United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with United States Department of the Interior, Bureau of Indian Affairs; the Arizona Agricultural Experiment Station; and the Tohono O'odham Nation

Soil Survey of Tohono O'odham Nation, Arizona

Parts of Maricopa, Pima, and Pinal Counties

How to Use This Soil Survey

General Soil Map

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

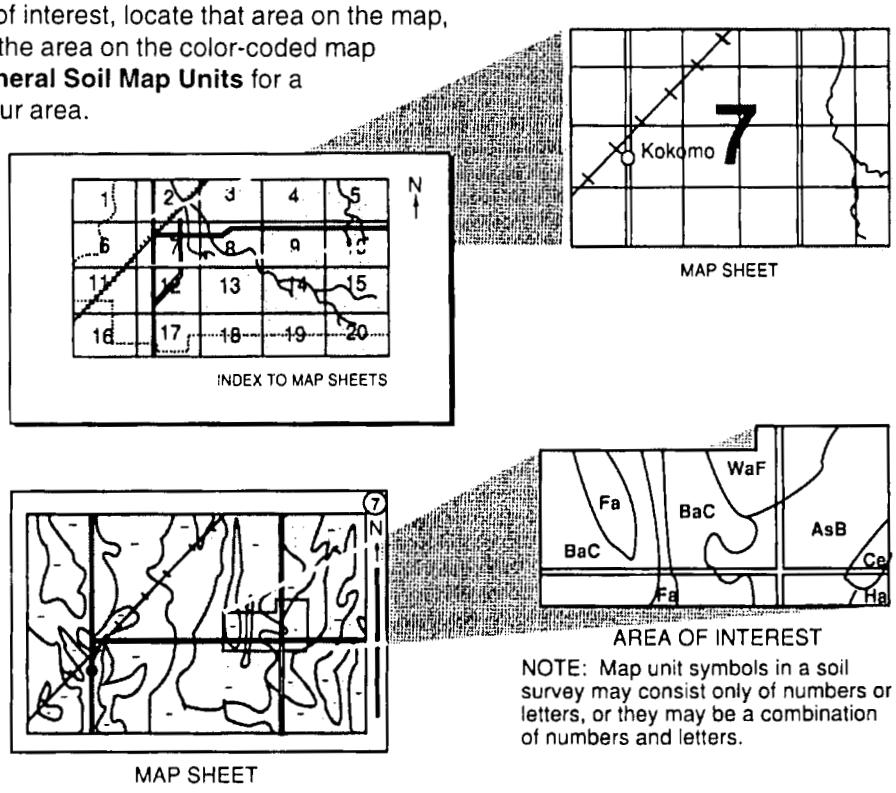
To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

Detailed Soil Maps

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

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

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



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.

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

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in June 1992. Soil names and descriptions were approved in January 1993. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1992. This survey was made cooperatively by the Natural Resources Conservation Service, the Bureau of Indian Affairs, the Arizona Agricultural Experiment Station, and the Tohono O'odham Nation. The survey is part of the technical assistance furnished to the Tohono O'odham Soil and Water Conservation District.

Cover: Typical landscape of Lajitas-Bosa-Rock outcrop complex, 15 to 50 percent slopes. This area, called Window Rock, is located approximately in the center of the survey area.

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").

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Foreword

This soil survey contains information that can be used in land-planning programs in the Tohono O'odham Nation, which includes parts of Maricopa, Pima, and Pinal counties. 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, tribal 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
Tohono O'odham Nation, Arizona,
Parts of Maricopa, Pima, and Pinal Counties

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United States Department of Agriculture, Natural Resources Conservation Service, and United States Department of the Interior, Bureau of Indian Affairs; in cooperation with the Arizona Agricultural Experiment Station and the Tohono O'odham Nation

Introduction

A nonprogressive soil survey covering the areas known as the Garcia Strip, Three Points, and Ak Chutum Vayva was released as an interim report by the Soil Conservation Service in November of 1981. Another report, called "Development Assistance to Papago Farms," was published in November 1979 by the Office of Arid Lands Studies, which is part of the University of Arizona's College of Agriculture. These earlier surveys cover a part of the present survey. The present survey, however, updates the earlier surveys and provides additional information and larger maps that show the soils in greater detail.

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

Soils information for the San Xavier Mission District of the Tohono O'odham Nation is included in the soil survey of Pima County, Arizona, Eastern Part. Soils information for the San Lucy District of the Tohono O'odham Nation is included in the soil survey of Gila Bend-Ajo Area, Parts of Maricopa and Pima Counties.

The general soil map and detailed maps have been joined with adjacent survey areas and discrepancies accounted for as follows:

The Tucson-Avra Valley Area, Arizona, soil survey is of such age that classification and mapping concepts have changed, and the most practical join has been made.

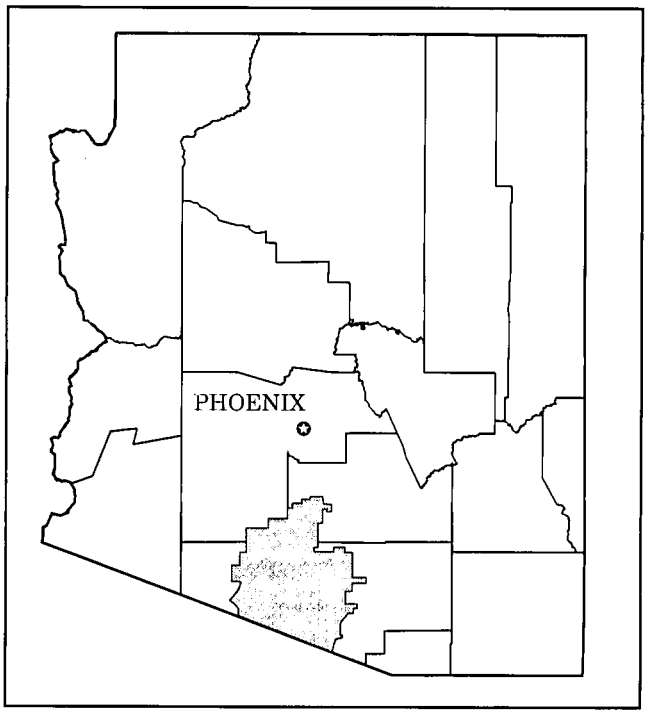

Figure 1.— Location of Tohono O'odham Nation, Parts of Maricopa, Pima, and Pinal Counties in Arizona.

The Gila Bend-Ajo Area, Arizona, Parts of Maricopa and Pima Counties soil survey and the Pinal County, Arizona, Western Part soil survey do not fully agree as to named components in the mapping units or joining of soil boundaries. The soils mapped as Lajitas-Bosa-Rock outcrop complex, 15 to 50 percent slopes, in the Sauceda Mountain area do

not join in name only. However, use and management are essentially the same for most soils in the two areas (soils of such an extent as to be named in one soil survey area are of minor extent in the adjoining area and are considered inclusions of similar soils). The field office technical guides in these areas will be updated by Technical Soil Services as needed.

The Pima County, Arizona, Eastern Part soil survey has been joined.

General Nature of the Area

The Tohono O'odham Nation encompasses portions of three counties in southern Arizona. Of a land area totalling 2,855,032 acres, 105,444 acres are in Maricopa County; 260,460 acres are in Pinal County; and 2,489,128 acres are in Pima County. The boundary extends from 20 miles west of Tucson to approximately 10 miles east of Ajo and from the Mexico-U.S. border to about 10 miles south of Casa Grande (fig. 1).

The survey area has a variety of terrain and soils. Vegetation ranges from desert shrubs to Mexican oak-pine woodland and oak savannah. Elevations range from 1,400 feet to 7,500 feet. The survey area is located in the Sonoran Desert section of the Basin and Range Province. The topography consists of northward- and southward-trending mountain ranges separated by broad basins or valleys.

Cattle ranching is the most important industry within the survey area. Irrigated agriculture is practiced along the Santa Rosa Wash on the northern end of the survey area. An egg production facility and several copper mining operations are also in the area.

History

William A. Svetlik, soil scientist, prepared this section.

Archaeological excavations have uncovered evidence that humans have been present in the survey area for at least 10,000 years. Present day Tohono O'odham (Papagos), the desert people who now live in this area, are thought to be descendants of the Hohokam Indians who flourished around 1400 A.D. Spanish explorers encountered the Tohono O'odham in 1540, 21 years after Cortez landed on the North American continent. At that time, the Tohono O'odham were scattered across the territory that extended from the Gila River south into what is now the north central part of Mexico. The first important contact between the Tohono O'odham and the Europeans came about when Father Kino started his missionary programs in the late 1600's and early 1700's.

The pre-Spanish Tohono O'odham economy was one of limited irrigated farming and gathering of wild food products. Their techniques were simple, with most fields being small and located at the footslopes of mountains in order to collect the runoff from desert storms. Extensive irrrigation canals along the Santa Cruz River, in the vicinity of the San Xavier Mission, supported the largest single concentration of Tohono O'odham in the region. During the winter they occupied the mountainous areas to hunt. This semiannual movement between summer and winter quarters was common to the Tohono O'odham way of life.

With the Spanish exploration and occupation of the New World the Tohono O'odham came under the rule of the Spanish crown. In 1812 Mexico declared its independence from Spain, and until 1853 the major portion of the Nation was under the political jurisdiction of Mexico. During this period the Tohono O'odham remained isolated, with little government contact.

In 1853, the Gadsden Purchase added the lands south of the Gila River to the United States. As a result, the Tohono O'odham came under the political jurisdiction of the United States. At the time of the Gadsden Purchase the land of the Tohono O'odham was considered available for non-Indian settlement, and many springs, wells, and grazing areas were soon claimed by ranchers moving into the area. Little was done to secure land for the exclusive use of the Tohono O'odham Nation until July 1, 1874, when a reservation of 70,000 acres was created by Executive Order near San Xavier Mission. Throughout the years more Executive Orders and Congressional Acts authorized the purchase of patented land to be added to the Tohono O'odham Nation. Today a total of 2,855,032 acres is held in trust for the use of the Tohono O'odham Nation.

Transportation

Arizona Highway 86 crosses the Tohono O'odham Nation approximately through the center from east to west. It is the main road to Ajo, Arizona and Puerto Penasco, Sonora, Mexico from Tucson, Arizona. Most villages on the Nation are served by paved roads.

Climate

The Tohono O'odham Nation has a very diverse climate, ranging from the dry, hot Sonoran desert of the west to the mild, cool Mexican oak-pine woodlands of Kitt and Baboquivari Peaks. Generally, summers are long and range from very hot to hot. Winters range from warm to cold, depending on the location in the survey area. About 60 percent of the rainfall occurs in the summer as violent thunderstorms. Winter rain occurs

as long-lasting, gentle showers. The higher elevations receive some snow in most years.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Ajo between 1915 and 1993, at Sells between 1949 and 1975, and at Kitt Peak between 1961 and 1993. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on the length of the growing season.

Ajo is just outside the survey area, but climatic data for it is representative of the hotter, drier part of the survey area. Sells represents the area of intermediate temperature and rainfall located between Ajo and Kitt Peak. Kitt Peak represents the high, cool mountains that receive snow.

In winter, the average temperature is 53 degrees in Ajo, 50 degrees in Sells, and 40 degrees at Kitt Peak. The average daily minimum temperature is 42 degrees F in Ajo, 35 degrees in Sells, and 32 degrees at Kitt Peak. The lowest temperature on record, 2 degrees F, occurred at Kitt Peak. In summer, the average temperature is 90 degrees F in Ajo, 86 degrees in Sells, and 70 degrees at Kitt Peak. The average daily maximum temperature is 103 degrees F in Ajo, 101 degrees in Sells, and 80 degrees at Kitt Peak. The highest temperature on record was 115 degrees F and occurred at Ajo.

Growing degree days are shown in table 3. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The average total precipitation at Ajo is 8.7 inches, at Sells is 12.2 inches, and at Kitt Peak is 25 inches. Of this, 60 percent falls as violent thunderstorms in July through September. Winter rains are gentle and occur in December through March.

Snow is abundant on the higher mountain peaks. Kitt Peak receives an average of 29 inches of snow. Snowfall can occur November through April. Trace amounts of snow can fall at both Ajo and Sells. The maximum monthly snowfall during the period recorded was 42.5 inches at Kitt Peak in February of 1996.

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 from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of probability that a given soil will be flooded in most years, but they cannot predict that flooding will always occur on a specific date.

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

Map Unit Composition

Soils in this survey area were mapped at two levels of detail. The detail of mapping in an area was selected based on the area's anticipated long term use.

At the most detailed level, map units are narrowly defined. Soil boundaries are plotted and verified at closely spaced intervals. Agricultural areas in the Santa Rosa Valley, Santa Cruz River area, the Kaka Valley, and the Aguire Valley were mapped at this level of detail. Narrowly defined map units identified on the Prime and Unique Farmland Table are suitable for planning intensive irrigated agriculture uses.

Most of the survey area is used as rangeland and was mapped at a less detailed level. The map units in this area are broadly defined. Soil boundaries were plotted and verified at widely spaced intervals. In general, these map units are less homogeneous and contain more included areas than the more detailed map units. These units are designed primarily for planning the management of large tracts of land as rangeland. They provide general information for more development, but the information should be used with caution. Onsite investigation is essential to provide the detail needed for planning intensive land uses.

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.

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

The textures used in the general map units are for the subsoil textures of that series and not for the surface texture.

Soil Descriptions

Soils on flood plains, stream terraces, alluvial fans, and basin floors

This group consists of three map units. It makes up about 20 percent of the survey area. The soils in this group are level to nearly level. They are loamy and clayey textured and well drained. They are subject to none to occasional periods of flooding. This group is used as rangeland and as cropland.

