin layer.	Improbable: thin layer.	Poor: depth to rock, too sandy, small stones.
50*: Wahweap----------	Poor: depth to rock.	Improbable: thin layer.	Improbable: thin layer.	Poor: depth to rock, too sandy, small stones.
Rock outcrop.				
51---------- Yumtheska	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones, slope.
52*: Yumtheska----------	Poor: depth to rock.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, small stones.
Houserock----------	Poor: depth to rock, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: depth to rock, too clayey, small stones.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 12.--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 evaluated. 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-- Pond reservoir areas	Embankments, dikes and levees	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
1---------- Aneth	Severe: seepage, slope.	Severe: piping.	Slope, droughty, fast intake.	Slope, soil blowing.	Too arid, slope, droughty.
2*, 3*:					
Arches----------	Severe: depth to rock, slope.	Severe: piping.	Slope, droughty, fast intake.	Slope, depth to rock, too sandy.	Too arid, slope, droughty.
Pensom----------	Severe: seepage, slope.	Severe: seepage, piping.	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
4---------- Barx	Severe: seepage.	Severe: piping.	Slope----------	Favorable--------	Too arid.
5*:					
Barx----------	Moderate: seepage, slope.	Severe: piping.	Slope, soil blowing, erodes easily.	Erodes easily, soil blowing.	Too arid, erodes easily.
Pensom----------	Severe: seepage.	Severe: seepage, piping.	Slope, droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
6*:					
Bidonia----------	Severe: depth to rock, slope.	Severe: thin layer.	Slope, soil blowing, percs slowly.	Slope, depth to rock, soil blowing.	Too arid, slope, depth to rock.
Rock outcrop.					
7*:					
Bison----------	Moderate: seepage, cemented pan, slope.	Severe: seepage, piping.	Slope, percs slowly, cemented pan.	Cemented pan, percs slowly.	Too arid, cemented pan, percs slowly.
Curob----------	Severe: cemented pan.	Severe: seepage.	Slope, droughty, cemented pan.	Cemented pan-----	Too arid, droughty.
8---------- Clayhole	Moderate: seepage, slope.	Severe: piping.	Slope----------	Favorable--------	Too arid.
9*:					
Clayhole---------	Moderate: seepage, slope.	Severe: piping.	Slope----------	Favorable--------	Too arid.
Torriorthents----	Severe: depth to rock, slope.	Slight----------	Slope, depth to rock, excess salt.	Slope, depth to rock.	Slope, excess salt, depth to rock.

See footnote at end of table.

Table 12.--Water Management--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes and levees	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
10*:					
Curhollow	Severe: depth to rock, cemented pan.	Severe: thin layer.	Slope, droughty, depth to rock.	Depth to rock, cemented pan.	Too arid, droughty.
Mellenthin	Severe: depth to rock.	Severe: seepage.	Slope, droughty, depth to rock.	Depth to rock	Too arid, droughty.
11--- Curob	Severe: cemented pan.	Severe: seepage.	Slope, droughty, fast intake.	Depth to rock, cemented pan.	Droughty, depth to rock.
12--- Curob	Severe: cemented pan.	Severe: seepage.	Slope, droughty, cemented pan.	Cemented pan	Too arid, droughty.
13--- Disterheff	Severe: slope.	Moderate: piping.	Slope, percs slowly.	Slope	Too arid, slope, percs slowly.
14*:					
Disterheff	Severe: slope.	Moderate: piping.	Slope, percs slowly.	Slope	Too arid, slope, percs slowly.
Houserock	Severe: depth to rock, slope.	Severe: thin layer.	Slope, droughty, percs slowly.	Slope, depth to rock, percs slowly.	Slope, droughty, depth to rock.
15--- Doak	Moderate: slope.	Moderate: piping.	Slope, soil blowing.	Erodes easily, soil blowing.	Erodes easily.
16--- Glenyon	Severe: seepage.	Severe: seepage, piping.	Excess salt	Erodes easily, too sandy.	Too arid, excess salt, erodes easily.
17*:					
Houserock	Severe: depth to rock, slope.	Severe: thin layer.	Slope, droughty, percs slowly.	Slope, depth to rock, percs slowly.	Slope, droughty, depth to rock.
Disterheff	Severe: slope.	Moderate: piping.	Slope, percs slowly.	Slope	Too arid, slope, percs slowly.
18--- Jocity	Slight	Moderate: piping.	Flooding	Favorable	Too arid.
19--- Jocity	Severe: seepage.	Moderate: piping.	Favorable	Erodes easily	Too arid, erodes easily, percs slowly.
20--- Keeseha	Severe: seepage.	Moderate: seepage.	Slope, percs slowly.	Favorable	Too arid, percs slowly.
21*, 22*:					
Kinan	Severe: seepage, slope.	Severe: piping.	Slope, droughty, soil blowing.	Slope, soil blowing.	Too arid, slope, droughty.

See footnote at end of table.

Table 12.--Water Management--Continued

Soil name and map symbol	Limitations for--		Features affecting--		
	Pond reservoir areas	Embankments, dikes and levees	Irrigation	Terraces and diversions	Grassed waterways
21*, 22*:					
Pennell	Severe: depth to rock, slope.	Severe: piping.	Slope, droughty, depth to rock.	Slope, depth to rock.	Too arid, slope, droughty.
23--- Klondike	Severe: depth to rock, slope.	Severe: piping.	Slope, depth to rock.	Slope, depth to rock, erodes easily.	Too arid, slope, erodes easily.
24--- Manikan	Moderate: seepage.	Severe: piping.	Favorable	Erodes easily	Too arid, erodes easily.
25, 26--- Mellenthin	Severe: depth to rock, slope.	Severe: seepage.	Slope, droughty, depth to rock.	Slope, depth to rock.	Too arid, slope, droughty.
27--- Monierco	Severe: depth to rock, slope.	Severe: thin layer.	Slope, depth to rock.	Slope, depth to rock.	Too arid, slope, depth to rock.
28--- Monue	Severe: seepage.	Severe: piping.	Slope, soil blowing.	Soil blowing	Too arid.
29*:					
Monue	Severe: seepage.	Severe: piping.	Slope, soil blowing.	Soil blowing	Too arid.
Seeg	Severe: seepage.	Severe: seepage.	Slope, droughty, soil blowing.	Soil blowing	Too arid, droughty.
30*:					
Needle	Severe: depth to rock, slope.	Severe: piping.	Slope, droughty, fast intake.	Slope, depth to rock, too sandy.	Too arid, slope, droughty.
Rock outcrop.					
31*:					
Needle	Severe: depth to rock.	Severe: piping.	Slope, droughty, fast intake.	Depth to rock, too sandy.	Too arid, droughty.
Sheppard	Severe: seepage.	Severe: seepage, piping.	Slope, droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
32--- Pagina	Severe: seepage.	Severe: piping.	Droughty, fast intake.	Depth to rock, soil blowing.	Too arid, droughty.
33*:					
Pagina	Severe: seepage, slope.	Severe: piping.	Slope, droughty, fast intake.	Slope, depth to rock, soil blowing.	Too arid, slope, droughty.
Wahweap	Severe: depth to rock, slope.	Severe: seepage.	Slope, droughty, fast intake.	Slope, depth to rock, soil blowing.	Too arid, slope, droughty.

See footnote at end of table.

Table 12.--Water Management--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes and levees	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
34---------- Pennell	Severe: depth to rock.	Severe: piping.	Slope, droughty, depth to rock.	Depth to rock----	Too arid, droughty.
35---------- Pennell	Severe: depth to rock, slope.	Severe: piping.	Slope, droughty, depth to rock.	Slope, depth to rock.	Too arid, slope, droughty.
36---------- Pennell	Severe: depth to rock, slope.	Severe: piping.	Slope, droughty, soil blowing.	Slope, depth to rock, soil blowing.	Too arid, slope, droughty.
37---------- Pensom	Severe: seepage, slope.	Severe: seepage, piping.	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
38*, 39*: Pensom----------	Severe: seepage, slope.	Severe: seepage, piping.	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
Arches----------	Severe: depth to rock, slope.	Severe: piping.	Slope, droughty, fast intake.	Slope, depth to rock, too sandy.	Too arid, slope, droughty.
40*. Pits, borrow					
41*. Rock outcrop					
42*: Rock outcrop.					
Needle----------	Severe: depth to rock, slope.	Severe: piping.	Slope, droughty, fast intake.	Slope, depth to rock, too sandy.	Too arid, slope, droughty.
43*: Rock outcrop.					
Torriorthents----	Severe: slope.	Slight----------	Slope----------	Slope----------	Slope.
44---------- Sheppard	Severe: seepage.	Severe: seepage, piping.	Slope, droughty, fast intake.	Too sandy, soil blowing.	Too arid, droughty.
45---------- Sheppard	Severe: seepage, slope.	Severe: seepage, piping.	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Too arid, slope, droughty.
46---------- Strych	Severe: seepage.	Severe: seepage.	Droughty---------	Favorable--------	Too arid, droughty.
47---------- Torriorthents					

See footnote at end of table.