1. Glenbar-Tatai-Sasco

Very warm, very deep, well drained, level and nearly level, moderately fine and medium textured soils on flood plains and stream terraces

Setting

Slope: 0 to 2 percent
Elevation: 1,400 to 2,200 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Percent of survey area: 5
- Glenbar soils: 42 percent
- Tatai soils: 17 percent
- Sasco soils: 9 percent
- Minor soils: 32 percent

Soil Properties and Qualities

Glenbar

Landform: flood plains
Depth class: very deep
Drainage class: well drained
Parent material: mixed stream alluvium
Textural class: moderately fine texture
Hazard of flooding: occasionally

Tatai

Landform: flood plains
Depth class: very deep
Drainage: well drained
Parent material: mixed stream alluvium
Textural class: moderately fine texture
Hazard of flooding: rare

Sasco

Landform: stream terraces
Depth class: very deep

Drainage class: well drained
Parent material: mixed stream alluvium
Textural class: medium texture
Hazard of flooding: none to rare

Minor soils

- Gilman, medium textured soils on flood plains and alluvial fans
- Ginland, clayey over loamy textured soils on flood plains
- Gadsden, fine textured soils on flood plains

Use and Management

Major land types: rangeland and cropland
Major land uses: livestock grazing and irrigated crop production

Management Factors

Glenbar: flooding, piping, erosion
Tatai: shrink-swell potential, piping, erosion
Sasco: seepage, piping, erosion

2. Casa Grande-Vecont-Tucson

Very warm, very deep, well drained, level and nearly level, moderately fine textured soils on basin floors

Setting

Slope: 0 to 3 percent
Elevation: 1,400 to 2,200 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Percent of survey area: 10
Casa Grande soils: 30 percent
Vecont and similar soils: 22 percent
Tucson and similar soils: 16 percent
Minor soils: 32 percent

Soil Properties and Qualities

Casa Grande

Landform: basin floors
Depth class: very deep
Drainage: well drained
Parent material: mixed fan alluvium and stream alluvium
Textural class: moderately fine texture
Salinity: very slight to moderate
Sodicity: moderate to strong

Vecont and similar soils

Landform: basin floors
Depth class: very deep
Drainage: well drained
Parent material: mixed stream alluvium
Textural class: moderately fine texture
Hazard of flooding: rare
Salinity: none to very slight
Similar soils: Kamato, fine textured soils on basin floors that are saline-sodic

Tucson and similar soils

Landform: basin floors
Depth class: very deep
Drainage class: well drained
Parent material: mixed fan alluvium
Textural class: moderately fine texture
Salinity: very slight to moderate
Sodicity: slight to moderate
Similar soils: Mohall, moderately fine textured soils that are not saline-sodic, on basin floors

Minor soils

- Rositas, coarse textured soils on dunes
- Valencia, moderately coarse over moderately fine textured soils on flood plains and alluvial fans

Use and Management

Major land types: rangeland and cropland
Major land uses: livestock grazing and irrigated crop production

Management Factors

Casa Grande: excessive sodium, piping, shrink-swell potential
Vecont: wind erosion, rare flooding
Tucson: excess salt, desert pavement

3. Glendale-Tubac-Grabe

Warm, very deep, well drained, level and nearly level, moderately fine, fine and medium textured soils on flood plains, alluvial fans, stream terraces, and basin floors

Setting

Slope: 0 to 3 percent
Elevation: 2,000 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.

Frost-free period: 240 to 260 days

Composition

Percent of survey area: 5
Glendale and similar soils: 36 percent
Tubac and similar soils: 20 percent
Grabe and similar soils: 11 percent
Minor soils: 33 percent

Soil Properties and Qualities

Glendale and similar soils

Landform: flood plains, stream terraces, alluvial fans
Depth class: very deep
Drainage: well drained
Parent material: mixed stream alluvium and fan alluvium
Textural class: moderately fine texture
Hazard of flooding: rare to occasionally
Similar soils: Chutum, medium textured soils on fan terraces and stream terraces that have a calcic horizon; the hazard of flooding ranges from none to rare

Tubac and similar soils

Landform: basin floors
Depth class: very deep
Drainage: well drained
Parent material: mixed stream alluvium
Textural class: fine texture
Hazard of flooding: none to rare
Similar soils: Hantz, fine textured soils on flood plains and alluvial fans that have an occasional flooding hazard

Grabe and similar soils

Landform: alluvial fans
Depth class: very deep
Drainage: well drained
Parent material: mixed stream alluvium and fan alluvium
Textural class: medium texture
Hazard of flooding: rare
Similar soils: Pajarito, moderately coarse textured soils on fan terraces that do not flood

Minor soils

• Vado, gravelly to very gravelly coarse textured soils on fan terraces that do not flood

Use and Management

Major land types: rangeland and cropland
Major land uses: livestock grazing and irrigated crop production

Management Factors

Glendale: erosion, flooding, piping
Tubac: flooding, shrink-swell potential, slow permeability
Grabe: flooding, wind erosion

Soils on fan terraces, stream terraces, and alluvial fans

This group consists of two map units. It makes up about 32 percent of the survey area. The soils in this group are dominantly level to gently sloping. They are loamy textured, somewhat excessively drained and well drained. These soils are subject to none to occasional periods of flooding. This group is used mainly as rangeland and in some areas as cropland.

4. Denure-Mohall-Trix

Very warm, very deep, somewhat excessively drained and well drained, level and nearly level, moderately coarse, moderately fine, and medium textured soils on fan terraces, stream terraces and alluvial fans

Setting

Slope: 0 to 3 percent
Elevation: 1,400 to 2,400 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Percent of survey area: 18
Denure and similar soils: 39 percent
Mohall soils and similar soils: 31 percent
Trix soils: 10 percent
Minor soils: 20 percent

Soil Properties and Qualities

Denure and similar soils

Landform: fan terraces

Depth class: very deep
Drainage: somewhat excessively drained
Parent material: mixed fan alluvium
Textural class: moderately coarse texture
Similar soils:
• Dateland, medium textured soils on the lower end of fan terraces
• Pahaka, moderately coarse over moderately fine textured soils on fan terraces

Mohall and similar soils

Landform: fan terraces and stream terraces
Depth class: very deep
Drainage: well drained
Parent material: mixed fan alluvium and stream alluvium
Textural class: moderately fine texture
Similar soils: Wintersburg, moderately fine textured soils that are on fan terraces and stream terraces and have a calcic horizon at shallow depths

Trix

Landform: alluvial fans
Depth class: very deep
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: medium texture
Hazard of flooding: rare to occasional

Use and Management

Major land types: rangeland and cropland
Major land uses: livestock grazing and irrigated crop production

Minor soils

• Momoli, gravelly to extremely gravelly moderately coarse textured soils on fan terraces and stream terraces

Management Factors

Denure: wind erosion, droughtiness
Mohall: wind erosion, seepage
Trix: piping, hazard of seepage, flooding

5. Bucklebar-Hayhook-Pajarito

Warm, very deep, well drained, nearly level to gently sloping, medium and moderately coarse textured soils on fan terraces

Setting

Slope: 1 to 3 percent
Elevation: 2,000 to 3,200 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Percent of survey area: 14
Bucklebar soils: 33 percent
Hayhook and similar soils: 27 percent
Pajarito and similar soils: 18 percent
Minor soils: 22 percent

Soil Properties and Qualities

Bucklebar and similar soils

Landform: fan terraces
Depth class: very deep
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: medium texture
Similar soils: Baboquivari, gravelly moderately fine textured soils on fan terraces that have 1 to 3 percent organic matter in the surface layer

Hayhook and similar soils

Landform: fan terraces
Depth class: very deep
Drainage: well
Parent material: mixed fan alluvium
Textural class: moderately coarse texture
Similar soils: Combate, gravelly coarse textured soils on alluvial fans that have 1 to 3 percent organic matter in the surface layer

Pajarito and similar soils

Landform: fan terraces
Depth class: very deep
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: moderately coarse texture
Similar soils: Sahuarita, moderately coarse over moderately fine textured soils on fan terraces

Minor soils

• Tubac, fine textured soils on basin floors

Use and Management

Major land types: rangeland and cropland
Major land uses: livestock grazing and irrigated crop production

Management Factors

Bucklebar: piping, hazard of wind erosion, hazard of seepage
Hayhook: droughtiness, piping, and hazard of seepage
Pajarito: droughtiness and hazard of wind erosion

Soils on relict fan terraces, fan terraces, and stream terraces

This group consists of four map units. It makes up about 27 percent of the area. The soils in this group are nearly level to steep. They are gravelly to extremely gravelly, loamy and clayey textured, and somewhat excessively drained to well drained. There is no hazard of flooding. These soils are used mainly as rangeland.

6. Gunsight-Pinamt-Hickiwan

Very warm, very deep and very shallow to shallow (to a hardpan), somewhat excessively drained and well drained, nearly level to strongly sloping, extremely gravelly moderately coarse, very gravelly moderately fine, and very gravelly moderately coarse textured soils on fan terraces and relict fan terraces

Setting

Slope: 1 to 15 percent
Elevation: 1,400 to 2,200 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Percent of survey area: 8
Gunsight and similar soils: 36 percent
Pinamt and similar soils: 25 percent
Hickiwan soils: 18 percent
Minor soils: 21 percent

Soil Properties and Qualities

Gunsight and similar soils

Landform: fan terraces and stream terraces
Depth class: very deep
Drainage: somewhat excessively drained
Parent material: mixed fan alluvium and stream alluvium
Textural class: extremely gravelly moderately coarse texture
Similar soils: Momoli, very gravelly moderately coarse textured soils on fan terraces and stream terraces

Pinamt and similar soils

Landform: fan terraces and relict fan terraces
Depth class: very deep
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: very gravelly moderately fine texture
Similar soils: Ajo, very gravelly moderately fine textured soils on relict fan terraces that have a hardpan at moderate depths

Hickiwan

Landform: relict fan terraces and fan terraces
Depth class: very shallow and shallow (to a hardpan)
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: very gravelly moderately coarse

Minor soils

- Denure, moderately coarse textured Denure soils on fan terraces
- Rillito, gravelly moderately coarse textured soils on fan terraces and stream terraces that have a calcic horizon
- Soils that have sandy textures in washes

Use and Management

Major land type: rangeland
Major land use: livestock grazing

Management Factors

Gunsight: droughtiness, content of rock fragments, hazard of seepage, calcium carbonate content
Pinamt: hazard of seepage, droughtiness, content of rock fragments
Hickiwan: droughtiness, hazard of seepage, depth to hardpan, calcium carbonate content

7. Soledad-Topawa-Agustin

Warm, very deep, well drained, nearly level to gently sloping, very gravelly moderately coarse, very

gravelly moderately fine, and gravelly moderately coarse textured soils on fan terraces

Setting

Slope: 1 to 5 percent
Elevation: 2,000 to 3,200 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Percent of survey area: 7
Soledad and similar soils: 41 percent
Topawa soils: 22 percent
Agustin and similar soils: 13 percent
Minor soils: 24 percent

Soil Properties and Qualities

Soledad and similar soils

Landform: fan terraces
Depth class: very deep
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: very gravelly moderately coarse texture
Similar soils: Vado, gravelly to extremely gravelly moderately coarse textured soils on fan terraces

Topawa

Landform: fan terraces
Depth class: very deep
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: very gravelly moderately fine texture

Agustin and similar soils

Landform: fan terraces
Depth class: very deep
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: gravelly moderately coarse texture
Similar soils: Arizo, gravelly and very gravelly coarse textured soils on alluvial fans and flood plains

Minor soils

- Stagecoach, very gravelly moderately coarse textured soils on fan terraces
- Riverwash

Use and Management

Major land type: rangeland
Major land use: livestock grazing

Management Factors

Soledad: hazard of seepage, content of rock fragments, droughtiness
Topawa: content of rock fragments, hazard of seepage
Agustin: droughtiness, hazard of seepage

8. Stagecoach-Nahda-Delnorte

Warm, very deep and moderately deep and shallow (to a hardpan), nearly level to moderately steep, very gravelly moderately coarse, very gravelly fine, and very gravelly medium textured soils on fan terraces

Setting

Slope: 1 to 20 percent
Elevation: 1,800 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260

Composition

Percent of survey area: 10
Stagecoach soils: 37 percent
Nahda soils: 23 percent
Delnorte soils: 18 percent
Minor soils: 22 percent

Soil Properties and Qualities

Stagecoach

Landform: fan terraces
Depth class: very deep
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: very gravelly moderately coarse texture

Nahda

Landform: fan terraces
Depth class: moderately deep (to a hardpan)
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: very gravelly fine texture

Delnorte

Landform: fan terraces
Depth class: shallow (to a hardpan)
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: very gravelly medium texture

Minor soils

- Delthorny, very gravelly moderately coarse textured soils on relict fan terraces that have a hardpan over bedrock
- Caracara, cobbly and extremely gravelly fine textured soils on relict fan terraces that have a hardpan over bedrock

Use and Management

Major land type: rangeland
Major land use: livestock grazing

Management Factors

Stagecoach: hazard of wind erosion, hazard of seepage, droughtiness, calcium carbonate content, content of rock fragments
Nahda: slow permeability, depth to hardpan, droughtiness
Delnorte: depth to hardpan, slope, calcium carbonate content, droughtiness

9. Caralampi-Selevin-Kimrose

Warm, very deep and shallow (to a hardpan), well drained, gently sloping to steep, extremely gravelly moderately fine, very gravelly fine, and very gravelly medium textured soils on relict fan terraces

Setting

Slope: 5 to 50 percent
Elevation: 2,800 to 3,800 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 63 to 67 degrees F.
Frost-free period: 215 to 250 days

Composition

Percent of the survey area: 2
Caralampi soils: 37 percent
Selevin soils: 28 percent
Kimrose soils: 18 percent
Minor soils: 17 percent

Soil Properties and Qualities

Caralampi

Landform: relict fan terraces
Depth class: very deep
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: extremely gravelly moderately fine texture

Selevin

Landform: relict fan terraces
Depth class: very deep
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: very gravelly fine texture

Kimrose

Landform: relict fan terraces
Depth class: shallow (to a hardpan)
Drainage: well drained
Parent material: mixed fan alluvium
Textural class: very gravelly medium texture

Minor soils

- Keysto, extremely cobbly moderately coarse textured soils on alluvial fans and stream terraces
- Riverwash

Use and Management

Major land type: rangeland
Major land use: livestock grazing

Management Factors

Caralampi: slope, droughtiness, content of rock fragments
Selevin: slope, content of rock fragments, hazard of seepage
Kimrose: shallow to a hardpan, calcium carbonate content, droughtiness

Soils on hills and mountains

This group consists of four map units. It makes up about 21 percent of the soil survey area. The soils in this group are gently sloping to very steep. They are very gravelly to extremely gravelly and extremely cobbly loamy and clayey textured and somewhat excessively drained to well drained. There is no hazard of flooding. This group is used as rangeland.

10. Quilotosa-Gachado-Rock Outcrop

Very warm, very shallow and shallow, somewhat excessively drained and well drained, gently sloping to steep, extremely gravelly moderately coarse and very gravelly medium textured soils on hills and mountains

Setting

Slope: 3 to 45 percent
Elevation: 1,400 to 3,200 feet

Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Percent of survey area: 2
Quilotosa and similar soils: 48 percent
Gachado and similar soils: 25 percent
Rock outcrop: 23 percent
Minor soils: 4 percent

Soil Properties and Qualities

Quilotosa and similar soils

Landform: hills and mountains
Depth class: very shallow and shallow
Drainage: somewhat excessively drained
Parent material: slope alluvium and residuum from granite
Textural class: extremely gravelly moderately coarse texture
Similar soils:
- Lomitas, extremely gravelly medium textured soils on hills
- Hyder, extremely cobbly medium textured soils on hills

Gachado and similar soils

Landform: hills
Depth class: very shallow and shallow
Drainage: well drained
Parent material: slope alluvium and residuum from rhyolite and andesite
Textural class: very gravelly medium texture
Similar soils:
- Chuichu, very channery moderately fine textured soils on hills
- Vaiva, very gravelly moderately fine textured soils on hills and mountains

Minor soils

- Guvo, very gravelly moderately coarse textured Guvo soils on hills that have a hardpan over bedrock
- Rock outcrop consists of areas of exposed schist, rhyolite, andesite, granite and basalt

Use and Management

Major land type: rangeland
Major land use: livestock grazing

Management Factors

Quilotosa: depth to bedrock, slope, content of rock fragments, and droughtiness
Gachado: depth to bedrock, slope, content of rock fragments, droughtiness

11. Anklam-Delthorny-Lajitas

Warm, very shallow and shallow, and very shallow to shallow (to a hardpan), well drained, gently sloping to steep, very gravelly moderately fine, extremely cobbly medium and very gravelly medium textured soils on hills and mountains.