Table 12.--Water Management--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes and levees	Features affecting-- Irrigation	Terraces and diversions	Grassed waterways
48*: Torriorthents---- Rock outcrop.					
49---------- Wahweap	Severe: depth to rock.	Severe: seepage.	Droughty, fast intake.	Depth to rock, soil blowing.	Too arid, droughty.
50*: Wahweap---------- Rock outcrop.	Severe: depth to rock, slope.	Severe: seepage.	Slope, droughty.	Slope, depth to rock, soil blowing.	Too arid, slope, droughty.
51---------- Yumtheska	Severe: depth to rock, slope.	Severe: thin layer.	Slope, droughty, depth to rock.	Slope, depth to rock.	Slope, droughty, depth to rock.
52*: Yumtheska--------	Severe: depth to rock, slope.	Severe: thin layer.	Slope, droughty, depth to rock.	Slope, depth to rock.	Slope, droughty, depth to rock.
Houserock--------	Severe: depth to rock, slope.	Severe: thin layer.	Slope, droughty, percs slowly.	Slope, depth to rock, percs slowly.	Slope, droughty, depth to rock.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 13.--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		Frag-ments > 10 inches	Frag-ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO			4	10	40	200		
	In				Pct	Pct					Pct	
1----------	0-2	Fine sand-----	SM, SP-SM	A-2	0	0	80-100	75-100	65-80	10-20	---	NP
Aneth	2-60	Loamy fine sand, sandy loam.	SM	A-2	0	0	80-100	75-100	75-90	20-35	---	NP
2*:												
Arches-------	0-16	Fine sand-----	SM	A-2	0	0	100	100	65-85	20-30	---	NP
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Pensom-------	0-2	Fine sand-----	SM	A-2	0	0	100	100	70-95	20-35	---	NP
	2-55	Fine sand, loamy fine sand.	SM	A-2	0	0	100	100	70-95	15-35	---	NP
	55	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
3*:												
Arches-------	0-1	Fine sand-----	SM	A-2	0	0	100	100	65-85	20-30	---	NP
	1-16	Fine sand-----	SM	A-2	0	0	100	100	65-85	20-35	---	NP
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Pensom-------	0-2	Fine sand-----	SM	A-2	0	0	100	100	70-95	20-35	---	NP
	2-55	Fine sand, loamy fine sand.	SM	A-2	0	0	100	100	70-95	15-35	---	NP
	55	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
4----------	0-3	Gravelly loam	CL-ML, ML, SC-SM, SM	A-2, A-4	0	0	55-80	50-75	40-70	30-55	20-30	5-10
Barx	3-29	Sandy clay loam, clay loam.	CL, CL-ML, SC, SC-SM	A-4, A-6	0	0	80-100	75-100	60-90	25-55	25-35	5-15
	29-60	Sandy loam, loam.	SM, SC-SM, CL-ML	A-2, A-4	0	0	80-100	75-100	45-70	20-40	10-25	NP-5
5*:												
Barx---------	0-3	Fine sandy loam.	SM, SC-SM, CL-ML, ML	A-4	0	0	100	100	70-95	40-65	20-30	NP-10
	3-29	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
	29-60	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
Pensom-------	0-2	Fine sand-----	SM	A-2	0	0	100	100	70-95	20-35	---	NP
	2-55	Fine sand, loamy fine sand.	SM	A-2	0	0	100	100	70-95	15-35	---	NP
	55	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

Table 13.--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	
6*:												
Bidonia------	0-2	Sandy loam----	SM, SC-SM	A-2, A-4	0	0	85-100	80-100	50-70	25-40	15-30	NP-10
	2-6	Channery fine sandy loam, loam.	CL-ML, ML, CL	A-4	0	0	55-100	50-100	50-95	50-75	10-30	NP-10
	6-12	Clay, sandy clay.	CL, CH	A-7	0	0	80-100	75-100	75-100	55-95	40-60	20-45
	12	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Rock outcrop.												
7*:												
Bison--------	0-4	Gravelly loam	CL-ML, CL, SC, SC-SM	A-2, A-4	0	0	55-80	50-75	40-70	30-55	20-30	5-10
	4-26	Gravelly loam, loam.	CL-ML, CL, SC, SC-SM	A-2, A-4	0	0-5	55-100	50-100	40-95	30-75	20-30	5-10
	26-38	Indurated-----	---	---	---	---	---	---	---	---	---	---
	38-60	Gravelly loam, gravelly sandy loam.	CL-ML, ML, SM, SC-SM	A-1, A-2, A-4	0	0-10	55-80	50-75	30-70	15-55	20-30	---
Curob--------	0-3	Very gravelly loam.	GM-GC, GC	A-2, A-1	0	0-5	50-60	35-50	30-50	20-35	20-30	5-10
	3-7	Gravelly loam, gravelly sandy loam.	SC-SM, CL-ML, SC, CL	A-2, A-4	0	0-5	70-85	60-75	50-70	25-55	20-30	5-10
	7-13	Very gravelly loam, very gravelly sandy loam.	GM-GC, GC, GP-GC	A-2, A-1	0	0-5	40-60	30-50	25-50	10-35	20-30	5-10
	13-19	Indurated-----	---	---	---	---	---	---	---	---	---	---
	19-60	Extremely gravelly loamy coarse sand.	GP, GP-GM, GM, GW-GM	A-1	0	0-10	10-30	5-25	5-15	0-5	10-15	NP
8---------- Clayhole	0-3	Silty clay loam.	CL	A-6	0	0	80-100	75-100	70-100	65-75	30-35	10-15
	3-44	Loam, silt loam.	CL, CL-ML, SC, SC-SM	A-4	0	0	80-100	75-100	65-95	45-75	20-30	5-10
	44-60	Silty clay loam.	CL	A-6	0	0	80-100	75-100	70-100	65-75	30-35	10-15
9*:												
Clayhole-----	0-3	Loam----------	CL, CL-ML, SC, SC-SM	A-4	0	0	80-100	75-100	65-95	45-75	20-30	5-10
	3-44	Loam, silt loam.	CL, CL-ML, SC, SC-SM	A-4	0	0	80-100	75-100	65-95	45-75	20-30	5-10
	44-60	Silty clay loam.	CL	A-6	0	0	80-100	75-100	70-100	65-75	30-35	10-15
Torriorthents	0-60	Variable------	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

Table 13.--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*:												
Curhollow----	0-2	Loam----------	CL-ML, CL, SC-SM, SC	A-4	0	0-5	80-100	75-100	65-95	45-75	20-30	5-10
	2-13	Very gravelly loam.	GC, GM-GC	A-2, A-4, A-1	0	0-5	30-55	25-50	20-50	15-40	20-30	5-10
	13-19	Cemented------	---	---	---	---	---	---	---	---	---	---
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Mellenthin---	0-2	Very gravelly loam.	GC, GM-GC	A-2, A-4, A-1	0-5	0-5	30-55	25-50	20-50	15-40	20-30	5-10
	2-8	Very gravelly loam.	GC, GM-GC	A-2, A-4, A-1	0-5	0-5	35-55	25-50	20-50	15-40	20-30	5-10
	8-13	Extremely gravelly sandy loam.	GW-GM, GP-GM	A-1	0	0-5	20-30	15-25	10-20	5-10	15-25	NP-5
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
11---------- Curob	0-9	Loamy sand----	SM	A-2	0	0	100	90-100	50-75	15-20	---	NP
	9-16	Gravelly sandy loam.	SM, GM, GM-GC, SC-SM	A-2, A-1	0	0	60-85	50-75	30-50	15-30	15-20	NP-5
	16-26	Indurated-----	---	---	---	---	---	---	---	---	---	---
	26	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
12---------- Curob	0-3	Very gravelly loam.	GM-GC, GC	A-2, A-1	0	0-5	50-60	35-50	30-50	20-35	20-30	5-10
	3-7	Gravelly loam, gravelly sandy loam.	SC-SM, CL-ML, SC, CL	A-2, A-4	0	0-5	70-85	60-75	50-70	25-55	20-30	5-10
	7-13	Very gravelly loam, very gravelly sandy loam.	GM-GC, GC, GP-GC	A-2, A-1	0	0-5	40-60	30-50	25-50	10-35	20-30	5-10
	13-19	Indurated-----	---	---	---	---	---	---	---	---	---	---
	19-60	Extremely gravelly loamy coarse sand.	GP, GP-GM, GM, GW-GM	A-1	0	0-10	10-30	5-25	5-15	0-5	10-15	NP
13---------- Disterheff	0-3	Very gravelly loam.	GC, GM-GC	A-1, A-4, A-2	0	0	30-55	25-50	20-50	15-40	20-30	5-10
	3-7	Clay loam, gravelly clay loam.	CL, GC, SC	A-6	0	0	55-100	50-100	45-100	35-80	30-35	10-15
	7-22	Clay, gravelly clay.	CL, CH, GC, SC	A-7	0	0	55-100	50-100	45-100	40-95	40-60	20-45
	22-37	Gravelly clay loam, clay loam.	CL, GC, SC	A-6	0	0	55-100	50-100	45-100	35-80	30-35	10-15
	37-60	Very gravelly clay loam, gravelly clay loam.	CL, GC, SC	A-2, A-6	0	0	35-80	25-75	20-75	20-60	30-35	10-15

See footnote at end of table.