Setting

Slope: 3 to 50 percent
Elevation: 2,000 to 4,500 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F
Frost-free period: 240 to 260 days

Composition

Percent of survey area: 15.5
Anklam and similar soils: 26 percent
Delthorny and similar soils: 23 percent
Lajitas and similar soils: 20 percent
Minor soils: 31 percent

Soil Properties and Qualities

Anklam and similar soils

Landform: hills and mountains
Depth class: shallow
Drainage: well drained
Parent material: slope alluvium and residuum from igneous rock
Textural class: very gravelly moderately fine texture
Similar soils:
- Bosa, very gravelly medium textured soils on hills and mountains
- Granolite, extremely gravelly fine textured soils on hills and mountains

Delthorny and similar soils

Landform: hills and mountains
Depth class: very shallow and shallow (to a hardpan)

Drainage: well drained
Parent material: colluvium and slope alluvium from basalt
Textural class: extremely cobbly medium texture
Similar soils:
- Pantano, very gravelly, moderately coarse textured, calcareous soils on hills and mountains
- Kohatk, very cobbly, medium textured, calcareous soils on hills and mountains
- Dixaleta, very channery, moderately coarse textured soils on hills and mountains

Lajitas and similar soils

Landform: hills and mountains
Depth class: very shallow and shallow
Drainage: well drained
Parent material: slope alluvium from andesite
Textural class: very gravelly medium texture
Similar soils:
- Garzona, very gravelly medium textured soils on hills and mountains
- Cellar, very gravelly moderately coarse textured soils on hills and mountains

Minor soils

- Rock outcrop consists of exposed areas of granite, gneiss, rhyolite, basalt, schist, limestone, and andesite

Use and Management

Major land type: rangeland
Major land use: livestock grazing

Management Factors

Anklam: slope, droughtiness, shallow to bedrock
Delthorny: slope, droughtiness, depth to hardpan/rock
Lajitas: slope, droughtiness, content of rock fragments, shallow to bedrock

12. Lampshire-Rock Outcrop-Chiricahua

Warm, very shallow and shallow, well drained, moderately steep to very steep, very gravelly moderately coarse and very gravelly fine textured soils on hills and mountains.

Setting

Slope: 15 to 65 percent
Elevation: 3,200 to 5,300 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 63 to 67 degrees F.
Frost-free period: 215 to 250 days

Composition

Percent of survey area: 3
Lampshire and similar soils: 41 percent
Rock outcrop: 19 percent
Chiricahua and similar soils: 15 percent
Minor soils: 25 percent

Soil Properties and Qualities

Lampshire and similar soils

Landform: hills and mountains
Depth class: very shallow and shallow
Drainage: well drained
Parent material: colluvium and slope alluvium from igneous rock
Textural class: very gravelly moderately coarse texture
Similar soils: Cellar, very gravelly moderately coarse textured soils that have less than 1 percent organic matter, on hills and mountains

Chiricahua and similar soils

Landform: hills
Depth class: shallow
Drainage: well drained
Parent material: slope alluvium and residuum from granite
Textural class: very gravelly fine texture
Similar soils:
- Pantak, very gravelly moderately fine textured soils that have 1 to 3 percent organic matter, on hills and mountains
- Oracle, gravelly moderately fine textured soils that have 1 to 2 percent organic matter, on hills

Minor soils

- Romero, very gravelly moderately coarse textured soils on hills and mountains

• Rock outcrop consists of areas of exposed gneiss, granite, andesite, and schist

Use and Management

Major land type: rangeland
Major land use: livestock grazing

Management Factors

Lampshire: slope, content of rock fragments, and depth to bedrock
Chiricahua: slope, slow permeability, and depth to bedrock

13. Far-Spudrock-Rock Outcrop

Cool, very shallow and shallow and moderately deep, well drained, steep and very steep, very gravelly moderately coarse textured soils on mountains.

Setting

Slope: 35 to 85 percent
Elevation: 5,300 to 7,500 feet
Mean annual precipitation: 20 to 24 inches
Mean annual air temperature: 52 to 57 degrees F.
Frost-free period: 160 to 195 days

Composition

Percent of the survey area: 0.5
Far soils: 21 percent
Spudrock soils: 16 percent
Rock outcrop: 13 percent
Minor soils: 50 percent

Soil Properties and Qualities

Far

Landform: mountains
Depth class: very shallow and shallow
Drainage: well drained
Parent material: slope alluvium and colluvium from granite and gneiss
Textural class: very gravelly moderately coarse texture

Spudrock

Landform: mountains
Depth class: moderately deep
Drainage: well drained
Parent material: slope alluvium, colluvium and residuum from granite and gneiss
Textural class: very gravelly moderately coarse texture

Minor soils

• Soils having less organic matter
• Soils having fewer rock fragments
• Soils having more clay
• Rock outcrop consists of areas of exposed granite and gneiss

Use and Management

Major land type: rangeland
Major land use: livestock grazing

Management Factors

Far: slopes, depth to bedrock, content of rock fragments
Spudrock: slopes, depth to bedrock, content of rock fragments

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 inclusions. They generally are in small areas and could not be mapped separately because of the scale used. 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, Glendale clay loam, 0 to 2 percent slopes, flooded, is a phase of the Glendale series.

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

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Casa Grande-Kamato complex, 0 to 1 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. Dateland-Denure association, 1 to 3 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 "Contents") 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—Ajo-Pinamt, deep, complex, 3 to 15 percent slopes

Setting

Landform: relict fan terraces
Slope range: Ajo 3 to 10 percent, Pinamt 3 to 15 percent
Elevation: 1,600 to 2,200 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Ajo and similar soils: 50 percent
Pinamt and similar soils: 30 percent
Contrasting inclusions: 20 percent

Typical Profile

Ajo

Surface layer: 45 to 70 percent rock fragments
0 to 2 inches—light brown extremely gravelly loam
2 to 8 inches—yellowish red extremely gravelly sandy clay loam
8 to 17 inches—reddish brown very gravelly clay loam
17 to 25 inches—red extremely cobbly clay loam
25 to 30 inches—reddish brown extremely gravelly clay loam
30 to 60 inches—indurated hardpan

Pinamt

Surface layer: 45 to 70 percent rock fragments
0 to 2 inches—light brown very gravelly fine sandy loam
2 to 18 inches—reddish yellow very gravelly fine sandy loam
18 to 28 inches—yellowish red very gravelly loam
28 to 41 inches—yellowish red very gravelly sandy clay loam, calcareous
41 to 60 inches—indurated hardpan

Soil Properties and Qualities

Ajo

Parent material: mixed fan alluvium
Depth class: moderately deep (to a hardpan)
Depth to unweathered bedrock: greater than 60 inches
Drainage class: well drained
Permeability: moderately slow
Available water capacity: very low
Potential rooting depth: 20 to 40 inches
Runoff: medium
Hazard of water erosion: slight
Hazard of wind erosion: very slight
Shrink-swell potential: moderate
Calcium carbonate equivalent: less than 15 percent above hardpan
Corrosivity: steel—high, concrete—low

Pinamt

Parent material: mixed fan alluvium
Depth class: deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: very low
Potential rooting depth: 41 inches or more
Runoff: medium
Hazard of water erosion: slight
Hazard of wind erosion: very slight
Shrink-swell potential: low
Salinity: none to very slight
Calcium carbonate equivalent: greater than 5 percent in lower part
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Hickiwan soils that are very shallow and shallow to a hardpan
- Gunsight and Momoli soils that are very deep, have

over 35 percent rock fragments, less than 18 percent clay, and are calcareous
• Soils that are shallow to moderately deep to bedrock

Similar inclusions:
• Ajo-like soils that are shallow to a hardpan
• Ajo soils that have a surface texture of fine sandy loam
• Pinamt soils that have a surface texture of sandy loam
• Soils that have an argillic horizon less than 25 inches thick

Use and Management

Major current use: rangeland

Soil-related factors:
• Ajo soil—hardpan at moderate depths, droughtiness, small stones
• Pinamt soil—droughtiness, content of rock fragments

Rangeland

Dominant vegetation on the Ajo soil:
• Potential plant community—creosotebush, bush muhly, triangle bursage, white ratany, cacti species
• Present plant community—creosotebush, triangle bursage, white ratany, cactus species

Dominant vegetation on the Pinamt soil:
• Potential plant community—creosotebush, threeawn, triangle bursage, bush muhly, Buckhorn cholla
• Present plant community—creosotebush, triangle bursage, Buckhorn cholla

General management considerations:
• This unit is easily traversed by livestock.
• Production of forage for livestock grazing is limited by low rainfall.
• Forage production, consisting of annual forbs and grasses, can be high in years of good winter and spring precipitation.

Suitable management practices:
• Grazing management to improve grazing distribution is most economically practiced by turning livestock water developments on and off.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited
Desertic riparian herbaceous plants: very poorly suited
Desertic riparian shrubs and trees: very poorly suited

Interpretive Groups

Land capability classification:
Ajo soil—VIIs nonirrigated
Pinamt soil—VIIs nonirrigated

Range site:
Ajo soil—Limy Upland, Deep, 7-10" p.z.
Pinamt soil—Limy Upland, Deep, 7-10" p.z.

2—Anklam-Cellar-Rock outcrop complex, 15 to 55 percent slopes

Setting

Landform: hills and mountains
Slope range: Anklam 15 to 35 percent, Cellar 15 to 55 percent
Elevation: 2,200 to 3,800 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Anklam and similar soils: 40 percent
Cellar and similar soils: 35 percent
Rock outcrop: 20 percent
Contrasting inclusions: 5 percent

Typical Profile

Anklam

0 to 2 inches—brown extremely gravelly sandy loam
2 to 10 inches—yellowish red extremely gravelly sandy clay loam
10 to 20 inches—highly fractured bedrock that has clay films on the fractures
20 inches—unweathered granite bedrock

Cellar

0 to 1 inch—yellowish brown very gravelly sandy loam

1 to 12 inches—yellowish brown very gravelly sandy loam
12 inches—unweathered granite bedrock

Soil Properties and Qualities

Anklam

Parent material: slope alluvium and residuum from igneous rock
Depth class: shallow
Depth to weathered bedrock: 10 to 20 inches
Depth to unweathered bedrock: 20 to 25 inches
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: moderate
Hazard of wind erosion: very slight
Shrink-swell potential: low
Corrosivity: steel—high, concrete—low

Cellar

Parent material: slope alluvium from igneous rock
Depth class: very shallow and shallow
Depth to unweathered bedrock: 4 to 20 inches
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: very rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: very slight
Shrink-swell potential: low
Corrosivity: steel—high, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, massive boulder piles, and nearly vertical cliffs of granite and other igneous rock. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near hilltops and mountaintops.

Inclusions

Contrasting inclusions:
- Soils that have greater than 35 percent clay
- Soils that are moderately deep to deep to unweathered bedrock
- Dixaleta soils that have higher calcium carbonate
- Metamorphic and sedimentary rock outcrops

Use and Management

Major current use: rangeland

Soil-related factors:
- Anklam and Cellar soils: slope, droughtiness, rock outcrop

Rangeland

Dominant vegetation on the Anklam and Cellar soils:
- Potential plant community—paloverde, bush muhly, threeawn, jojoba, clubmoss, slender grama
- Present plant community—paloverde, triangle bursage, white brittlebush, ocotillo, saguaro

General management considerations:
- This soil produces forage for year-round use by livestock.
- Steep slopes, rocky surfaces and areas of rock outcrop limit access and result in poor grazing distribution.

Suitable management practices:
- Manage grazing distribution problems by using fencing, livestock water developments, and construction of trails to permit more animals to graze in smaller areas for shorter periods of time.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Interpretive Groups

Land capability classification:
Anklam soils—VIIs nonirrigated
Cellar soils—VIIe nonirrigated

Range site:
Anklam and Cellar soils—Shallow Hills, 10-13" p.z.

3—Anklam very gravelly sandy loam, 3 to 15 percent slopes

Setting

Landform: hills
Slope range: 3 to 15 percent
Elevation: 2,200 to 3,200 feet

Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Anklam and similar soils: 70 percent
Contrasting inclusions: 30 percent

Typical Profile

Rock fragments on surface: 60 percent gravel and 10 percent cobble
0 to 6 inches—brown very gravelly sandy loam
6 to 12 inches—yellowish red very gravelly sandy clay loam
12 to 20 inches—weathered bedrock that has clay films on the fragments
20 inches—unweathered granite bedrock

Soil Properties and Qualities

Parent material: slope alluvium and residuum from igneous rock
Depth class: shallow
Depth to weathered bedrock: 10 to 20 inches
Depth to unweathered bedrock: 20 to 25 inches
Drainage class: well drained
Permeability: moderately slow
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: very slight
Shrink-swell potential: low
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Rock outcrop
- Soils that are moderately deep to deep to an indurated hardpan
- Arizo soils that are very deep and sandy
- Soils that have greater than 35 percent clay
- Soils moderately deep to bedrock
- Dixaleta soils that are calcareous
- Cellar soils that have less clay

Use and Management

Major current use: rangeland

Soil-related factors: shallow to bedrock, droughtiness; slope

Rangeland

Dominant vegetation on the Anklam soil:
- Potential plant community—slender grama, bush muhly, threeawns, false-mesquite, paloverde
- Present plant community—paloverde, triangle bursage, cacti

General management considerations:
- These soils are easily traversed by livestock.
- These soils produce year-round browse.
- Livestock prefer these soils to adjacent hills and mountains.

Suitable management practices:
- Improve range quality by using fencing and livestock water developments to control grazing use.

Wildlife Habitat Suitability

Desertic herbaceous plants: well suited
Desertic shrubs and trees: well suited

Interpretive Groups

Land capability classification:
Anklam soil—VIIs nonirrigated

Range site:
Anklam soil—Shallow Upland, 10-13" p.z.

4—Arizo-Riverwash complex, 0 to 3 percent slopes

Setting

Landform: alluvial fans and flood plains
Hazard of flooding: Arizo—rare to occasional, Riverwash—common
Slope range: 0 to 3 percent
Elevation: 2,000 to 3,200
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Arizo and similar soils: 85 percent
Riverwash and similar soils: 10 percent
Contrasting inclusions: 5 percent

Typical Profile

Arizo

Rock fragments on surface: 20 to 35 percent
0 to 18 inches—yellowish brown gravelly loamy sand
18 to 60 inches—light yellowish brown very gravelly loamy sand

Soil Properties and Qualities

Arizo

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: excessively drained
Permeability: rapid
Available water capacity: very low
Potential rooting depth: 60 inches or more
Runoff: very slow except during thunderstorms and during periods when runoff from higher-lying soils causes flooding
Hazard of water erosion: slight
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Calcium carbonate: less than 10 percent
Corrosivity: steel—high, concrete—low

Riverwash

Riverwash consists of very deep, excessively drained, stratified sands, gravel, cobbles, and stones from numerous sources. The materials are in the drainages of this unit and are subject to common flooding and shifting.

Inclusions

Contrasting inclusions:
• Hayhook soils that have less than 15 percent rock fragments and textures of sandy loam
• Vado and Stagecoach soils that have more than 35 percent rock fragments and have calcium carbonate accumulations
• Arizo-like soils that are moderately deep to bedrock

Similar inclusions:
• Arizo soils that have surface textures of coarse sand

Use and Management

Major current use: rangeland

Soil-related factors: hazard of flooding; sandy textures, and droughtiness

Rangeland

Dominant vegetation on the Arizo soil:
• Potential plant community—mesquite, dropseeds, Arizona cottontop, paloverde, bush muhly, threeawns, black grama
• Present plant community—paloverde, big bursage, mesquite, brittlebush, burroweed, annuals

General management considerations:
• Livestock prefer this soil because of easy access, the availability of shade, and seasonal water from local flooding.
• This soil produces forage for year-round use.
• This soil is susceptible to erosion when the protective vegetation cover is depleted by overgrazing.