Table 13.--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	
14*:												
Disterheff---	0-3	Gravelly loam	SC, SC-SM, CL-ML, CL	A-2, A-4	0	0	55-80	50-75	40-70	30-55	20-30	5-10
	3-7	Clay loam, gravelly clay loam.	CL, GC, SC	A-6	0	0	55-100	50-100	45-100	35-80	30-35	10-15
	7-22	Clay, gravelly clay.	CL, CH, GC, SC	A-7	0	0	55-100	50-100	45-100	40-95	40-60	20-45
	22-37	Gravelly clay loam, clay loam.	CL, GC, SC	A-6	0	0	55-100	50-100	45-100	35-80	30-35	10-15
	37-60	Very gravelly clay loam, gravelly clay loam.	CL, GC, SC	A-2, A-6	0	0	35-80	25-75	20-75	20-60	30-35	10-15
Houserock----	0-3	Gravelly loam	CL-ML, CL, SC, SC-SM	A-2, A-4	0	0-10	60-85	50-75	40-70	30-55	20-30	5-10
	3-8	Gravelly clay loam, very gravelly clay loam.	GC, SC	A-2, A-6	0	0	50-75	40-65	35-65	30-50	30-35	10-15
	8-19	Very gravelly clay, extremely gravelly clay.	GC	A-2, A-7	0	0	25-60	20-50	15-50	15-45	45-60	20-45
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
15---------- Doak	0-2	Fine sandy loam.	SM, ML, CL-ML, SC-SM	A-4	0	0	100	100	80-95	40-60	20-25	NP-5
	2-60	Loam, clay loam, sandy clay loam.	CL	A-6	0	0	100	100	80-100	60-80	25-40	10-20
16---------- Glenyon	0-2	Silty clay loam.	CL	A-6	0	0	95-100	90-100	85-100	75-95	30-35	10-15
	2-34	Silty clay loam.	CL	A-6	0	0	95-100	90-100	85-100	75-95	30-35	10-15
	34-60	Loamy sand, loamy fine sand.	SM	A-2	0	0	100	100	55-70	15-20	0-25	NP
17*:												
Houserock----	0-3	Gravelly loam	CL-ML, CL, SC, SC-SM	A-2, A-4	0	0-10	60-85	50-75	40-70	30-55	20-30	5-10
	3-8	Gravelly clay loam, very gravelly clay loam.	GC, SC	A-2, A-6	0	0	50-75	40-65	35-65	30-50	30-35	10-15
	8-19	Very gravelly clay, extremely gravelly clay.	GC	A-2, A-7	0	0	25-60	20-50	15-50	15-45	45-60	20-45
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

Table 13.--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	
17*:												
Disterheff---	0-3	Gravelly loam	SC, SC-SM, CL-ML, CL	A-2, A-4	0	0	55-80	50-75	40-70	30-55	20-30	5-10
	3-7	Clay loam, gravelly clay loam.	CL, GC, SC	A-6	0	0	55-100	50-100	45-100	35-80	30-35	10-15
	7-22	Clay, gravelly clay.	CL, CH, GC, SC	A-7	0	0	55-100	50-100	45-100	40-95	40-60	20-45
	22-37	Gravelly clay loam, clay loam.	CL, GC, SC	A-6	0	0	55-100	50-100	45-100	35-80	30-35	10-15
	37-60	Very gravelly clay loam, gravelly clay loam.	CL, GC, SC	A-2, A-6	0	0	35-80	25-75	20-75	20-60	30-35	10-15
18---------- Jocity	0-4	Clay loam-----	ML, CL	A-6	0	0	100	100	90-100	70-80	35-40	10-15
	4-60	Stratified silt loam to clay loam.	ML, CL	A-6	0	0	100	95-100	85-100	60-90	35-40	10-15
19---------- Jocity	0-4	Silty clay loam.	CL	A-6, A-7	0	0	100	100	90-100	70-95	30-50	10-30
	4-60	Loam, clay loam, silt loam.	CL	A-6	0	0	100	100	85-100	60-90	30-35	10-15
20---------- Keeseha	0-1	Loam----------	CL-ML, CL	A-4	0	0	90-100	80-90	70-85	50-65	20-30	5-10
	1-2	Clay loam-----	ML, CL	A-4, A-6	0	0	90-100	80-90	70-90	55-70	30-40	5-15
	2-14	Clay----------	CL, CH	A-7	0	0	90-100	80-90	70-90	60-80	40-55	20-30
	14-19	Gravelly clay loam.	ML, CL	A-4, A-6	0	0	70-85	60-75	55-75	50-60	30-40	5-15
	19-60	Gravelly sandy loam.	SM, SC-SM	A-2, A-1	0	0	70-85	60-75	35-50	20-30	15-25	NP-5
21*, 22*:												
Kinan--------	0-1	Gravelly sandy loam.	SM, SC-SM	A-2, A-1	0	0-5	70-85	60-75	35-50	20-30	15-25	NP-5
	1-13	Sandy loam----	SM, SC-SM	A-2, A-4	0	0	95-100	90-100	55-70	25-40	15-25	NP-5
	13-27	Very gravelly sandy loam.	GM-GC, GM, GP-GM, SM	A-1	0	0-10	40-60	30-50	20-40	10-20	10-25	NP-5
	27-60	Loam, sandy loam.	SM, SC-SM	A-2, A-4	0	0	95-100	90-100	55-70	25-40	15-25	NP-5
Pennell------	0-4	Gravelly sandy loam.	SM, SC-SM, GM-GC, GM	A-4, A-2, A-1	0	0-5	55-80	50-75	35-70	20-55	15-25	NP-10
	4-7	Sandy loam----	SM, SC-SM	A-2, A-4	0	0-5	95-100	85-95	50-65	25-40	15-20	NP-5
	7-14	Very gravelly sandy loam.	SM, GM, GP-GM, GM-GC	A-1	0	0-5	45-60	35-50	20-35	10-20	15-20	NP-5
	14-19	Sandy loam----	SM, SC-SM	A-2, A-4	0	0-5	95-100	85-95	50-65	25-40	15-20	NP-5
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
23---------- Klondike	0-1	Sandy clay loam.	SC-SM, SC, CL, CL-ML	A-4, A-6, A-2	0	0-5	80-100	75-100	60-90	25-55	25-35	5-15
	1-11	Loam, gravelly loam, clay loam.	CL-ML, CL, SC, SC-SM	A-2, A-4	0	0-5	75-100	70-100	40-85	30-75	20-30	5-10
	11	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

Table 13.--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	
24---------- Manikan	0-3	Silty clay loam.	ML, CL	A-6, A-7	0	0	95-100	90-100	80-100	75-85	35-45	10-20
	3-30	Silt loam, loam.	CL-ML	A-4	0	0	95-100	90-100	80-100	65-80	25-30	5-10
	30-42	Silty clay loam.	ML, CL	A-6, A-7	0	0	95-100	90-100	85-100	75-85	35-45	10-20
	42-60	Loam----------	CL-ML	A-4	0	0	90-100	85-100	65-80	50-70	20-30	5-10
25, 26-------- Mellenthin	0-2	Very gravelly loam.	GC, GM-GC	A-2, A-4, A-1	0-5	0-5	30-55	25-50	20-50	15-40	20-30	5-10
	2-8	Very gravelly loam.	GC, GM-GC	A-2, A-4, A-1	0-5	0-5	35-55	25-50	20-50	15-40	20-30	5-10
	8-13	Extremely gravelly sandy loam.	GW-GM, GP-GM	A-1	0	0-5	20-30	15-25	10-20	5-10	15-25	NP-5
	13	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
27---------- Monierco	0-1	Clay loam-----	CL	A-6	0	0	95-100	85-100	75-100	60-80	30-40	10-15
	1-10	Clay loam-----	ML, CL	A-6, A-7	0	0	95-100	95-100	85-100	65-80	35-45	10-20
	10-19	Gravelly loam	SC-SM, GC, SC, GM-GC	A-4	0	0	70-85	60-75	50-70	35-50	15-25	5-10
	19	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
28---------- Monue	0-1	Sandy loam----	SM, SC-SM	A-2, A-4	0	0	100	95-100	55-70	30-40	15-20	NP-5
	1-43	Fine sandy loam.	SM, ML, CL-ML, SC-SM	A-4	0	0	100	95-100	70-85	40-55	15-25	NP-5
	43-60	Silty clay loam.	CL	A-6	0	0	100	95-100	90-100	80-95	30-40	10-15
29*:												
Monue--------	0-43	Fine sandy loam.	SM, ML, CL-ML, SC-SM	A-4	0	0	100	95-100	70-85	40-55	15-25	NP-5
	43-60	Silty clay loam.	CL	A-6	0	0	100	95-100	90-100	80-95	30-40	10-15
Seeg---------	0-3	Fine sandy loam.	SM	A-4	0	0-5	80-100	75-100	50-85	30-55	10-25	NP-5
	3-18	Gravelly fine sandy loam.	SM	A-2, A-4	0	0-5	55-80	50-75	35-65	20-40	10-25	NP-5
	18-46	Very gravelly loam, extremely gravelly loam.	GM, GM-GC, SM, SC-SM	A-2, A-4	0	0-5	20-55	15-50	15-50	10-40	20-30	5-10
	46-60	Fine sandy loam.	SM	A-4	0	0-5	80-100	75-100	50-85	30-55	10-25	NP-5
30*:												
Needle-------	0-2	Fine sand-----	SM	A-2	0	0	95-100	95-100	60-80	20-35	---	NP
	2-11	Fine sand, loamy fine sand.	SM	A-2	0	0	95-100	95-100	60-80	20-35	0-25	NP
	11	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Rock outcrop.												

See footnote at end of table.

Table 13.--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	
31*:												
Needle-------	0-2	Fine sand-----	SM	A-2	0	0	95-100	95-100	60-80	20-35	---	NP
	2-11	Fine sand, loamy fine sand.	SM	A-2	0	0	95-100	95-100	60-80	20-35	0-25	NP
	11	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Sheppard-----	0-4	Fine sand-----	SM, SP-SM	A-2	0	0	100	100	65-80	10-20	---	NP
	4-60	Loamy fine sand, fine sand, loamy sand.	SM	A-2	0	0	100	90-100	70-80	15-25	---	NP
32---------- Pagina	0-2	Loamy sand----	SM	A-2, A-1	0	0	80-100	75-100	45-75	15-30	10-25	NP
	2-22	Loamy fine sand.	SM, SP-SM	A-2, A-1	0	0	80-100	75-100	40-75	10-30	10-25	NP
	22-38	Sandy loam----	SM, SC-SM	A-2, A-4, A-1	0	0	80-100	75-100	45-70	20-40	15-25	NP-5
	38	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
33*:												
Pagina-------	0-2	Fine sand-----	SM	A-2	0	0	80-100	75-100	50-80	15-30	---	NP
	2-22	Loamy fine sand.	SM, SP-SM	A-2, A-1	0	0	80-100	75-100	40-75	10-30	10-25	NP
	22-38	Sandy loam----	SM, SC-SM	A-2, A-4, A-1	0	0	80-100	75-100	45-70	20-40	15-25	NP-5
	38	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
Wahweap------	0-1	Fine sand-----	SM	A-2	0	0	100	90-100	60-80	20-35	---	NP
	1-12	Loamy fine sand, fine sand, gravelly loamy fine sand.	SM, SP-SM	A-2, A-1	0	0	75-100	70-100	25-85	10-35	0-25	NP
	12-19	Very gravelly fine sandy loam, extremely gravelly fine sandy loam.	GW-GM, GM, SM, GP-GM	A-1	0	0-10	20-60	15-50	10-40	10-20	15-20	NP-5
	19	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
34---------- Pennell	0-4	Cobbly loam---	SM, SC-SM, ML, CL-ML	A-4	0-5	25-35	85-95	75-85	65-80	45-60	15-25	NP-10
	4-7	Sandy loam----	SM, SC-SM	A-2, A-4	0	0-5	95-100	85-95	50-65	25-40	15-20	NP-5
	7-14	Very gravelly sandy loam.	SM, GM, GP-GM, GM-GC	A-1	0	0-5	45-60	35-50	20-35	10-20	15-20	NP-5
	14-19	Sandy loam----	SM, SC-SM	A-2, A-4	0	0-5	95-100	85-95	50-65	25-40	15-20	NP-5
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

Table 13.--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	
35---------- Pennell	0-4	Gravelly sandy loam.	SM, SC-SM, GM-GC, GM	A-4, A-2, A-1	0	0-5	55-80	50-75	35-70	20-55	15-25	NP-10
	4-7	Sandy loam----	SM, SC-SM	A-2, A-4	0	0-5	95-100	85-95	50-65	25-40	15-20	NP-5
	7-14	Very gravelly sandy loam.	SM, GM, GP-GM, GM-GC	A-1	0	0-5	45-60	35-50	20-35	10-20	15-20	NP-5
	14-19	Sandy loam----	SM, SC-SM	A-2, A-4	0	0-5	95-100	85-95	50-65	25-40	15-20	NP-5
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
36---------- Pennell	0-4	Sandy loam----	SM, SC-SM	A-2, A-4	0	0-5	95-100	85-95	50-65	25-40	15-20	NP-5
	4-7	Sandy loam----	SM, SC-SM	A-2, A-4	0	0-5	95-100	85-95	50-65	25-40	15-20	NP-5
	7-14	Very gravelly sandy loam.	SM, GM, GM-GC, SC-SM	A-1	0	0-5	45-60	35-50	20-35	10-20	15-20	NP-5
	14-19	Sandy loam----	SM, SC-SM	A-2, A-4	0	0-5	95-100	85-95	50-65	25-40	15-20	NP-5
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
37---------- Pensom	0-2	Fine sand-----	SM	A-2	0	0	100	100	70-95	20-35	---	NP
	2-55	Fine sand, loamy fine sand.	SM	A-2	0	0	100	100	70-95	15-35	---	NP
	55	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
38*, 39*: Pensom-------	0-2	Loamy fine sand.	SM	A-2, A-4	0	0	100	100	75-90	30-40	---	NP
	2-55	Fine sand, loamy fine sand.	SM	A-2	0	0	100	100	70-95	15-35	---	NP
	55	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
Arches-------	0-16	Loamy fine sand.	SM	A-4	0	0	100	100	85-95	35-45	---	NP
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
40*. Pits, borrow												
41*. Rock outcrop												
42*: Rock outcrop.												
Needle-------	0-2	Fine sand-----	SM	A-2	0	0	95-100	95-100	60-80	20-35	---	NP
	2-11	Fine sand, loamy fine sand.	SM	A-2	0	0	95-100	95-100	60-80	20-35	0-25	NP
	11	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---
43*: Rock outcrop.												
Torriorthents	0-60	Variable------	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

Table 13.--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	
44, 45-------- Sheppard	0-4	Loamy fine sand.	SM	A-2	0	0	100	100	65-80	25-35	---	NP
	4-60	Loamy fine sand, fine sand, loamy sand.	SM	A-2	0	0	100	90-100	70-80	15-25	---	NP
46---------- Strych	0-2	Loam----------	CL-ML, CL, SC-SM, SC	A-4	0	0-5	80-100	75-100	65-95	45-75	20-30	5-10
	2-14	Very gravelly loam.	GC, GM-GC	A-2, A-4, A-1	0	0-10	30-55	25-50	20-50	15-40	20-30	5-10
	14-32	Extremely gravelly loam.	GM, GM-GC, GP-GC	A-2, A-1	0	0-10	20-30	15-25	15-25	10-20	20-30	5-10
	32-60	Extremely gravelly sandy loam.	GW-GM, GP-GM	A-1	0	0-10	20-30	15-25	10-20	5-10	10-25	NP-5
47---------- Torriorthents	0-60	Variable------	---	---	---	---	---	---	---	---	---	---
48*: Torriorthents	0-60	Variable------	---	---	---	---	---	---	---	---	---	---
Rock outcrop.												
49---------- Wahweap	0-1	Loamy sand----	SM	A-2	0	0	100	90-100	50-75	15-30	10-25	NP
	1-12	Loamy fine sand, fine sand, gravelly loamy fine sand.	SM, SP-SM	A-2, A-1	0	0	75-100	70-100	25-85	10-35	0-25	NP
	12-19	Very gravelly fine sandy loam, extremely gravelly fine sandy loam.	GW-GM, GM, SM, GP-GM	A-1	0	0-10	20-60	15-50	10-40	10-20	15-20	NP-5
	19	Weathered bedrock.	---	---	---	---	---	---	---	---	---	---
50*: Wahweap------	0-1	Gravelly sandy loam.	SM, GM, GM-GC, SC-SM	A-1, A-2	0	0	55-80	50-75	30-50	15-30	10-25	NP-5
	1-12	Loamy fine sand, fine sand, gravelly loamy fine sand.	SM, SP-SM	A-2, A-1	0	0	75-100	70-100	25-85	10-35	0-25	NP
	12-19	Very gravelly fine sandy loam, extremely gravelly fine sandy loam.	GW-GM, GM, SM, GP-GM	A-1	0	0-10	20-60	15-50	10-40	10-20	15-20	NP-5
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---	---

See footnote at end of table.