Suitable management practices:
• Fencing can help control grazing distribution and thereby maintain adequate plant cover.
• Other suitable range management practices to improve grazing distribution and range condition include livestock water developments and grade stabilization structures.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: suited
Desertic riparian shrubs and trees: suited

Interpretive Groups

Land capability classification: Arizo soil—VIIe nonirrigated

Range site: Arizo soil—Sandy Upland, 10-13" p.z.

5—Baboquivari-Combate complex, 1 to 8 percent slopes

Setting

Landform: Baboquivari—fan terraces, Combate—alluvial fans (fig. 2)
Slope range: 1 to 8 percent
Elevation: 2,800 to 4,200 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 63 to 67 degrees F.
Frost-free period: 215 to 250 days

Composition

Baboquivari and similar soils: 45 percent

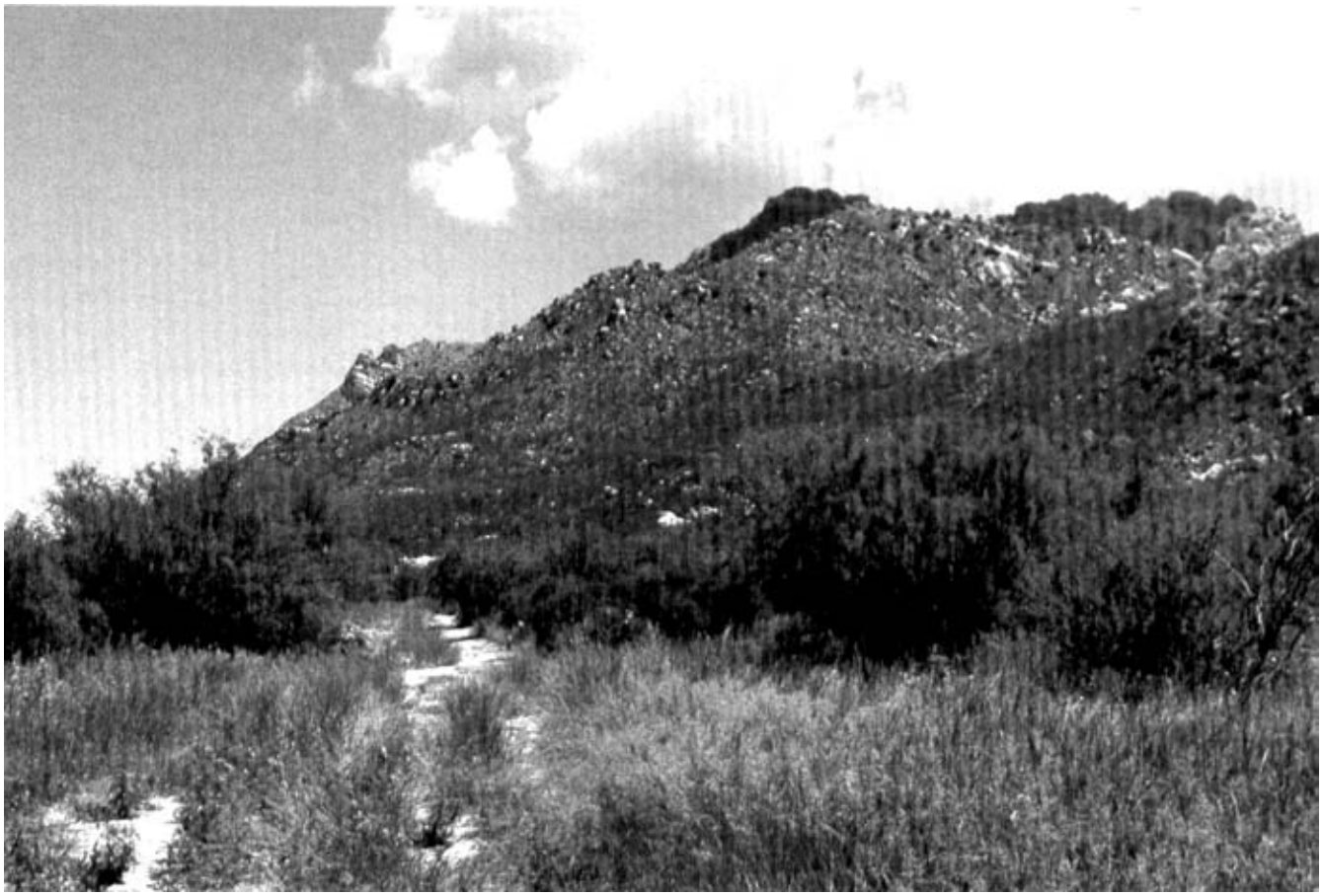

Figure 2.—Typical landscape of Baboquivari-Combate complex, 1 to 8 percent slopes.

Combate and similar soils: 45 percent
Contrasting inclusions: 10 percent

Typical Profile

Baboquivari

0 to 2 inches—yellowish brown gravelly coarse sandy loam
2 to 14 inches—brown to dark brown gravelly coarse sandy loam
14 to 40 inches—yellowish red gravelly sandy clay loam
40 to 51 inches—yellowish red gravelly coarse sandy loam
51 to 60 inches—reddish yellow gravelly loamy sand

Combate

0 to 1 inch—brown gravelly loamy coarse sand
1 to 15 inches—dark grayish brown gravelly loamy coarse sand
15 to 29 inches—brown to dark brown gravelly coarse sandy loam
29 to 60 inches—yellowish brown gravelly coarse sandy loam

Soil Properties and Qualities

Baboquivari

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: moderate
Corrosivity: steel—moderate, concrete—low

Combate

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid

Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: steel—high, concrete—moderate

Inclusions

Contrasting inclusions:
- Arizo-like soils in the drainages that are sandy and flood
- Slope gradients greater than 8 percent
- Rock outcrop
- Soils that are moderately deep to bedrock
- Tubac-like soils that have more than 35 percent clay
- Romero and Oracle soils that are shallow to weathered bedrock

Similar inclusions:
- Soils that are similar to Baboquivari and Combate but have less organic matter and are lighter in color
- Baboquivari soils that have surface textures of loamy sand
- Combate soils that have surface textures of sandy loam

Use and Management

Major current use: rangeland

Soil-related factors:
- Baboquivari—droughtiness, hazard of seepage
- Combate soil—droughtiness, hazard of seepage, fast intake rate

Rangeland

Dominant vegetation on the Baboquivari soil:
- Potential plant community—black grama, sideoats grama, plains lovegrass, cane beardgrass, Arizona cottontop
- Present plant community—mesquite, range ratany, shrubby buckwheat, catclaw acacia and snakeweed

Dominant vegetation on the Combate soil:
- Potential plant community—Arizona cottontop, sideoats grama, spike dropseed, green sprangletop
- Present plant community—mesquite, wait-a-bit mimosa, shrubby buckwheat, and catclaw mimosa

General management considerations:
- This unit is easily traversed by livestock.
- This unit produces forage for year-round use.
- Brush encroachment is a serious problem. Competition from woody plants must be reduced before effective perennial grass cover can be maintained.
- This unit responds well to good grazing management practices and is potentially one of the best upland range sites in the survey area.

Suitable management practices:
- Controlled burning is effective in controlling poisonous half shrubs such as snakeweed and burroweed on this unit.
- Other suitable range management practices to improve grazing distribution and range condition include fencing, livestock water development, and range seeding.

Wildlife Habitat Suitability

Baboquivari
Desertic herbaceous plants: well suited
Desertic shrubs and trees: well suited

Combate
Desertic herbaceous plants: well suited
Desertic shrubs and trees: well suited
Desertic riparian herbaceous plants: suited
Desertic riparian shrubs and trees: suited

Interpretive Groups

Land capability classification:
Baboquivari soils—VIs nonirrigated
Combate soils—VIe nonirrigated

Range site:
Baboquivari soil—Sandy Loam Upland, 12-16" p.z.
Combate soil—Sandy Loam, Deep, 12-16" p.z.

6—Bucklebar-Hayhook-Tubac complex, 0 to 3 percent slopes

Setting

Landform: Bucklebar and Hayhook—fan terraces, Tubac—basin floors
Hazard of flooding: Bucklebar and Hayhook none, Tubac rare to occasional
Slope range: Bucklebar and Hayhook 1 to 3 percent, Tubac 0 to 1 percent
Elevation: 2,000 to 3,200
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.

Frost-free period: 240 to 260 days

Composition

Bucklebar and similar soils: 55 percent
Hayhook and similar soils: 20 percent
Tubac and similar soils: 15 percent
Contrasting inclusions: 10 percent

Typical Profile

Bucklebar

0 to 3 inches—strong brown sandy loam
3 to 9 inches—strong brown sandy loam
9 to 37 inches—reddish brown loam
37 to 60 inches—strong brown loam

Hayhook

0 to 1 inch—yellowish brown loamy sand
1 to 6 inches—yellowish brown sandy loam
6 to 19 inches—strong brown sandy loam
19 to 60 inches—yellowish brown sandy loam

Tubac

0 to 5 inches—brown sandy loam
5 to 28 inches—brown and reddish brown clay
28 to 43 inches—brown sandy clay loam
43 to 52 inches—brown clay
52 to 60 inches—yellowish red sandy clay loam

Soil Properties and Qualities

Bucklebar

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: moderately high
Shrink-swell potential: moderate
Calcium carbonate equivalent: less than 15 percent in low part
Corrosivity: steel—high, concrete—low

Hayhook

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: high
Shrink-swell potential: low
Corrosivity: steel—high, concrete—low

Tubac

Parent material: mixed stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: slight, but drainageways are entrenched and channeled. Headcutting and deposition may occur following heavy summer and winter storms.
Hazard of wind erosion: moderately high
Shrink-swell potential: high
Calcium carbonate equivalent: less than 15 percent
Salinity: none to very slight in the lower part
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Soils that have more than 15 percent calcium carbonate in the lower part
- Grabe soils in drainageways that are loamy
- Arizo soils in drainageways that are sandy and subject to flooding

Similar inclusions:
- Pajarito and Sahuarita soils that have calcium carbonate accumulations
- Glendale soils that have silty textures and are subject to flooding
- Tubac soils that have surface textures of fine sandy loam

Use and Management

Major current use: rangeland

Soil-related factors:
- Bucklebar—hazard of wind erosion, seepage and piping
- Hayhook—hazard of droughtiness, seepage and erosion
- Tubac—shrink-swell potential, hazard of flooding

Rangeland

Dominant vegetation on the Bucklebar soil:
- Potential plant community—paloverde, Arizona

cottontop, threeawns, plains bristlegrass, Rothrock grama, bush muhly
• Present plant community—mesquite, paloverde, burroweed, triangle bursage, annuals

Dominant vegetation on the Hayhook soil:
• Potential plant community—paloverde, bush muhly, Santa Rita threeawns, Rothrock grama, spike dropseed
• Present plant community—mesquite, paloverde, burroweed, cacti

Dominant vegetation on the Tubac soil:
• Potential plant community—mesquite, bush muhly, Rothrock grama, tobosa, vine mesquite
• Present plant community—mesquite, snakeweed, cacti, annuals

General management considerations:
• This unit is easily traversed by livestock.
• It produces forage for year-round use.
• Brush encroachment is a serious problem on much of this unit. The competition from woody plants must be reduced before this unit will respond to grazing management.

Suitable management practices:
• Other suitable range management practices to improve grazing distribution and range condition include fencing, livestock water development, and range seeding.

Cropland

General management considerations for the Bucklebar soil:
• To maintain soil productivity, manage soil to sustain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
• A hazard of soil blowing exists when soil surface is disturbed or left unprotected by vegetation.
• A tillage pan forms easily if this soil is tilled when wet.
• Intake rates and slope can affect uniform distribution of irrigation water.

Suitable management practices for the Bucklebar soil:
• Rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis, to improve fertility and increase the water intake rate and available water holding capacity.
• Wind erosion can be reduced by keeping the soil rough and cloddy when it is not protected by vegetation.
• Break up tillage pans by ripping or chiseling when the soil is dry to increase the effective rooting depth, enhance root development, and improve internal drainage.
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.

General management considerations for the Hayhook soil:
• To maintain soil productivity, sustain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
• A hazard of wind erosion exists when the soil surface is disturbed or left unprotected by vegetation.
• Intake rates and slope can affect uniform distribution of irrigation water.
• Moderately rapid permeability of this soil can cause deep percolation, which can result in the leaching of plant nutrients.

Suitable management practices for the Hayhook soil:
• Rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis, to improve fertility and increase the water intake rate and available water holding capacity.
• Wind erosion can be reduced by keeping the soil rough and cloddy when it is not protected by vegetation.
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• Irrigation water needs to be applied in amounts large enough to wet the root zone but small enough to minimize the leaching of plant nutrients.

General management considerations for the Tubac soil:
• These soils have a hazard of flooding.
• To maintain soil productivity, sustain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
• A tillage pan forms easily if this soil is tilled when wet.
• Intake rates and slope can affect uniform distribution of irrigation water.

Suitable management practices for the Tubac soil:
• The risk of flooding can be reduced by the use of levees, dikes, and diversions.
• Rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis, to improve fertility and increase the water intake rate and available water holding capacity.
• Break up tillage pans by ripping or chiseling when

the soil is dry to increase the effective rooting depth, enhance root development, and improve internal drainage.
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.

Wildlife Habitat Suitability

Bucklebar and Hayhook
Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Tubac
Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: suited
Desertic riparian shrubs and trees: suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Bucklebar soil—IIe irrigated and VIIe nonirrigated
Hayhook soil—IIIe irrigated and VIIe nonirrigated
Tubac soil—IIIw irrigated and VIIw nonirrigated

Range site:
Bucklebar soil—Sandy Loam Upland, 10-13" p.z.
Hayhook soil—Sandy Loam, Deep, 10-13" p.z.
Tubac soil—Clayey Bottom, 10-13" p.z.