Table 13.--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	
50*:												
Rock outcrop.												
51----------	0-2	Very gravelly	GC, GM-GC	A-2, A-4,	0	0-10	30-55	25-50	20-50	15-40	20-30	5-15
Yumtheska		loam.		A-1, A-6								
	2-19	Very gravelly	GC, GM-GC	A-2, A-4,	0	0-15	30-55	25-50	20-50	15-40	20-30	5-15
		loam.		A-1, A-6								
	19	Unweathered	---	---	---	---	---	---	---	---	---	---
		bedrock.										
52*:												
Yumtheska----	0-2	Gravelly loam	SC, SC-SM,	A-2, A-4	0	0-10	55-80	50-75	40-70	30-55	20-30	5-10
			CL-ML, CL									
	2-19	Very gravelly	GC, GM-GC	A-2, A-4,	0	0-15	30-55	25-50	20-50	15-40	20-30	5-15
		loam.		A-1, A-6								
	19	Unweathered	---	---	---	---	---	---	---	---	---	---
		bedrock.										
Houserock----	0-3	Gravelly loam	CL-ML, CL,	A-2, A-4	0	0-10	60-85	50-75	40-70	30-55	20-30	5-10
			SC, SC-SM									
	3-8	Gravelly clay	GC, SC	A-2, A-6	0	0	50-75	40-65	35-65	30-50	30-35	10-15
		loam, very										
		gravelly clay										
		loam.										
	8-19	Very gravelly	GC	A-2, A-7	0	0	25-60	20-50	15-50	15-45	45-60	20-45
		clay,										
		extremely										
		gravelly										
		clay.										
	19	Unweathered	---	---	---	---	---	---	---	---	---	---
		bedrock.										

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 14.--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		Wind erodibility group	Organic matter
									K	T		
	In	Pct	G/cc	In/hr	In/in	pH	mmhos/cm					Pct
1----------	0-2	1-5	1.50-1.60	6.0-20	0.05-0.07	7.4-8.4	<2	Low	0.15	5	1	<.5
Aneth	2-60	3-10	1.55-1.65	6.0-20	0.08-0.10	7.4-8.4	<2	Low	0.15			
2*:												
Arches----------	0-16	2-4	1.30-1.40	6.0-20	0.06-0.08	7.4-8.4	<2	Low	0.28	1	1	<1
	16	---	---	---	---	---	---	---	---			
Pensom----------	0-2	3-8	1.40-1.50	>20	0.05-0.08	7.9-8.4	<2	Low	0.15	3	1	<1
	2-55	3-8	1.40-1.50	>20	0.05-0.08	7.9-8.4	<2	Low	0.15			
	55	---	---	---	---	---	---	---	---			
3*:												
Arches----------	0-1	2-4	1.30-1.40	6.0-20	0.06-0.08	7.4-8.4	<2	Low	0.28	1	1	<1
	1-16	2-6	1.30-1.50	6.0-20	0.06-0.08	7.4-9.0	<2	Low	0.28			
	16	---	---	---	---	---	---	---	---			
Pensom----------	0-2	3-8	1.40-1.50	>20	0.05-0.08	7.9-8.4	<2	Low	0.15	3	1	<1
	2-55	3-8	1.40-1.50	>20	0.05-0.08	7.9-8.4	<2	Low	0.15			
	55	---	---	---	---	---	---	---	---			
4----------	0-3	7-27	1.15-1.25	0.6-2.0	0.10-0.15	7.4-8.4	<2	Low	0.24	5	4L	1-2
Barx	3-29	20-35	1.25-1.50	0.6-2.0	0.12-0.16	7.4-8.4	<2	Moderate	0.28			
	29-60	5-20	1.35-1.50	2.0-6.0	0.09-0.13	7.9-8.4	<2	Low	0.20			
5*:												
Barx----------	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
	3-29	22-35	1.25-1.40	0.6-2.0	0.16-0.19	7.4-9.0	<2	Moderate	0.24			
	29-60	16-30	1.25-1.40	0.6-2.0	0.11-0.18	7.9-9.0	<2	Moderate	0.28			
Pensom----------	0-2	3-8	1.40-1.50	>20	0.05-0.08	7.9-8.4	<2	Low	0.15	3	1	<1
	2-55	3-8	1.40-1.50	>20	0.05-0.08	7.9-8.4	<2	Low	0.15			
	55	---	---	---	---	---	---	---	---			
6*:												
Bidonia----------	0-2	5-20	1.20-1.35	2.0-6.0	0.10-0.13	7.4-7.8	<2	Low	0.24	2	3	1-2
	2-6	5-27	1.25-1.50	0.6-6.0	0.07-0.18	7.4-8.4	<2	Low	0.24			
	6-12	40-60	1.15-1.30	0.06-0.2	0.12-0.16	7.4-8.4	<2	High	0.32			
	12	---	---	---	---	---	---	---	---			
Rock outcrop.												
7*:												
Bison----------	0-4	7-27	1.15-1.25	0.6-2.0	0.10-0.14	7.9-8.4	<2	Low	0.17	2	4L	<1
	4-26	7-27	1.25-1.50	0.6-2.0	0.10-0.18	7.9-8.4	<2	Low	0.17			
	26-38	---	---	---	---	---	---	---	---			
	38-60	5-27	1.25-1.50	0.06-2.0	0.10-0.14	7.9-8.4	<2	Low	0.17			
Curob----------	0-3	15-25	1.30-1.40	0.6-2.0	0.07-0.09	7.9-8.4	<2	Low	0.15	1	8	1-2
	3-7	15-25	1.30-1.40	0.6-2.0	0.10-0.14	7.9-8.4	<2	Low	0.32			
	7-13	15-25	1.30-1.40	0.6-2.0	0.07-0.09	7.9-8.4	<2	Low	0.17			
	13-19	---	---	---	---	---	---	---	---			
	19-60	0-5	1.45-1.55	6.0-20	0.01-0.03	7.9-8.4	<2	Low	0.02			

See footnote at end of table.

Table 14.--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
8	0-3	27-35	1.15-1.30	0.2-0.6	0.12-0.16	7.4-8.4	<2	Moderate	0.32	5	4L	<1
Clayhole	3-44	7-27	1.25-1.50	0.6-2.0	0.10-0.14	7.4-8.4	<2	Low	0.32			
	44-60	27-35	1.15-1.30	0.2-0.6	0.12-0.16	7.4-8.4	<2	Moderate	0.32			
9*:												
Clayhole	0-3	7-27	1.15-1.25	0.6-2.0	0.10-0.14	7.4-8.4	<2	Low	0.32	5	4L	<1
	3-44	7-27	1.25-1.50	0.6-2.0	0.10-0.14	7.4-8.4	<2	Low	0.32			
	44-60	27-35	1.15-1.30	0.2-0.6	0.12-0.16	7.4-8.4	<2	Moderate	0.32			
Torriorthents	0-60	---	---	---	---	7.9-9.0	2-8	---	---	---	---	---
10*:												
Curhollow	0-2	7-27	1.15-1.25	0.6-2.0	0.14-0.18	7.4-8.4	<2	Low	0.32	1	4L	1-2
	2-13	7-27	1.15-1.25	0.6-2.0	0.05-0.12	7.4-8.4	<2	Low	0.10			
	13-19	---	---	---	---	---	---	---	---			
	19	---	---	---	---	---	---	---	---			
Mellenthin	0-2	7-27	1.15-1.25	0.6-2.0	0.05-0.12	7.4-8.4	<2	Low	0.10	2	8	1-2
	2-8	7-27	1.25-1.50	0.6-2.0	0.05-0.12	7.9-8.4	<2	Low	0.10			
	8-13	5-20	1.35-1.50	2.0-6.0	0.03-0.05	7.9-8.4	<2	Low	0.05			
	13	---	---	---	---	---	---	---	---			
11	0-9	3-8	1.40-1.50	6.0-20	0.06-0.09	7.9-8.4	<2	Low	0.15	1	2	<1
Curob	9-16	10-15	1.30-1.40	2.0-6.0	0.07-0.10	7.9-8.4	<2	Low	0.17			
	16-26	---	---	---	---	---	---	---	---			
	26	---	---	---	---	---	---	---	---			
12	0-3	15-25	1.30-1.40	0.6-2.0	0.07-0.09	7.9-8.4	<2	Low	0.15	1	8	1-2
Curob	3-7	15-25	1.30-1.40	0.6-2.0	0.10-0.14	7.9-8.4	<2	Low	0.32			
	7-13	15-25	1.30-1.40	0.6-2.0	0.07-0.09	7.9-8.4	<2	Low	0.17			
	13-19	---	---	---	---	---	---	---	---			
	19-60	0-5	1.45-1.55	6.0-20	0.01-0.03	7.9-8.4	<2	Low	0.02			
13	0-3	7-27	1.15-1.25	0.6-2.0	0.05-0.09	7.4-7.8	<2	Low	0.10	5	8	1-3
Disterheff	3-7	27-35	1.25-1.50	0.2-0.6	0.12-0.18	7.4-8.4	<2	Moderate	0.24			
	7-22	35-60	1.15-1.30	0.06-0.2	0.09-0.13	7.4-8.4	<2	High	0.28			
	22-37	27-35	1.25-1.50	0.2-0.6	0.12-0.16	7.9-8.4	<2	Moderate	0.24			
	37-60	27-35	1.25-1.50	0.2-0.6	0.07-0.11	7.9-8.4	<2	Moderate	0.15			
14*:												
Disterheff	0-3	7-25	1.15-1.25	0.6-2.0	0.10-0.15	7.4-7.8	<2	Low	0.24	5	4L	1-3
	3-7	27-35	1.25-1.50	0.2-0.6	0.12-0.18	7.4-8.4	<2	Moderate	0.24			
	7-22	35-60	1.15-1.30	0.06-0.2	0.09-0.13	7.4-8.4	<2	High	0.28			
	22-37	27-35	1.25-1.50	0.2-0.6	0.12-0.16	7.9-8.4	<2	Moderate	0.24			
	37-60	27-35	1.25-1.50	0.2-0.6	0.07-0.11	7.9-8.4	<2	Moderate	0.15			
Houserock	0-3	7-27	1.15-1.25	0.6-2.0	0.10-0.15	7.4-7.8	<2	Low	0.24	1	4L	1-3
	3-8	27-40	1.25-1.50	0.2-0.6	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	8-19	40-60	1.15-1.30	0.06-0.2	0.03-0.10	7.4-8.4	<2	High	0.10			
	19	---	---	---	---	---	---	---	---			
15	0-2	10-20	1.40-1.50	2.0-6.0	0.11-0.14	7.4-8.4	<2	Low	0.28	5	3	.5-.6
Doak	2-60	25-35	1.40-1.50	0.2-0.6	0.15-0.18	7.9-9.0	2-4	Moderate	0.37			
16	0-2	27-40	1.05-1.15	0.2-0.6	0.19-0.21	8.5-9.0	2-8	Moderate	0.32	5	4L	<1
Glenyon	2-34	35-40	1.15-1.30	0.2-0.6	0.19-0.21	8.5-9.0	2-8	Moderate	0.37			
	34-60	0-15	1.35-1.50	6.0-20	0.06-0.10	7.9-8.4	<2	Low	0.10			

See footnote at end of table.

Table 14.--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
17*:												
Houserock	0-3	7-27	1.15-1.25	0.6-2.0	0.10-0.15	7.4-7.8	<2	Low	0.24	1	4L	1-3
	3-8	27-40	1.25-1.50	0.2-0.6	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	8-19	40-60	1.15-1.30	0.06-0.2	0.03-0.10	7.4-8.4	<2	High	0.10			
	19	---	---	---	---	---	---	---	---			
Disterheff	0-3	7-25	1.15-1.25	0.6-2.0	0.10-0.15	7.4-7.8	<2	Low	0.24	5	4L	1-3
	3-7	27-35	1.25-1.50	0.2-0.6	0.12-0.18	7.4-8.4	<2	Moderate	0.24			
	7-22	35-60	1.15-1.30	0.06-0.2	0.09-0.13	7.4-8.4	<2	High	0.28			
	22-37	27-35	1.25-1.50	0.2-0.6	0.12-0.16	7.9-8.4	<2	Moderate	0.24			
	37-60	27-35	1.25-1.50	0.2-0.6	0.07-0.11	7.9-8.4	<2	Moderate	0.15			
18	0-4	30-35	1.30-1.40	0.2-0.6	0.18-0.20	7.4-8.4	<2	Moderate	0.32	5	4L	<.5
Jocity	4-60	18-35	1.30-1.40	0.2-0.6	0.18-0.20	7.9-8.4	<2	Moderate	0.32			
19	0-4	27-45	1.15-1.25	0.06-0.2	0.14-0.21	7.4-7.8	<2	High	0.28	5	4	<1
Jocity	4-60	23-28	1.25-1.40	0.2-0.6	0.15-0.21	7.9-9.0	<2	Moderate	0.37			
20	0-1	15-25	1.15-1.25	0.6-2.0	0.15-0.18	7.4-8.4	<2	Low	0.32	5	4L	1-2
Keeseha	1-2	27-35	1.25-1.50	0.2-0.6	0.17-0.20	7.4-8.4	<2	Moderate	0.32			
	2-14	40-50	1.15-1.30	0.06-0.2	0.12-0.15	7.4-8.4	<2	High	0.32			
	14-19	27-35	1.25-1.50	0.2-0.6	0.14-0.18	7.4-8.4	<2	Moderate	0.28			
	19-60	10-20	1.35-1.50	2.0-6.0	0.08-0.11	7.4-8.4	<2	Low	0.20			
21*, 22*:												
Kinan	0-1	10-20	1.25-1.35	2.0-6.0	0.08-0.10	7.4-8.4	<2	Low	0.17	5	3	<1
	1-13	5-20	1.25-1.35	2.0-6.0	0.11-0.14	7.4-8.4	<2	Low	0.24			
	13-27	5-20	1.35-1.50	2.0-6.0	0.05-0.08	7.9-8.4	<2	Low	0.05			
	27-60	5-20	1.25-1.35	2.0-6.0	0.11-0.14	7.9-8.4	<2	Low	0.24			
Pennell	0-4	10-20	1.30-1.35	0.6-2.0	0.12-0.15	7.9-8.4	<2	Low	0.32	1	4L	<.5
	4-7	10-15	1.35-1.40	2.0-6.0	0.10-0.13	7.9-8.4	<2	Low	0.20			
	7-14	10-15	1.35-1.40	2.0-6.0	0.05-0.08	7.9-8.4	<2	Low	0.15			
	14-19	10-15	1.35-1.40	2.0-6.0	0.10-0.13	7.9-8.4	<2	Low	0.20			
	19	---	---	---	---	---	---	---	---			
23	0-1	20-35	1.15-1.25	0.2-0.6	0.12-0.16	7.4-8.4	<2	Moderate	0.32	1	5	.5-1
Klondike	1-11	5-30	1.25-1.50	0.2-0.6	0.10-0.18	7.4-8.4	<2	Low	0.37			
	11	---	---	---	---	---	---	---	---			
24	0-3	30-40	1.05-1.15	0.2-0.6	0.19-0.21	7.4-8.4	<2	Moderate	0.32	5	4L	1-2
Manikan	3-30	18-27	1.30-1.40	0.6-2.0	0.19-0.21	7.4-8.4	<2	Low	0.49			
	30-42	30-40	1.05-1.15	0.2-0.6	0.19-0.21	7.4-8.4	0-2	Moderate	0.43			
	42-60	12-25	1.30-1.40	0.6-2.0	0.15-0.17	7.4-8.4	0-2	Low	0.37			
25, 26	0-2	7-27	1.15-1.25	0.6-2.0	0.05-0.12	7.4-8.4	<2	Low	0.10	2	8	1-2
Mellenthin	2-8	7-27	1.25-1.50	0.6-2.0	0.05-0.12	7.9-8.4	<2	Low	0.10			
	8-13	5-20	1.35-1.50	2.0-6.0	0.03-0.05	7.9-8.4	<2	Low	0.05			
	13	---	---	---	---	---	---	---	---			
27	0-1	27-35	1.40-1.50	0.2-0.6	0.17-0.21	7.4-8.4	<2	Moderate	0.32	1	4L	<1
Monierco	1-10	35-40	1.45-1.55	0.2-0.6	0.19-0.21	7.4-8.4	<2	Moderate	0.32			
	10-19	10-20	1.40-1.55	0.6-2.0	0.12-0.15	7.4-8.4	<2	Low	0.32			
	19	---	---	---	---	---	---	---	---			
28	0-1	10-15	1.35-1.40	2.0-6.0	0.11-0.13	7.4-8.4	<2	Low	0.20	5	3	<1
Monue	1-43	10-18	1.35-1.40	2.0-6.0	0.13-0.15	7.9-8.4	<2	Low	0.24			
	43-60	27-35	1.20-1.25	0.2-0.6	0.19-0.21	>8.4	<2	Moderate	0.32			

See footnote at end of table.