7—Caralampi-Selevin-Kimrose complex, 5 to 50 percent slopes

Setting

Landform: relict fan terraces
Slope range: Caralampi 15 to 50 percent, Selevin and Kimrose 5 to 15 percent
Elevation: 2,800 to 3,800 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 63 to 67 degrees F.
Frost-free period: 215 to 250 days

Composition

Caralampi and similar soils: 40 percent
Selevin and similar soils: 30 percent
Kimrose and similar soils: 20 percent
Contrasting inclusions: 10 percent

Typical Profile

Caralampi

0 to 2 inches—brown to dark brown very gravelly sandy loam
2 to 10 inches—dark reddish brown extremely gravelly sandy clay loam
10 to 26 inches—reddish brown extremely gravelly sandy clay loam
26 to 60 inches—reddish brown extremely gravelly sandy clay loam

Selevin

0 to 1 inch—reddish brown extremely gravelly sandy loam
1 to 16 inches—dark reddish brown very gravelly sandy clay
16 to 32 inches—reddish brown extremely gravelly sandy clay loam
32 to 60 inches—pink extremely gravelly sandy loam, calcareous

Kimrose

0 to 2 inches—strong brown very gravelly sandy loam
2 to 12 inches—strong brown very gravelly sandy clay loam, calcareous
12 to 20 inches—white extremely gravelly sandy loam, calcareous
20 to 60 inches—indurated hardpan

Soil Properties and Qualities

Caralampi

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: very low
Potential rooting depth: 60 inches or more
Runoff: rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: slight
Shrink-swell potential: moderate
Calcium carbonate equivalent: less than 15 percent
Corrosivity: steel—high, concrete—low

Selevin

Parent material: mixed fan alluvium
Depth class: very deep

Drainage class: well drained
Permeability: slow
Available water capacity: very low
Potential rooting depth: 60 inches or more
Runoff: medium to rapid
Hazard of water erosion: slight
Hazard of wind erosion: very slight
Shrink-swell potential: high
Calcium carbonate equivalent: greater than 15 percent, below 30 inches
Corrosivity: steel—high, concrete—low

Figure 3.—Typical landscape of Caralampi very gravelly sandy loam in an area of Caralampi-Selevin-Kimrose complex, 5 to 50 percent slopes.

Kimrose

Parent material: mixed fan alluvium
Depth class: shallow (to hardpan)
Drainage class: well drained
Permeability: moderately slow
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
Shrink-swell potential: moderate
Calcium carbonate equivalent: greater than 15 percent in the lower part
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Baboquivari soils that contain less than 35 percent rock fragments
- Chiricahua soils that are shallow to bedrock
- Keysto soils in drainages that are sandy and flood
- Soils that are calcareous and do not have a hardpan
- Soils that have less organic matter in the surface layer
- Soils that are moderately deep to hardpan
- Soils that are dark in color throughout and have greater than 35 percent clay content

Similar inclusions:
- Selevin soils that have surface textures of sandy clay loam

Use and Management

Major current use: rangeland

Soil-related factors:
- Caralampi soil—content of rock fragments, slope, droughtiness (fig. 3)
- Selevin soil—slope, content of rock fragments, hazard of seepage
- Kimrose soil—shallow to a hardpan, calcareous, droughtiness

Rangeland

Dominant vegetation on the Caralampi soil:
- Potential plant community—sideoats grama, black grama, hairy grama, sprucetop grama, cane beardgrass, false mesquite
- Present plant community—mesquite, cacti, snakeweed, yucca, curly-mesquite

Dominant vegetation on the Selevin soil:
- Potential plant community—curly-mesquite,

sideoats grama, false-mesquite, tobosa, paloverde, mesquite
• Present plant community—mesquite, snakeweed, paloverde, curly-mesquite, cacti

Dominant vegetation on the Kimrose soil:
• Potential plant community—bush muhly, black grama, whitethorn, creosotebush, paloverde
• Present plant community—whitethorn, creosotebush, paloverde, bush muhly, cacti

General management considerations:
• This unit is easily traversed by livestock.
• It provides forage for year-round use.
• The vegetation on the Selevin and Caralampi soils are preferred by livestock.
• Brush encroachment is a serious problem in this unit.
• The unit will respond to grazing management.
• Grazing management, utilizing fencing and livestock water developments, helps improve grazing distribution.
• Other suitable range management practices to improve range condition include range seeding and brush management.

Suitable management practices:
• Encourage uniform grazing on these soils by fencing and developing permanent water.
• Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Caralampi and Selevin
Desertic herbaceous plants: well suited
Desertic shrubs and trees: well suited

Kimrose
Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Interpretive Groups

Land capability classification:
Caralampi soil—VIe nonirrigated
Selevin and Kimrose soils—VIs nonirrigated

Range site:
Caralampi soil—Loamy Hills, 12-16" p.z.
Selevin soil—Clay Loam Upland, 12-16" p.z.
Kimrose soil—Limy Upland, 12-16" p.z.

8—Casa Grande-Kamato complex, 0 to 1 percent slopes

Setting

Landform: basin floors
Hazard of flooding: Casa Grande—none, Kamato—occasional
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Casa Grande and similar soils: 60 percent
Kamato and similar soils: 25 percent
Contrasting inclusions: 15 percent

Typical Profile

Casa Grande

0 to 9 inches—brown loam
9 to 21 inches—light brown to pink clay loam saline-sodic
21 to 46 inches—light brown to pink clay loam saline-sodic, calcareous
46 to 60 inches—very pale brown sandy clay loam saline-sodic, calcareous

Kamato

0 to 2 inches—light reddish brown loam
2 to 8 inches—light reddish brown sandy clay loam
8 to 13 inches—light reddish brown sandy clay, saline-sodic
13 to 26 inches—light reddish brown clay, saline-sodic
26 to 60 inches—light reddish brown clay loam, saline-sodic

Soil Properties and Qualities

Casa Grande

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: well drained

Permeability: slow
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: moderate
Shrink-swell potential: moderate
Salinity: moderate
Sodicity: moderate to strong
Calcium carbonate equivalent: greater than 15 percent below 20 inches
Corrosivity: steel—high, concrete—high

Kamato

Parent material: mixed stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: high
Salinity: very slightly to strong
Sodicity: moderate to strong
Calcium carbonate equivalent: 5 to 10 percent in the lower part
Corrosivity: steel—high, concrete—high

Inclusions

Contrasting inclusions:
- Tucson and Mohall soils that are none to slightly saline
- Soils that have an indurated hardpan at moderate depths
- Vecont soils that are fine textured and none to slightly saline
- Tatai soils that are silty textured over a buried Casa Grande soil

Similar inclusions:
- Kamato soils that have surface textures of fine sandy loam or sandy clay loam

Use and Management

Major current use: rangeland

Soil-related factors:
- Casa Grande soil—excess sodium, piping, and droughtiness, ponding
- Kamato soil—excess sodium, hazard of flooding, moderately slow permeability

Rangeland

Dominant vegetation on the Casa Grande soil:
- Potential plant community—desert saltbush, thinleaf fourwing saltbush, mesquite annual forbs and grasses
- Present plant community—desert saltbush, thinleaf fourwing saltbush, wolfberry, cholla, mesquite, annual forbs and grasses

Dominant vegetation on the Kamato soil:
- Potential plant community—twoflower trichloris, threeawns, bush muhly, desert saltbush, thinleaf fourwing saltbush, wolfberry, mesquite, annuals
- Present plant community—mesquite, desert saltbush, wolfberry, annual grasses and forbs

General management considerations for the Casa Grande soil:
- Potential vegetation is dominated by salt tolerant shrubs.
- The majority of perennial forage is provided by evergreen saltbush browse.
- This soil is easily traversed by livestock.
- Proper grazing distribution is difficult on this site because permanent water is not available.
- Overgrazing reduces the plant cover and increases the rate of erosion.
- Extra care in management is needed to protect this soil from erosion.
- Salt is generally not needed on this soil because of the salt content of available browse.
- When annuals are not available, the energy requirements of livestock will not be met by the available forage.

Suitable management practices for the Casa Grande soil:
- Encourage uniform grazing on this soil by developing and controlling permanent waters.
- Provide an energy supplement when annuals are not available.
- Control erosion and promote forage production with proper utilization.
- Provide periodic rest during the growing season to maintain plant vigor and production.

General management considerations for the Kamato soil:
- This soil is among the most productive in the survey area.
- Potential vegetation is dominated by a mixture of salt tolerant grasses and shrubs.
- Important perennial forage potentially includes threeawns, twoflower trichloris, and bush muhly.

• This soil benefits from run-on moisture, which increases the amount of forage produced.
• Livestock movement is hindered by dense brushy growth.
• This soil has shade for livestock.
• Unless controlled, livestock will generally overgraze this area because of the availability of water and abundance of feed.
• Extra care in management is needed to protect this soil from erosion.
• Salt is generally not needed on this soil because of the salt content of available browse.

Suitable management practices for the Kamato soil:
• Thin trees to encourage production of perennial grasses.
• Provide erosion protection if the plant cover is disturbed.
• Seeding can be used to improve range condition when there are not enough remnant perennial grasses to reestablish the site.
• Use water-spreading dikes to increase the area benefiting from run-on moisture.
• Prevent overgrazing of this soil by fencing or controlling water availability.
• Provide periodic rest during the growing season to maintain plant vigor and production.

Cropland

General management considerations for the Casa Grande soil:
• The subsoil and substratum have a high content of calcium carbonate, salts and sodium. This reduces the soil's permeability and the availability of nutrients.
• The sodium in the Casa Grande soil causes this soil to disperse and/or compact.
• Intake rates and slope can affect uniform distribution of irrigation water.
• Distribution of irrigation water is affected by contrasting textures and/or permeability rates.
• Excessive cultivation can result in the formation of a tillage pan.
• Tillage pans can be broken by ripping when the soil is dry. This increases the effective rooting depth, enhances root development, and improves internal drainage. Roots are not restricted and can easily grow in all directions.
• To maintain soil productivity, sustain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.

Suitable management practices for Casa Grande soil:
• Salt-tolerant crops should be selected and properly designed irrigation systems installed to assure uniform application of irrigation water and to control salt movement.
• The effects of sodium can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Effects of compaction can be controlled by not tilling when the soil is wet. Compaction can be broken up by ripping when the soil is dry.
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• Onsite investigations are needed to identify contrasting textures and/or permeability rates prior to land leveling fields to assure uniform irrigation water distribution.
• Rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis, to improve fertility and increase the water intake rate and available water holding capacity.

General management considerations for the Kamato soil:
• The subsoil and substratum have a high content of calcium carbonate, salts and sodium; this reduces the permeability and the availability of nutrients.
• The sodium in the Kamato soil causes this soil to disperse and/or compact.
• These soils have a hazard of flooding.
• A tillage pan forms easily if this soil is tilled when wet.
• To maintain soil productivity proper soil conditions should be sustained, including good soil tilth, organic matter, aeration, and structure.

Suitable management practices for the Kamato soil:
• Salt-tolerant crops should be selected and properly designed irrigation systems installed to assure uniform application of irrigation water and to control salt movement.
• The effects of sodium can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.
• Effects of compaction can be controlled by not tilling when the soil is wet. Compaction can be broken up by ripping when the soil is dry.
• The risk of flooding can be reduced by the use of levees, dikes, and diversions.
• Break up tillage pans by ripping or chiseling when the soil is dry to increase the effective rooting depth, enhance root development, and improve internal drainage.
• Rotate crops and incorporate crop residue into the

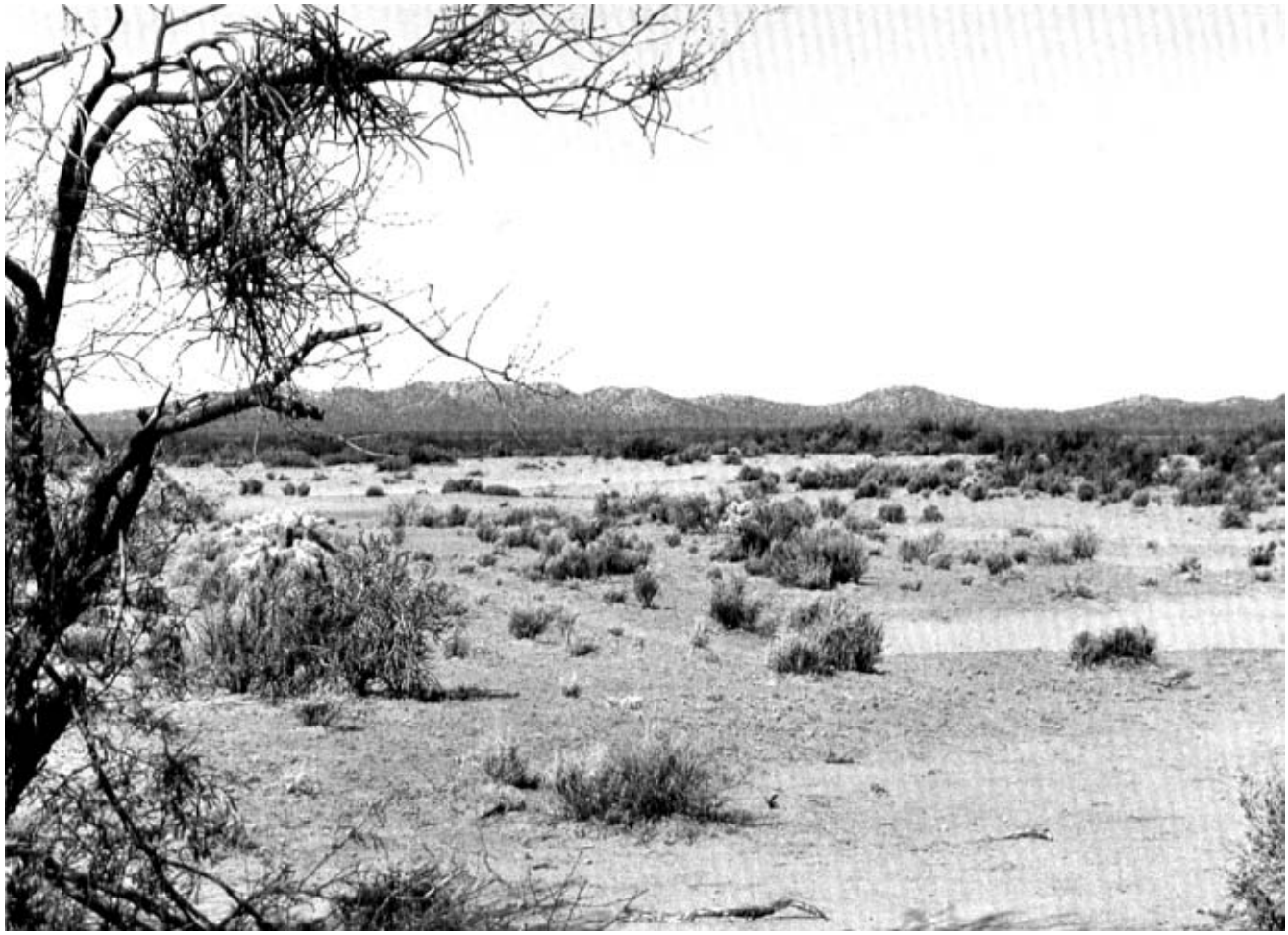

Figure 4.—Typical landscape of Casa Grande-Rositas-Valencia complex, 0 to 5 percent slopes

soil, or add other organic matter on a regular basis, to improve fertility and increase the water intake rate and available water holding capacity.

Wildlife Habitat Suitability

Casa Grande
Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Kamato
Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited
Desertic riparian herbaceous plants: very poorly suited
Desertic riparian shrubs and trees: very poorly suited

Interpretive Groups

Land capability classification:
Casa Grande soils—IIs irrigated and VIIs nonirrigated
Kamato soils—IIIs irrigated and VIIs nonirrigated

Range site:
Casa Grande soil—Saline Loam, 7-10" p.z.
Kamato soil—Saline Bottom, 7-10" p.z.

9—Casa Grande-Rositas-Valencia complex, 0 to 5 percent slopes

Setting

Landform: Casa Grande—basin floors, Rositas—dunes, Valencia—alluvial fans and flood plains (fig. 4)
Hazard of flooding: Casa Grande and Rositas—none, Valencia—rare to occasional
Slope range: Casa Grande 0 to 2 percent, Rositas 1 to 5 percent, Valencia 0 to 1 percent
Elevation: 1,400 to 2,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.

Frost-free period: 250 to 300 days

Composition

Casa Grande and similar soils: 60 percent
Rositas and similar soils: 20 percent
Valencia and similar soils:15 percent
Contrasting inclusions: 5 percent

Typical Profile

Casa Grande

0 to 4 inches—light brown fine sandy loam
4 to 10 inches—yellowish red sandy loam, saline-sodic
10 to 24 inches—yellowish red sandy clay loam, saline-sodic
24 to 60 inches—light brown and reddish brown clay loam, saline-sodic, calcareous

Rositas

0 to 1 inch—light yellowish brown loamy sand
1 to 23 inches—light brown loamy sand
23 to 60 inches—light yellowish brown loamy sand

Valencia

0 to 10 inches—light yellowish brown fine sandy loam
10 to 25 inches—brown and strong brown sandy loam
25 to 60 inches—strong brown sandy clay loam, saline-sodic

Soil Properties and Qualities

Casa Grande

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: moderately high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: moderate
Salinity: very slight to moderate
Sodicity: moderate to strong
Calcium carbonate equivalent: greater than 15 percent below 20 inches
Corrosivity: steel—high, concrete—high

Rositas

Parent material: eolian sand
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: very slow
Hazard of erosion by water: slight
Hazard of erosion by wind: very high
Shrink-swell potential: low
Salinity: very slightly
Corrosivity: steel—high, concrete—low

Valencia

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid in the upper part and moderately slow in the lower part
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: low in the upper part and moderate in the lower part
Salinity: moderate
Sodicity: slight to strong
Calcium carbonate equivalent: less than 5 percent in the upper part
Corrosivity: steel—high, concrete—moderate

Inclusions

Contrasting inclusions:
- Pahaka soils that have textures of sandy loam to moderate depths over a buried argillic horizon
- Glenbar soils that have silty textures and that flood
- Sandy soils that contain accumulations of calcium carbonate
- Tucson and Mohall soils that are none to slightly saline
- Tatai soils that have silty textures over buried Casa Grande soil

Similar inclusions:
- Denure soils that have sandy loam textures
- Casa Grande soils that have textures of coarse sandy loam or loamy coarse sand in the lower parts

Use and Management

Major current use: rangeland

Soil-related factors:
- Casa Grande—excess sodium, piping, slow permeability, hazard of wind erosion, ponding (fig. 5)
- Rositas—droughtiness, hazard of wind erosion and seepage, piping
- Valencia soil—hazard of flooding and seepage, excess sodium

Rangeland

Dominant vegetation on the Casa Grande soil:
- Potential plant community—desert saltbush, thinleaf fourwing saltbush, wolfberry, annual grasses and forbs, mesquite
- Present plant community—thin leaf, fourwing and desert saltbush, wolfberry, annual grasses and forbs

Dominant vegetation on the Rositas soil:
- Potential plant community—big galleta, Santa Rita threeawns, dropseeds, Mormon-tea, annual grasses and forbs, desert and fourwing saltbush
- Present plant community—creosotebush, birdcage primrose, big galleta, mesa dropseed, spike dropseed, annual grasses and forbs.

Dominant vegetation on the Valencia soil:
- Potential plant community—trichloris, bush muhly, Rothrock grama, desert and fourwing saltbush, threeawns, wolfberry, mesquite
- Present plant community—desert saltbush, mesquite, wolfberry, annual grasses and forbs, catclaw, greythorn.

General management considerations on the Casa Grande soil:
- Potential vegetation is dominated by salt tolerant shrubs.

Figure 5.—Typical landscape of Casa Grande-Rositas-Valencia complex, 0 to 5 percent slopes. Accumulations of salt are visible on the eroded areas of the Casa Grande soil.

• The majority of perennial forage is provided by evergreen saltbush browse.
• This soil is easily traversed by livestock.
• Proper grazing distribution is difficult on this site because of the unavailability of permanent water.
• Overgrazing reduces the plant cover and increases the rate of erosion.
• Extra care in management is needed to protect this soil from erosion.
• Salt is generally not needed on this soil because of the salt content of available browse.
• When annuals are not available, the energy requirements of livestock will not be met by the available forage.

Suitable management practices on the Casa Grande soil:
• Encourage uniform grazing on this soil by developing and controlling permanent waters.
• Provide an energy supplement when annuals are not available.
• Control erosion and promote forage production with proper utilization.
• Provide periodic rest during the growing season to maintain plant vigor and production.

General management consideration on the Rositas soil:
• Potential vegetation is dominated by a mixture of salt tolerant grasses and shrubs.
• Important perennial forage potentially includes big galleta.
• Livestock movement is hindered by loose sands.
• Proper grazing distribution is difficult on this soil because of the unavailability of permanent water.
• Overgrazing reduces the plant cover and increases the rate of erosion.
• Extra care in management is needed to protect this soil from erosion.
• Salt is generally not needed on this soil because of the salt content of available browse.

Suitable management practices on the Rositas soil:
• Provide erosion protection if the plant cover is disturbed.
• Encourage uniform grazing on this soil by developing and controlling permanent waters.
• Control erosion and promote forage production with proper utilization.
• Provide periodic rest during the growing season to maintain plant vigor and production

General management considerations on the Valencia soil:
• This soil is among the most productive in the survey area.
• Potential vegetation is dominated by a mixture of salt tolerant grasses and shrubs.
• Important perennial forage potentially includes threeawns, twoflower trichloris, and bush muhly.
• This soil benefits from run-on moisture which increases the amount of forage produced.
• Livestock movement is hindered by dense brushy growth.
• This soil has shade for livestock.
• Livestock will generally overgraze this area, unless controlled, because of the availability of water and abundance of feed.
• Extra care in management is needed to protect this soil from erosion.
• Salt is generally not needed on this soil because of the salt content of available browse.

Suitable management practices on the Valencia soil:
• Thin trees to encourage production of perennial grasses.
• Provide erosion protection if the plant cover is disturbed.
• Seeding can be used to improve range condition when there are not enough remnant perennial grasses to reestablish the site.
• Use water-spreading dikes to increase the area benefiting from run-on moisture.
• Prevent overgrazing of this soil by fencing or controlling water availability.
• Provide periodic rest during the growing season to maintain plant vigor and production.

Cropland

General management considerations on the Casa Grande soil:
• The subsoil and substratum have a high content of calcium carbonate, salts, and sodium, which reduces the permeability and the availability of nutrients.
• The sodium causes this soil to disperse and/or compact.
• Intake rates and slope can affect uniform distribution of irrigation water.
• Distribution of irrigation water is affected by contrasting textures and/or permeability rates.
• Excessive cultivation can result in the formation of a tillage pan.
• To maintain soil productivity proper soil conditions should be sustained, including good soil tilth, organic matter, aeration, and structure.

Suitable management practices on the Casa Grande soil:
- Salt-tolerant crops should be selected and properly designed irrigation systems installed to assure uniform application of irrigation water and to control salt movement.
- The effects of sodium can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.
- Effects of compaction can be controlled by not tilling when the soil is wet. Compaction can be broken up by ripping when the soil is dry.
- Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
- Onsite investigations are needed to identify contrasting textures and/or permeability rates prior to land leveling fields to assure uniform irrigation water distribution.
- Tillage pans can be broken by ripping when the soil is dry. This increases the effective rooting depth, enhances root development, and improves internal drainage. Roots are not restricted and can easily grow in all directions.
- To improve fertility and increase both the water intake rate and available water holding capacity, rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis.

General management considerations on the Rositas soil:
- Intake rates and slope can affect uniform distribution of irrigation water.
- Rapid permeability of this soil can cause deep percolation which could result in the leaching of plant nutrients.
- A hazard of wind erosion exists when the soil surface is disturbed or left unprotected by vegetation.
- To sustain soil productivity, proper soil conditions should be maintained, including good soil tilth, organic matter, aeration, and structure.

Suitable management practices on the Rositas soil:
- Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
- Application of irrigation water needs to be managed in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.
- Wind erosion can be reduced by keeping the soil rough and cloddy when not protected by vegetation.
- Maintain fertility and tilth by returning all crop residue to the soil and using a cropping system that includes grasses, legumes or grass-legume mixtures.

General management considerations on the Valencia soil:
- The subsoil and substratum have a high content of calcium carbonate, salts, and sodium, which reduces the permeability and the availability of nutrients.
- Distribution of irrigation water is affected by contrasting textures and/or permeability rates.
- These soils have a hazard of flooding.
- Excessive cultivation can result in the formation of a tillage pan.
- To sustain soil productivity, proper soil conditions should be maintained, including good soil tilth, organic matter, aeration, and structure.

General management practices on the Valencia soil:
- Salt-tolerant crops should be selected and properly designed irrigation systems installed to assure uniform application of irrigation water and to control salt movement.
- Onsite investigations are needed to identify contrasting textures and/or permeability rates prior to land leveling fields to assure uniform irrigation water distribution.
- The risk of flooding can be reduced by the use of levees, dikes and diversions.
- Tillage pans can be broken by ripping when the soil is dry. This increases the effective rooting depth, enhances root development, and improves internal drainage. Roots are not restricted and can easily grow in all directions.
- Returning all crop residue to the soil and using a cropping system that includes grasses, legumes or grass-legume mixtures will help maintain fertility and tilth.

Wildlife Habitat

Casa Grande and Rositas
Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Valencia
Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: very poorly suited
Desertic riparian shrubs and trees: very poorly suited

Interpretive Groups

Land capability classification:
Casa Grande and Rositas soils—IIIe irrigated and VIIe nonirrigated
Valencia soil—IIIw irrigated and VIIw nonirrigated

Figure 6.—Typical landscape of Cellar-Lampshire-Rock outcrop complex, 15 to 60 percent slopes.

Range site:
Casa Grande soil—Sandy Loam, (saline), 7-10" p.z.
Rositas soil—Sandy Upland, (saline), 7-10" p.z.
Valencia soil—Saline Bottom, 7-10" p.z.

10—Cellar-Lampshire-Rock outcrop complex, 15 to 60 percent slopes

Setting

Landform: mountains and hills (fig. 6)
Slope range: 15 to 60 percent. Cellar soils are on the warmer, drier south slopes; and Lampshire soils are on the cooler, more moist north slopes.
Elevation: 3,200 to 5,300 feet
Mean annual precipitation: 10 to 16 inches
Mean annual air temperature: 63 to 67 degrees F.
Frost-free period: 215 to 250 days

Composition

Cellar and similar soils: 35 percent
Lampshire and similar soils: 30 percent
Rock outcrop: 25 percent
Contrasting inclusions: 10 percent

Typical Profile

Cellar

0 to 1 inch—yellowish brown very gravelly sandy loam
1 to 11 inches—dark yellowish brown very gravelly sandy loam

11 inches—unweathered gneiss bedrock

Lampshire

0 to 1 inch—dark grayish brown gravelly sandy loam
1 to 4 inches—dark brown very gravelly sandy loam
4 to 8 inches—highly fractured gneiss
8 inches—unweathered gneiss bedrock

Soil Properties and Qualities

Cellar

Parent material: slope alluvium from igneous and metamorphic rocks
Depth class: very shallow and shallow
Depth to unweathered bedrock: 4 to 20 inches
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Corrosivity: steel—high, concrete—low

Lampshire

Parent material: slope alluvium from igneous and metamorphic rock
Depth class: very shallow and shallow
Depth to unweathered bedrock: 4 to 20 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Corrosivity: steel—moderate, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, massive boulder piles and nearly vertical cliffs of granite, gneiss, and igneous and metamorphic rock. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near the hilltops and mountaintops.

Inclusions

Contrasting inclusions:
- Pantak soils that have 18 to 35 percent clay
- Slopes that are less than 15 percent
- Chiricahua soils that have more than 35 percent clay

Similar inclusions:
- Soils that have less than 35 percent rock fragments
- Dixaleta soils that are calcareous
- Romero soils that are very shallow and shallow to weathered schist

Use and Management

Major current use: rangeland

Soil-related factors:
Cellar and Lampshire soils: shallowness to bedrock, content of rock fragments, droughtiness, slope

Rangeland

Dominant vegetation on the Cellar soil:
- Potential plant community—slender grama, jojoba, paloverde, ocotillo, bush muhly, janusia
- Present plant community—mesquite, slender grama, jojoba, paloverde, ocotillo, bush muhly, janusia

Dominant vegetation on the Lampshire soil:
- Potential plant community—sideoats grama, black grama, hairy grama, slender grama, sprucetop grama, shrubby buckwheat, sotol
- Present plant community—mesquite, sideoats grama, black grama, hairy grama, slender grama, sprucetop grama, shrubby buckwheat, sotol

General management considerations:
- Potential vegetation is dominated by desert shrubs.
- Important perennial forage potentially includes bush muhly, slim tridens and big galleta.
- Production on this site is limited by shallow soils.
- Livestock movement is hindered by steep cobbly slopes.
- Proper grazing distribution is difficult on these soils because of steep slopes and the unavailability of water.
- Overgrazing reduces the plant cover and increases the rate of erosion.

Suitable management practices:
- Encourage uniform grazing on these soils by fencing and developing permanent water.
- Improve distribution and utilization by concentrating

a high number of livestock on the area for a short period of time.
• Use stocker-type cattle on rough slopes that cows with calves will avoid.
• Concentrate management on included soils in drainageways where the majority of forage is produced.
• Control erosion and promote forage production with proper utilization.
• Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat:

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Interpretive Groups

Land capability classification:
Cellar soil—VIIe nonirrigated
Lampshire soil—VIIe nonirrigated

Range site:
Cellar and Lampshire soils—Granitic Hills, 12-16" p.z.

11—Chiricahua-Lampshire complex, 15 to 45 percent slopes

Setting

Landform: hills
Slope range: 15 to 45 percent
Elevation: 3,200 to 4,200 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 63 to 67 degrees F.
Frost-free period: 215 to 250 days

Composition

Chiricahua and similar soils: 60 percent
Lampshire and similar soils: 30 percent
Contrasting inclusions: 10 percent

Typical Profile

Chiricahua

0 to 3 inches—reddish brown very cobbly loam
3 to 6 inches—dark reddish brown clay loam
6 to 12 inches—reddish brown clay
12 to 16 inches—dark reddish brown gravelly clay
16 to 19 inches—red gravelly clay
19 to 25 inches—weathered bedrock that has clay films on the rock fragments
25 inches—unweathered granite bedrock

Lampshire

0 to 3 inches—brown to dark brown extremely gravelly sandy loam
3 to 8 inches—brown to dark brown extremely gravelly sandy loam
8 inches—unweathered granite bedrock

Soil Properties and Qualities

Chiricahua

Parent material: residuum and slope alluvium from granite
Depth class: shallow
Depth to weathered bedrock: 10 to 20 inches
Depth to unweathered bedrock: 20 to 30 inches
Drainage class: well drained
Permeability: slow
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: rapid to very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: high
Corrosivity: steel—moderate, concrete—moderate

Lampshire

Parent material: slope alluvium and colluvium from granite
Depth class: very shallow and shallow
Depth to unweathered bedrock: 4 to 20 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Corrosivity: steel—moderate, concrete—low

Inclusions

Contrasting inclusions:
• Soils that are shallow and calcareous
• Pantak soils that have 18 to 35 percent clay
• Caralampi and Selevin soils that are very deep

Similar inclusions:
• Slopes of less than 15 percent
• Soils that are shallow to bedrock and have less organic matter

- Chiricahua soils that have surface textures of sandy clay loam
- Soils that have more than 35 percent rock fragments
- Chiricahua-like soils that are moderately deep
- Soils on rhyolite

Use and Management

Major current use: rangeland

Soil-related factors:
- Chiricahua—slope, shrink-swell potential, clayey texture, shallow to bedrock
- Lampshire—very shallow and shallow to bedrock, content of rock fragments, droughtiness

Rangeland

Dominant vegetation on the Chiricahua soils:
- Potential plant community—sideoats grama, tanglehead grama, curly-mesquite, false-mesquite, ocotillo, cane beardgrass
- Present plant community—mesquite, sideoats grama, hairy grama, sprucetop grama, curly-mesquite, false-mesquite, ocotillo

Dominant vegetation on the Lampshire soils:
- Potential plant community—sideoats grama, slender grama, hairy grama, black grama, shrubby buckwheat, plains lovegrass, tanglehead, cane beardgrass
- Present plant community—sideoats grama, bush muhly, catclaw acacia, shrubby buckwheat, ocotillo

General management considerations:
- This unit produces forage for year-round use.
- Steep slopes, rocky surfaces and areas of rock outcrop limit access and result in poor grazing distribution.
- Overcome grazing distribution problems by using grazing management practices, such as fencing, livestock water developments, and trail construction, that will permit more animals to graze in smaller areas for shorter periods of time.
- Controlled burning and brush management help improve grazing distribution and range conditions.