Table 14.--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
29*:												
Monue	0-43	10-20	1.35-1.40	2.0-6.0	0.13-0.15	7.4-8.4	<2	Low	0.24	5	3	<1
	43-60	27-35	1.20-1.25	0.2-0.6	0.19-0.21	>8.4	<2	Moderate	0.32			
Seeg	0-3	5-20	1.25-1.35	2.0-6.0	0.11-0.15	7.9-8.4	<2	Low	0.28	5	3	<1
	3-18	5-20	1.35-1.50	2.0-6.0	0.08-0.13	7.9-8.4	<2	Low	0.20			
	18-46	7-27	1.25-1.50	0.6-2.0	0.05-0.12	7.9-8.4	<2	Low	0.10			
	46-60	5-20	1.35-1.50	2.0-6.0	0.11-0.15	7.9-8.4	<2	Low	0.28			
30*:												
Needle	0-2	0-10	1.35-1.45	>20	0.05-0.07	7.4-8.4	<2	Low	0.10	1	1	<1
	2-11	0-15	1.45-1.55	>20	0.05-0.08	7.4-8.4	<2	Low	0.10			
	11	---	---	---	---	---	---	---	---			
Rock outcrop.												
31*:												
Needle	0-2	0-10	1.35-1.45	>20	0.05-0.07	7.4-8.4	<2	Low	0.10	1	1	<1
	2-11	0-15	1.45-1.55	>20	0.05-0.08	7.4-8.4	<2	Low	0.10			
	11	---	---	---	---	---	---	---	---			
Sheppard	0-4	2-5	1.50-1.60	6.0-20	0.05-0.07	7.4-8.4	<2	Low	0.20	5	1	<.5
	4-60	3-8	1.50-1.60	6.0-20	0.06-0.08	7.4-9.0	<2	Low	0.20			
32	0-2	0-15	1.45-1.55	6.0-20	0.05-0.08	7.9-8.4	<2	Low	0.15	2	2	<1
Pagina	2-22	0-15	1.45-1.55	6.0-20	0.08-0.11	7.9-8.4	<2	Low	0.15			
	22-38	5-20	1.35-1.50	2.0-6.0	0.09-0.13	7.9-8.4	<2	Low	0.20			
	38	---	---	---	---	---	---	---	---			
33*:												
Pagina	0-2	0-10	1.35-1.45	6.0-20	0.04-0.07	7.9-8.4	<2	Low	0.10	2	1	<1
	2-22	0-15	1.45-1.55	6.0-20	0.08-0.11	7.9-8.4	<2	Low	0.15			
	22-38	5-20	1.35-1.50	2.0-6.0	0.09-0.13	7.9-8.4	<2	Low	0.20			
	38	---	---	---	---	---	---	---	---			
Wahweap	0-1	0-10	1.45-1.55	>20	0.05-0.07	7.9-8.4	<2	Low	0.10	1	1	<1
	1-12	0-15	1.45-1.55	6.0-20	0.05-0.10	7.9-8.4	<2	Low	0.15			
	12-19	5-20	1.35-1.50	2.0-6.0	0.06-0.10	7.9-8.4	<2	Low	0.15			
	19	---	---	---	---	---	---	---	---			
34	0-4	10-20	1.30-1.35	0.6-2.0	0.12-0.15	7.9-8.4	<2	Low	0.32	1	4L	<.5
Pennell	4-7	10-15	1.35-1.40	2.0-6.0	0.10-0.13	7.9-8.4	<2	Low	0.20			
	7-14	10-15	1.35-1.40	2.0-6.0	0.05-0.08	7.9-8.4	<2	Low	0.15			
	14-19	10-15	1.35-1.40	2.0-6.0	0.10-0.13	7.9-8.4	<2	Low	0.20			
	19	---	---	---	---	---	---	---	---			
35	0-4	10-20	1.30-1.35	0.6-2.0	0.12-0.15	7.9-8.4	<2	Low	0.32	1	4L	<.5
Pennell	4-7	10-15	1.35-1.40	2.0-6.0	0.10-0.13	7.9-8.4	<2	Low	0.20			
	7-14	10-15	1.35-1.40	2.0-6.0	0.05-0.08	7.9-8.4	<2	Low	0.15			
	14-19	10-15	1.35-1.40	2.0-6.0	0.10-0.13	7.9-8.4	<2	Low	0.20			
	19	---	---	---	---	---	---	---	---			
36	0-4	10-15	1.35-1.40	2.0-6.0	0.10-0.13	7.9-8.4	<2	Low	0.20	1	3	<.5
Pennell	4-7	10-15	1.35-1.40	2.0-6.0	0.10-0.13	7.9-8.4	<2	Low	0.20			
	7-14	10-15	1.35-1.40	2.0-6.0	0.05-0.08	7.9-8.4	<2	Low	0.15			
	14-19	10-15	1.35-1.40	2.0-6.0	0.10-0.13	7.9-8.4	<2	Low	0.20			
	19	---	---	---	---	---	---	---	---			
37	0-2	3-8	1.40-1.50	>20	0.05-0.08	7.9-8.4	<2	Low	0.15	3	1	<1
Pensom	2-55	3-8	1.40-1.50	>20	0.05-0.08	7.9-8.4	<2	Low	0.15			
	55	---	---	---	---	---	---	---	---			

See footnote at end of table.

Table 14.--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
38*, 39*:												
Pensom----------	0-2	2-10	1.40-1.50	>20	0.08-0.10	7.9-8.4	<2	Low-------	0.17	3	2	<1
	2-55	3-8	1.40-1.50	>20	0.05-0.08	7.9-8.4	<2	Low-------	0.15			
	55	---	---	---	---	---	---	----------	----			
Arches----------	0-16	3-8	1.40-1.50	6.0-20	0.08-0.10	7.4-8.4	<2	Low-------	0.28	1	2	<1
	16	---	---	---	---	---	---	----------	----			
40*.												
Pits, borrow												
41*.												
Rock outcrop												
42*:												
Rock outcrop.												
Needle----------	0-2	0-10	1.35-1.45	>20	0.05-0.07	7.4-8.4	<2	Low-------	0.10	1	1	<1
	2-11	0-15	1.45-1.55	>20	0.05-0.08	7.4-8.4	<2	Low-------	0.10			
	11	---	---	---	---	---	---	----------	----			
43*:												
Rock outcrop.												
Torriorthents---	0-60	---	---	---	---	7.4-8.4	<2	----------	----	---	---	---
44, 45----------	0-4	2-5	1.50-1.60	6.0-20	0.06-0.08	7.4-8.4	<2	Low-------	0.24	5	2	<.5
Sheppard	4-60	3-8	1.50-1.60	6.0-20	0.06-0.08	7.4-9.0	<2	Low-------	0.20			
46----------	0-2	7-27	1.15-1.25	0.6-2.0	0.14-0.18	7.9-8.4	<2	Low-------	0.32	5	4L	1-2
Strych	2-14	7-27	1.25-1.50	0.6-2.0	0.05-0.12	7.9-8.4	<2	Low-------	0.10			
	14-32	7-27	1.25-1.50	0.6-2.0	0.04-0.07	7.9-8.4	<2	Low-------	0.05			
	32-60	5-20	1.35-1.50	2.0-6.0	0.03-0.05	7.9-8.4	<2	Low-------	0.05			
47----------	0-60	---	---	---	---	7.9-9.0	2-8	----------	----	---	---	---
Torriorthents												
48*:												
Torriorthents---	0-60	---	---	---	---	7.9-8.4	<2	----------	----	---	---	---
Rock outcrop.												
49----------	0-1	0-15	1.45-1.55	6.0-20	0.06-0.09	7.9-8.4	<2	Low-------	0.15	1	1	<.5
Wahweap	1-12	0-15	1.45-1.55	6.0-20	0.05-0.10	7.9-8.4	<2	Low-------	0.15			
	12-19	5-20	1.35-1.50	2.0-6.0	0.06-0.10	7.9-8.4	<2	Low-------	0.15			
	19	---	---	---	---	---	---	----------	----			
50*:												
Wahweap----------	0-1	5-20	1.25-1.35	2.0-6.0	0.07-0.11	7.9-8.4	<2	Low-------	0.20	1	3	<1
	1-12	0-15	1.45-1.55	6.0-20	0.05-0.10	7.9-8.4	<2	Low-------	0.15			
	12-19	5-20	1.35-1.50	2.0-6.0	0.06-0.10	7.9-8.4	<2	Low-------	0.15			
	19	---	---	---	---	---	---	----------	----			
Rock outcrop.												
51----------	0-2	7-27	1.25-1.50	0.6-2.0	0.05-0.10	7.4-8.4	<2	Low-------	0.10	2	8	1-3
Yumtheska	2-19	7-27	1.25-1.50	0.6-2.0	0.05-0.10	7.4-8.4	<2	Low-------	0.10			
	19	---	---	---	---	---	---	----------	----			

See footnote at end of table.