Suitable management practices:
- Improve distribution and utilization by concentrating a high number of livestock on the area for a short period of time.
- Use stocker-type cattle on rough slopes that cows with calves will avoid.
- Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Interpretive Groups

Land capability classification:
Chiricahua soils—VIe nonirrigated
Lampshire soils—VIIe nonirrigated

Range site:
Chiricahua and Lampshire soils—Shallow Upland, 12-16" p.z.

12—Chuichu-Rock outcrop complex, 15 to 45 percent slopes

Setting

Landform: hills
Slope range: 15 to 45 percent
Elevation: 1,400 to 2,600 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Chuichu and similar soils: 65 percent
Rock outcrop and similar soils: 25 percent
Contrasting inclusions: 10 percent

Typical Profile

Chuichu

Rock fragments on surface: 60 percent schist channers
0 to 2 inches—brown very channery sandy loam
2 to 19 inches—yellowish red very channery loam
19 to 25 inches—weathered schist that has clay films and calcium carbonate coatings in the fractures
25 inches—unweathered schist bedrock

Soil Properties and Qualities

Chuichu

Parent material: residuum and slope alluvium from schist
Depth class: shallow
Depth to weathered bedrock: 15 to 20 inches
Depth to unweathered bedrock: 20 to 45 inches
Drainage class: well drained
Permeability: moderately slow

Available water capacity: very low
Potential rooting depth: 15 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: present in the lower part and in the fractures of the bedrock
Corrosivity: steel—high, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, massive boulder piles, and nearly vertical cliffs of schist that contain small areas of quartzite, granite, rhyolite and andesite rock. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near the hilltops and mountaintops.

Inclusions

Contrasting inclusions:
- Pinamt and Momoli soils that are very deep and calcareous on the lower slopes of hills
- Hickiwan soils that are very shallow and shallow to a hardpan and skirt the lower slopes

Similar inclusions:
- Soils that are moderately deep to bedrock
- Soils that have less than 18 percent clay
- Chuichu soils that have surface textures of fine sandy loam

Use and Management

Major current use: rangeland

Soil-related factors: shallow to bedrock, slope, droughtiness, content of rock fragments

Rangeland

Dominant vegetation on the Chuichu soil:
- Potential plant community—paloverde, bush muhly, threeawns, slim tridens, ocotillo, triangle bursage, buckhorn cholla
- Present plant community—paloverde, triangle bursage, cacti, saguaro

General management considerations:
- Potential vegetation is dominated by desert shrubs.
- The majority of perennial forage is provided by seasonally available browse.
- Production on this site is limited by shallow soils.
- Livestock movement is hindered by steep cobbly slopes.
- Proper grazing distribution is difficult on these soils because of steep slopes and the unavailability of water.
- Overgrazing reduces the plant cover and increases the rate of erosion.

Suitable management practices:
- Encourage uniform grazing on these soils by fencing and developing permanent water.
- Improve distribution and utilization by concentrating a high number of livestock on the area for a short period of time.
- Use stocker-type cattle on rough slopes that cows with calves will avoid.
- Concentrate management on included soils in drainageways where the majority of forage is produced.
- Control erosion and promote forage production with proper utilization.
- Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Desertic herbaceous plants: very poorly suited
Desertic shrubs and trees: very poorly suited

Interpretive Groups

Land capability classification:
Chuichu soil—VIIe nonirrigated

Range site:
Chuichu soil—Shallow Hills, 7-10" p.z.

13—Chutum loam, 1 to 3 percent slopes

Setting

Landform: fan terraces and stream terraces
Slope range: 1 to 3 percent
Elevation: 2,200 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

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

Typical Profile

0 to 2 inches—light brown loam
2 to 11 inches—brown clay loam, calcareous

11 to 60 inches—light brown and brown clay loam, calcareous

Soil Properties and Qualities

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderate
Shrink-swell potential: moderate
Salinity: none to very slight
Sodicity: none to slight
Calcium carbonate equivalent: greater than 15 percent below 2 inches
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Hantz soils that have clay textures and flood
- Soils that have less clay in the subsoil
- Glendale soils that have silty textures, are non-calcareous, and flood
- Soils that are very strongly alkaline

Similar inclusions:
- Chutum soils that have surface textures of silt loam
- Chutum-like soils that are saline-sodic in the lower parts

Use and Management

Major current use: rangeland

Soil-related factors: high content of calcium carbonate, hazard of flooding and erosion

Rangeland

Dominant vegetation on the Chutum soils:
- Potential plant community—creosotebush, bush muhly, whiplash pappasgrass, fluffgrass, threeawn, desert zinnia, annual grasses and forbs
- Present plant community—creosotebush, mesquite, fourwing saltbush, wolfberry, annual grasses and forbs.

General management considerations:
- Limited forage for year-round use
- Seasonal production of annual grasses and forbs is high if preceded by good winter and spring rain

Suitable management practices:
- Improve grazing distribution with fencing and livestock water developments

Cropland

General management considerations:
- Intake rates and slope can affect uniform distribution of irrigation water.
- The subsoil and substratum have a high content of calcium carbonate, salts, and sodium. This reduces the soil's permeability and the availability of nutrients.
- To maintain soil productivity, sustain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
- Excessive cultivation can result in the formation of a tillage pan.

Suitable management practices:
- Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
- Select salt tolerant crops and install properly designed irrigation systems to assure uniform application of irrigation water and control salt movement.
- Overcome grazing distribution problems by using grazing management practices, such as fencing, livestock water developments, and trail construction, that will permit more animals to graze in smaller areas for shorter periods of time.
- Tillage pans can be broken by ripping when the soil is dry. This increases the effective rooting depth, enhances root development, and improves internal drainage. Roots are not restricted and can easily grow in all directions.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: very poorly suited
Desertic riparian shrubs and trees: very poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Chutum soil—IIs irrigated and VIIs nonirrigated

Range site:
Chutum soil—Limy Fan, 10-13" p.z.

14—Combate gravelly loamy coarse sand, 2 to 8 percent slopes

Setting

Landform: alluvial fans
Slope range: 2 to 8 percent
Elevation: 3,000 to 4,200 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 63 to 67 degrees F.
Frost-free period: 215 to 250 days

Composition

Combate and similar soils: 95 percent
Contrasting inclusions: 5 percent

Typical Profile

Rock fragments on surface: 20 to 35 percent gravel
0 to 3 inches—dark brown gravelly loamy coarse sand
3 to 60 inches—dark brown gravelly coarse sandy loam

Soil Properties and Qualities

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: low
Corrosivity: steel—high, concrete—moderate

Inclusions

Contrasting inclusions:
- Rock outcrop
- Hayhook soils that have less organic matter
- Baboquivari soils that have textures of sandy clay loam and clay loam

Similar inclusions:
- Soils that have slope gradients greater than 8 percent
- Soils that are moderately deep to bedrock
- Soils that have calcium carbonate in the lower horizons at a moderate depth
- Combate soils that have surface textures of sandy loam

Use and Management

Major current use: rangeland

Soil-related factors: droughtiness, hazard of seepage

Rangeland

Dominant vegetation on the Combate soil:
- Potential plant community—Arizona cottontop, spike dropseed, sideoats grama, green sprangletop, perennial forbs
- Present plant community—mesquite, wait-a-bit mimosa, shrubby buckwheat, threeawns, Rothrock grama, annual forbs

General management considerations:
- This soil is easily traversed by livestock.
- It produces forage for year-round use.
- Brush encroachment is a serious problem on this soil.
- Generally, in areas that have less than 14 inches of average annual precipitation, competition from woody plants must be reduced before this soil will respond favorably to grazing management practices. In areas that have higher precipitation, brush management is not required to produce effective vegetative cover.
- Changes in perennial grass cover are obvious in wet years and in dry years because of the low water holding capacity of the soil.

Suitable management practices:
- Controlled burning is effective in controlling poisonous half shrubs such as snakeweed and burroweed on this soil.
- Other suitable range management practices to improve grazing distribution and range condition include range seeding, fencing, livestock water developments, and implementing planned grazing systems.

Wildlife Habitat Suitability

Desertic herbaceous plants: well suited
Desertic shrubs and trees: well suited
Desertic riparian herbaceous plants: suited
Desertic riparian shrubs and trees: suited

Interpretive Groups

Land capability classification:
Combate soil—VIe nonirrigated

Range site:
Combate soil—Sandy Loam, Deep, 12-16" p.z.

15—Dateland-Denure association, 1 to 3 percent slopes

Setting

Landform: fan terraces; Dateland soils are on the lower end of the terraces, and Denure soils are on the upper end of the terraces
Slope range: Dateland 1 to 2 percent, Denure 1 to 3 percent
Elevation: 1,400 to 2,200 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Dateland and similar soils: 50 percent
Denure and similar soils: 35 percent
Contrasting inclusions: 15 percent

Typical Profile

Dateland

0 to 7 inches—yellowish brown fine sandy loam
7 to 30 inches—light yellowish brown and light brown loam
30 to 52 inches—light brown silt loam
52 to 60 inches—brown loam

Denure

0 to 2 inches—light yellowish brown gravelly sandy loam
2 to 11 inches—light yellowish brown fine sandy loam
11 to 23 inches—light yellowish brown gravelly sandy loam
23 to 60 inches—light yellowish brown and light brown fine sandy loam

Soil Properties and Qualities

Dateland

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: low
Calcium carbonate equivalent: less than 5 percent
Salinity: none to very slight
Corrosivity: steel—high, concrete—low

Denure

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: low to moderate
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: low
Calcium carbonate equivalent: less than 5 percent
Salinity: none to very slight
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Momoli soils that have more than 35 percent rock fragments
- Soils that are sandy and gravelly in drainageways that flood
- Soils that have gravelly subhorizons

Similar inclusions:
- Valencia soils that receive extra runoff water
- Pahaka soils that have textures of sandy loam to moderate depths over a buried argillic horizon
- Dateland soils that have surface textures of sandy loam
- Rillito soils that are calcareous

Use and Management

Major current use: rangeland

Soil-related factors: droughtiness, seepage, hazard of wind erosion

Rangeland

Dominant vegetation on the Dateland soil:
- Potential plant community—creosotebush, ratany, bush muhly, annual grasses and forbs.
- Present plant community—creosotebush, annual grasses and forbs

Dominant vegetation on the Denure soil:
- Potential plant community—creosotebush, bush muhly, triangle bursage, white ratany, annual grasses and forbs

• Present plant community—creosotebush, mesquite, annual grasses and forbs

General management considerations:
• These soils are easily traversed by livestock.
• Production of forage for livestock grazing is limited by low rainfall.
• Forage production, consisting of annual forbs and grasses, can be high in years of good winter and spring precipitation.

Suitable management practices:
• Grazing management to improve grazing distribution is most economically practiced by turning livestock water developments on and off.

Cropland

General management considerations:
• Intake rates and slope can affect uniform distribution of irrigation water.
• To maintain soil productivity proper soil conditions should be sustained, including good soil tilth, organic matter, aeration, and structure.
• A hazard of wind erosion exists when soil surface is disturbed or left unprotected by vegetation.
• Distribution of irrigation water is affected by contrasting textures and/or permeability rates.
• Moderately rapid to moderate permeability of these soils can cause deep percolation which could result in the leaching of plant nutrients.
• Excessive cultivation can result in the formation of a tillage pan.

Suitable management practices:
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• Rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis, to improve fertility and increase the water intake rate and available water holding capacity.
• Wind erosion can be reduced by keeping the soil rough and cloddy when it is not protected by vegetation.
• Onsite investigations are needed to identify contrasting textures and/or permeability rates prior to land leveling fields to assure uniform irrigation water distribution.
• Manage application of irrigation water in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.
• Tillage pans can be broken by ripping when the soil is dry. This increases the effective rooting depth, enhances root development, and improves internal drainage. Roots are not restricted and can easily grow in all directions.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Dateland soils—IIe irrigated and VIIe nonirrigated
Denure soils—IIIe irrigated and VIIe nonirrigated

Range site:
Dateland and Denure soils—Limy fan, 7-10" p.z.

16—Delnorte-Stagecoach complex, 1 to 20 percent slopes

Setting

Landform: fan terraces
Slope range: Delnorte 1 to 10 percent, Stagecoach 3 to 20 percent
Elevation: 2,000 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Delnorte and similar soils: 45 percent
Stagecoach and similar soils: 45 percent
Contrasting inclusions: 10 percent

Typical Profile

Delnorte

Rock fragments on surface: 40 percent gravel and cobble
0 to 1 inch—light brown very gravelly loam
1 to 11 inches—light brown very gravelly loam, calcareous
11 inches—indurated hardpan. Under the hardpan is unconsolidated alluvium

Stagecoach

Rock fragments on surface: 40 percent gravel and cobble
0 to 1 inch—light brown very gravelly sandy loam
1 to 10 inches—brown gravelly sandy loam
10 to 24 inches—light brown gravelly sandy loam, calcareous

24 to 32 inches—light brown very gravelly sandy loam, calcareous
32 to 60 inches—pinkish white very gravelly sandy loam, calcareous

Soil Properties and Qualities

Delnorte

Parent material: mixed fan alluvium
Depth class: shallow (to a hardpan)
Depth to unweathered bedrock: greater than 60 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: greater than 15 percent
Corrosivity: steel—high, concrete—low

Stagecoach

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: medium to rapid
Hazard of erosion by water: slight to moderate
Hazard of erosion by wind: very slight
Shrink-swell potential: low

Figure 7.—Typical landscape of Delthorny-Caracara complex, 3 to 25 percent slopes.