Table 14.--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
52*:												
Yumtheska	0-2	7-25	1.15-1.25	0.6-2.0	0.10-0.15	7.4-7.8	<2	Low	0.24	2	4L	1-3
	2-19	7-27	1.25-1.50	0.6-2.0	0.05-0.10	7.4-8.4	<2	Low	0.10			
	19	---	---	---	---	---	---	---	---			
Houserock	0-3	7-27	1.15-1.25	0.6-2.0	0.10-0.15	7.4-7.8	<2	Low	0.24	1	4L	1-3
	3-8	27-40	1.25-1.50	0.2-0.6	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	8-19	40-60	1.15-1.30	0.06-0.2	0.03-0.10	7.4-8.4	<2	High	0.10			
	19	---	---	---	---	---	---	---	---			

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 15.--Soil and Water Features

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" 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			Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
					In		In				
1---------- Aneth	A	None---------	---	---	>60	---	---	---	Low------	High-----	Low.
2*, 3*:											
Arches-----------	D	None---------	---	---	10-20	Hard	---	---	Low------	High-----	Low.
Pensom-----------	A	None---------	---	---	>40	Hard	---	---	Low------	High-----	Low.
4---------- Barx	B	None---------	---	---	>60	---	---	---	Low------	High-----	Low.
5*:											
Barx----------	B	None---------	---	---	>60	---	---	---	Low------	High-----	Low.
Pensom-----------	A	None---------	---	---	>40	Hard	---	---	Low------	High-----	Low.
6*:											
Bidonia----------	D	None---------	---	---	10-20	Hard	---	---	Low------	High-----	Low.
Rock outcrop.											
7*:											
Bison------------	B	None---------	---	---	>60	---	20-40	Thin	Low------	High-----	Low.
Curob------------	D	None---------	---	---	>60	---	10-20	Thick	Low------	High-----	Low.
8---------- Clayhole	B	Rare---------	---	---	>60	---	---	---	Low------	High-----	High.
9*:											
Clayhole---------	B	Rare---------	---	---	>60	---	---	---	Low------	High-----	High.
Torriorthents----	D	None---------	---	---	4-60	Soft	---	---	Low------	High-----	High.
10*:											
Curhollow--------	C	None---------	---	---	10-20	Hard	10-20	Thin	Low------	High-----	Low.
Mellenthin-------	D	None---------	---	---	10-20	Hard	---	---	Low------	High-----	Low.
11---------- Curob	D	None---------	---	---	20-40	Hard	10-20	Thick	Low------	High-----	Low.
12---------- Curob	D	None---------	---	---	>60	---	10-20	Thick	Low------	High-----	Low.
13---------- Disterheff	C	None---------	---	---	>60	---	---	---	Low------	High-----	Low.
14*:											
Disterheff-------	C	None---------	---	---	>60	---	---	---	Low------	High-----	Low.
Houserock--------	D	None---------	---	---	10-20	Hard	---	---	Low------	High-----	Low.
15---------- Doak	B	None---------	---	---	>60	---	---	---	Low------	High-----	Low.

See footnote at end of table.

Table 15.--Soil and Water Features--Continued

Soil name and map symbol	Hydrologic group	Flooding			Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
					In		In				
16---------- Glenyon	B	None	---	---	>60	---	---	---	Low	High	Low.
17*:											
Houserock	D	None	---	---	10-20	Hard	---	---	Low	High	Low.
Disterheff	C	None	---	---	>60	---	---	---	Low	High	Low.
18---------- Jocity	B	Occasional	Very brief	Jul-Sep	>60	---	---	---	Low	High	Low.
19---------- Jocity	B	None	---	---	>60	---	---	---	Low	High	Low.
20---------- Keeseha	C	None	---	---	>60	---	---	---	Low	High	Low.
21*, 22*:											
Kinan	B	None	---	---	>60	---	---	---	Low	High	Low.
Pennell	D	None	---	---	10-20	Hard	---	---	Low	High	Low.
23---------- Klondike	D	None	---	---	10-20	Soft	---	---	Low	High	Low.
24---------- Manikan	B	None	---	---	>60	---	---	---	Moderate	High	Low.
25, 26---------- Mellenthin	D	None	---	---	10-20	Hard	---	---	Low	High	Low.
27---------- Monierco	D	None	---	---	10-20	Soft	---	---	Low	High	Low.
28---------- Monue	B	None	---	---	>60	---	---	---	Low	High	Low.
29*:											
Monue	B	None	---	---	>60	---	---	---	Low	High	Low.
Seeg	B	None	---	---	>60	---	---	---	Low	High	Low.
30*:											
Needle	D	None	---	---	10-20	Hard	---	---	Low	High	Low.
Rock outcrop.											
31*:											
Needle	D	None	---	---	10-20	Hard	---	---	Low	High	Low.
Sheppard	A	None	---	---	>60	---	---	---	Low	High	Moderate.
32---------- Pagina	C	None	---	---	20-40	Soft	---	---	Low	High	Low.
33*:											
Pagina	C	None	---	---	20-40	Soft	---	---	Low	High	Low.
Wahweap	D	None	---	---	10-20	Soft	---	---	Low	High	Low.

See footnote at end of table.

Table 15.--Soil and Water Features--Continued

Soil name and map symbol	Hydrologic group	Flooding			Bedrock		Cemented pan		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Hardness	Depth	Hardness		Uncoated steel	Concrete
					In		In				
34, 35, 36-------- Pennell	D	None--------	---	---	10-20	Hard	---	---	Low------	High-----	Low.
37---------------- Pensom	A	None--------	---	---	>40	Hard	---	---	Low------	High-----	Low.
38*, 39*:											
Pensom-----------	A	None--------	---	---	>40	Hard	---	---	Low------	High-----	Low.
Arches-----------	D	None--------	---	---	10-20	Hard	---	---	Low------	High-----	Low.
40*. Pits, borrow											
41*. Rock outcrop											
42*: Rock outcrop.											
Needle-----------	D	None--------	---	---	10-20	Hard	---	---	Low------	High-----	Low.
43*: Rock outcrop.											
Torriorthents----	D	None--------	---	---	40-60	Hard	---	---	Low------	---	---
44, 45---------- Sheppard	A	None--------	---	---	>60	---	---	---	Low------	High-----	Moderate.
46---------------- Strych	B	None--------	---	---	>60	---	---	---	Low------	High-----	Low.
47---------------- Torriorthents	D	None--------	---	---	4-60	Soft	---	---	Low------	High-----	High.
48*: Torriorthents---- Rock outcrop.	D	None--------	---	---	4-60	Hard	---	---	Low------	---	---
49---------------- Wahweap	D	None--------	---	---	10-20	Soft	---	---	Low------	High-----	Low.
50*: Wahweap---------- Rock outcrop.	D	None--------	---	---	10-20	Soft	---	---	Low------	High-----	Low.
51---------------- Yumtheska	D	None--------	---	---	10-20	Hard	---	---	Low------	High-----	Low.
52*: Yumtheska--------	D	None--------	---	---	10-20	Hard	---	---	Low------	High-----	Low.
Houserock--------	D	None--------	---	---	10-20	Hard	---	---	Low------	High-----	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

Table 16.--Classification of the Soils

Soil name	Family or higher taxonomic class
Aneth	Sandy, mixed, mesic Typic Torriorthents
Arches	Mixed, mesic Lithic Torripsamments
Barx	Fine-loamy, mixed, mesic Ustollic Haplargids
Bidonia	Clayey, kaolinitic, mesic Lithic Ustollic Haplargids
Bison	Coarse-loamy, mixed, mesic Typic Paleorthids
Clayhole	Fine-loamy, mixed (calcareous), mesic Typic Torrifluvents
Curhollow	Loamy-skeletal, mixed, mesic, shallow Ustollic Paleorthids
Curob	Loamy-skeletal, mixed, mesic, shallow Typic Paleorthids
Disterheff	Fine, montmorillonitic, mesic Aridic Haplustalfs
Doak	Fine-loamy, mixed, mesic Typic Haplargids
Glenyon	Clayey over sandy or sandy-skeletal, mixed (calcareous), mesic Typic Torriorthents
Houserock	Clayey-skeletal, montmorillonitic, mesic Lithic Haplustalfs
Jocity	Fine-loamy, mixed (calcareous), mesic Typic Torrifluvents
Keeseha	Fine, mixed, mesic Ustollic Haplargids
Kinan	Coarse-loamy, mixed, mesic Typic Calciorthids
Klondike	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Manikan	Fine-loamy, mixed (calcareous), mesic Ustic Torrifluvents
Mellenthin	Loamy-skeletal, mixed, mesic Lithic Ustollic Calciorthids
Monierco	Loamy, mixed, mesic, shallow Typic Haplargids
Monue	Coarse-loamy, mixed, mesic Typic Camborthids
Needle	Mixed, mesic Lithic Torripsamments
Pagina	Coarse-loamy, mixed, mesic Typic Calciorthids
Pennell	Loamy, mixed, mesic Lithic Calciorthids
Pensom	Mixed, mesic Ustic Torripsamments
Seeg	Loamy-skeletal, mixed, mesic Typic Calciorthids
Sheppard	Mixed, mesic Typic Torripsamments
Strych	Loamy-skeletal, mixed, mesic Ustollic Calciorthids
Torriorthents	Torriorthents
Wahweap	Loamy-skeletal, mixed, mesic, shallow Typic Calciorthids
Yumtheska	Loamy-skeletal, mixed, mesic Lithic Calciustolls

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