Calcium carbonate equivalent: greater than 15 percent below 10 inches
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Drainageways within the unit that have cut down to the hardpan
• Agustin soils that have less than 18 percent clay and 15 to 35 percent rock fragments
• Nahda soils that have greater than 35 percent clay
• Topawa soils lack a hardpan and are very deep
• Chutum soils that have 18 to 35 percent clay and less than 35 percent rock fragments

Similar inclusions:
• Slopes greater than 20 percent
• Soils that have a hardpan less than 10 inches deep
• Delnorte soils that have a fine sandy loam or sandy loam surface texture
• Delnorte-like soils that have 40 percent calcium carbonate in areas associated with limestone

Use and Management

Major current use: rangeland

Soil-related factors:
• Delnorte soil—depth to hardpan, droughtiness, slope
• Stagecoach soil—droughtiness, slope, calcium carbonate, content of rock fragments, hazard of seepage

Rangeland

Dominant vegetation on the Delnorte soil:
• Potential plant community—creosotebush, paloverde, bush muhly, threeawns, desert zinnia, slim tridens
• Present plant community—creosotebush, paloverde, bursage, white ratany, ocotillo, fluffgrass, annual grasses and forbs, saguaro

Dominant vegetation on the Stagecoach soil:
• Potential plant community—creosotebush, bush muhly, red grama, slim tridens, threeawns, desert zinnia, coldenia, paloverde
• Present plant community—creosotebush, paloverde, bursage, ratany, ocotillo, fluffgrass, annual grasses and forbs, ironwood, saguaro, cholla

General management considerations:
• Included soils in drainageways in this unit produce most of the forage used by livestock.

Suitable management practices:
• Grazing management should be focused on improving forage production in these drainageways.
• Other suitable range management practices to improve grazing distribution and range condition include fencing and livestock water development.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Delnorte and Stagecoach soils—VIIs nonirrigated

Range site:
Delnorte soil—Limy Upland, 10-13" p.z.
Stagecoach soil—Limy Upland, Deep, 10-13" p.z.

17—Delthorny-Caracara complex, 3 to 25 percent slopes

Setting

Landform: relict fan terraces and hills (fig. 7)
Slope range: 3 to 25 percent
Elevation: 2,000 to 3,500 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Delthorny and similar soils: 50 percent
Caracara and similar soils: 30 percent
Contrasting inclusions: 20 percent

Typical Profile

Delthorny

0 to 2 inches—brown very gravelly sandy loam
2 to 9 inches—light brown very gravelly sandy loam, calcareous
9 to 16 inches—indurated hardpan
16 inches—unweathered conglomerate bedrock

Caracara

0 to 1 inch—brown to dark brown extremely gravelly sandy loam
1 to 9 inches—reddish brown cobbly sandy clay loam
9 to 19 inches—reddish brown extremely gravelly clay
19 to 32 inches—mixed light brown and white very gravelly sandy clay loam, calcareous

32 to 40 inches—indurated hardpan
40 inches—unweathered conglomerate bedrock

Soil Properties and Qualities

Delthorny

Parent material: slope alluvium and colluvium from conglomerate
Depth class: very shallow and shallow (to a hardpan)
Depth to unweathered bedrock: 10 to 35 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 6 to 20 inches
Runoff: medium to rapid
Hazard of erosion by water: slight to moderate
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: 1 to 20 percent above the hardpan
Corrosivity: steel—high, concrete—low

Caracara

Parent material: fan alluvium from conglomerate
Depth class: moderately deep (to a hardpan)
Depth to unweathered bedrock: 25 to 60 inches
Drainage class: well drained
Permeability: slow
Available water capacity: very low
Potential rooting depth: 20 to 40 inches
Runoff: medium to rapid
Hazard of erosion by water: slight to moderate
Hazard of erosion by wind: very slight
Shrink-swell potential: high
Calcium carbonate equivalent: less than 10 percent in the upper part and greater than 10 percent in the lower part
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Vado soils that are very deep
- Arizo soils in drainageways that are sandy and flood
- Stagecoach soils that are very deep and calcareous
- Areas of Rock outcrop

Similar inclusions:
- Soils that have weakly cemented hardpans to the conglomerate
- Caracara soils that have surface textures of fine sandy loam
- Caracara soils that have less than 35 percent rock fragments
- Caracara-like soils that have less than 35 percent clay

Use and Management

Major current use: rangeland

Soil-related factors:
- Delthorny—hardpan at very shallow and shallow depths, droughtiness, slope, calcium carbonate, content of rock fragments
- Caracara—hardpan at moderate depths, slope, content of rock fragments

Rangeland

Dominant vegetation on the Delthorny soil:
- Potential plant community—creosotebush, bush muhly, paloverde, cacti, ocotillo, jojoba
- Present plant community—creosotebush, paloverde, cacti, fluffgrass

Dominant vegetation on the Caracara soil:
- Potential plant community—curly-mesquite, slender grama, bush muhly, threeawns, paloverde, cacti, triangle bursage, slender janusia, false mesquite, jojoba
- Present plant community—triangle bursage, paloverde, ocotillo, cacti

General management considerations:
- This unit is easily traversed by livestock.
- The Caracara soil produces forage for year-round use. It will respond to good grazing management.
- Production of forage for livestock grazing on the Delthorny soil is limited by unfavorable soil characteristics.

Suitable management practices:
- Suitable range management practices to improve grazing distribution and range condition include fencing, livestock water developments, brush management and range seeding.

Wildlife Habitat Suitability

Delthorny
Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Caracara
Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Interpretive Groups

Land capability classification:
Delthorny and Caracara soils—VIIs nonirrigated

Range site:
Delthorny soils—Gravelly Hills, 10-13" p.z.
Caracara soils—Loamy Hills, 10-13" p.z.

18—Delthorny-Garzona-Rock outcrop complex, 15 to 60 percent slopes

Setting

Landform: hills and mountains (fig. 8)
Slope range: Delthorny 15 to 45 percent, Garzona 20 to 60 percent
Elevation: 2,200 to 4,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Delthorny and similar soils: 50 percent
Garzona and similar soils: 25 percent
Rock outcrop: 20 percent
Contrasting inclusions: 5 percent

Typical Profile

Delthorny

Rock fragments on surface: 35 percent cobbles and 20 percent stones

Figure 8.—Typical landscape of Delthorny-Garzona-Rock outcrop complex, 15 to 60 percent slopes.

0 to 2 inches—light yellowish brown extremely stony fine sandy loam
2 to 11 inches—yellowish brown extremely cobbly loam, calcareous
11 to 18 inches—indurated hardpan
18 inches—unweathered basalt bedrock

Garzona

0 to 2 inches—light brown extremely stony fine sandy loam
2 to 8 inches—brown very gravelly loam
8 to 12 inches—brown very gravelly clay loam
12 inches—unweathered basalt bedrock

Soil Properties and Qualities

Delthorny

Parent material: colluvium and slope alluvium from basalt
Depth class: very shallow and shallow (to a hardpan)
Depth to unweathered bedrock: 15 to 30 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 6 to 20 inches
Runoff: rapid to very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: 1 to 20 percent above the hardpan
Corrosivity: steel—high, concrete—low

Garzona

Parent material: slope alluvium and colluvium from basalt
Depth class: shallow
Depth to unweathered bedrock: 10 to 20 inches
Drainage class: somewhat excessively drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate: coatings on the bedrock
Corrosivity: steel—high, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, massive boulders, and nearly vertical cliffs of basalt. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near the hilltops and mountaintops.

Inclusions

Contrasting inclusions:
- Soils in drainageways that receive runoff from surrounding areas. These soils are inundated for very brief periods during intense summer showers.
- Soils that are moderately deep to bedrock
- Soils that have clayey textures
- Limestone rock outcrops

Similar inclusions:
- Soils that are calcareous throughout and shallow
- Delthorny soils that have slopes greater than 30 percent
- Garzona soils that have surface textures of loam

Use and Management

Major current use: rangeland

Soil-related factors: slope, large stones, shallow to bedrock and hardpan, content of rock fragments

Rangeland

Dominant vegetation on the Delthorny soil:
- Potential plant community—bush muhly, paloverde, brittle bush, janusia, slim tridens, triangle bursage, cacti
- Present plant community—paloverde, brittlebush, janusia, slim tridens, cacti

Dominant vegetation on the Garzona soil:
- Potential plant community—paloverde, brittlebush, ocotillo, bush muhly, threeawns, Arizona cottontop, slim tridens, slender janusia
- Present plant community—paloverde, brittlebush, ocotillo

General management considerations:
- These soils produce forage for year round-use by livestock.
- Steep slopes, rocky surfaces and areas of rock outcrop limit access and result in poor grazing distribution.

Suitable management practices:
- Improve distribution and utilization by concentrating a high number of livestock on the area for a short period of time.

• Use stocker-type cattle on rough slopes that cows with calves will avoid.
• Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Desertic herbaceous plants: very poorly suited
Desertic shrubs and trees: very poorly suited

Interpretive Groups

Land capability classification:
Delthorny soil—VIIe nonirrigated
Garzona soil—VIIe nonirrigated

Range site:
Delthorny and Garzona soils—Basalt Hills, 10-13" p.z.

19—Denure-Momoli complex, 1 to 5 percent slopes

Setting

Landform: Denure fan terraces, Momoli fan terraces and stream terraces
Slope range: Denure 1 to 3 percent, Momoli 1 to 5 percent
Elevation: 1,400 to 2,200 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Denure and similar soils: 45 percent
Momoli and similar soils: 45 percent
Contrasting inclusions: 10 percent

Typical Profile

Denure

Rock fragments on surface: 35 percent gravel
0 to 1 inch—light yellowish brown very gravelly sandy loam
1 to 18 inches—light brown fine sandy loam
18 to 60 inches—light brown fine sandy loam

Momoli

Rock fragments on surface: 60 to 80 percent
0 to 2 inches—brown extremely gravelly sandy loam
2 to 21 inches—light brown gravelly sandy loam
21 to 33 inches—light brown extremely gravelly coarse sandy loam
33 to 54 inches—pink very gravelly coarse sandy loam
54 to 60 inches—light brown gravelly sandy loam

Soil Properties and Qualities

Denure

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Salinity: none to very slight
Sodicity: none to slight
Calcium carbonate equivalent: less than 5 percent
Corrosivity: steel—high, concrete—low

Momoli

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Salinity: none to very slight
Calcium carbonate equivalent: less than 5 percent in the control section
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Gilman-like soils that are in a lower position and that receive extra run-on moisture
• Gunsight soils that are calcareous
• Pinamt soils that have 18 to 35 percent clay
• Sandy soils in the drainages

Similar inclusions:
• Dateland soils that have loam textures

Figure 9.—Typical landscape of Denure fine sandy loam in an area of Denure-Pahaka complex, 1 to 3 percent slopes.

- Denure soils that have gravelly coarse sandy loam subsoils
- Rillito soils that are calcareous
- Pahaka soils that have sandy loam textures to moderate depths over a buried argillic horizon

Use and Management

Major current use: rangeland

Soil-related factors:
- Denure soil—droughtiness, hazard of seepage and piping
- Momoli—droughtiness, hazard of seepage and stones

Rangeland

Dominant vegetation on the Denure soil:
- Potential plant community—creosotebush, bush muhly, annual grasses and forbs, triangle bursage, white ratany
- Present plant community—creosotebush, annual forbs and grasses

Dominant vegetation on the Momoli soil:
- Potential plant community—creosotebush, bush muhly, cacti, white ratany, triangle bursage, annual grasses and forbs
- Present plant community—creosotebush, cacti, annual grasses and forbs

General management considerations:
- These soils are easily traversed by livestock.
- Production of forage for livestock grazing is limited by low rainfall.
- Forage production, consisting of annual forbs and grasses, can be high in years of good winter and spring precipitation.

Suitable management practices:
- Grazing management to improve grazing distribution is most economically practiced by turning livestock water developments on and off.

Wildlife Habitat Suitability

Denure
Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Momoli
Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Denure and Momoli soils—VIIs nonirrigated

Range site:
Denure soil—Limy Fan, 7-10" p.z.
Momoli soil—Limy Upland, Deep, 7-10" p.z.

20—Denure-Pahaka complex, 1 to 3 percent slopes

Setting

Landform: fan terraces (fig. 9)
Slope range: 1 to 3 percent
Elevation: 1,400 to 2,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Denure and similar soils: 65 percent
Pahaka and similar soils: 30 percent
Contrasting inclusions: 5 percent

Typical Profile

Denure

0 to 2 inches—strong brown fine sandy loam
2 to 60 inches—strong brown sandy loam

Pahaka

0 to 2 inches—light brown fine sandy loam
2 to 28 inches—brown sandy loam
28 to 60 inches—reddish brown sandy clay loam

Soil Properties and Qualities

Denure

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: low to moderate
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: low
Calcium carbonate equivalent: less than 5 percent
Salinity: none to very slight
Corrosivity: steel—high, concrete—low

Pahaka

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid in the upper part and moderately slow in the lower part
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: moderate at lower depths
Calcium carbonate equivalent: less than 5 percent
Salinity: none to very slight
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Mohall soils that have 18 to 35 percent clay
- Momoli soils that have more than 35 percent rock fragments

Similar inclusions:
- Denure soils that are calcareous
- Pahaka soils that have surface textures of loam

Use and Management

Major current use: rangeland

Soil-related factors:
• Denure soil—droughtiness, hazard of wind erosion, and seepage, piping
• Pahaka soil—hazard of wind erosion and seepage, piping

Rangeland

Dominant vegetation on the Denure and Pahaka soils:
• Potential plant community—bush muhly, white bursage, creosotebush, big galleta, annual grasses and forbs
• Present plant community—creosotebush, triangle bursage, white bursage, annual grasses and forbs

General management considerations:
• These soils are easily traversed by livestock.
• These soils produce forage for year-round use.
• Carrying capacities are generally low except in years of good winter and spring precipitation.

Suitable management practices:
• Concentrate management on included soils in drainageways where the majority of forage is produced.
• Provide periodic rest during the growing season to maintain plant vigor and production.

Cropland

General management considerations:
• Intake rates and slope can affect uniform distribution of irrigation water.
• Distribution of irrigation water is affected by contrasting textures and/or permeability rates.
• Moderately rapid permeability of these soils can cause deep percolation which could result in the leaching of plant nutrients.
• Excessive cultivation can result in the formation of a tillage pan.
• To sustain soil productivity, maintain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
• A hazard of wind erosion exists when soil surface is disturbed or left unprotected by vegetation.

Suitable management practices:
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• Onsite investigations are needed to identify contrasting textures and/or permeability rates prior to land leveling fields to assure uniform irrigation water distribution.
• Manage application of irrigation water in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.
• Tillage pans can be broken by ripping when the soil is dry. This increases the effective rooting depth, enhances root development, and improves internal drainage. Roots are not restricted and can easily grow in all directions.
• Returning all crop residue to the soil and using a cropping system that includes grasses, legumes or grass-legume mixtures will help maintain fertility and tilth.
• Wind erosion can be reduced by keeping the soil rough and cloddy when it is not protected by vegetation.

Wildlife Habitat Suitability

Denure and Pahaka
Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Denure soil—IIIe irrigated and VIIe nonirrigated
Pahaka soil—IIe irrigated and VIIe nonirrigated

Range site:
Denure and Pahaka soils—Sandy Loam Upland, 7-10" p.z.

21—Dixaleta-Rock outcrop complex, 15 to 70 percent slopes

Setting

Landform: hills and mountains
Slope range: 15 to 70 percent
Elevation: 2,000 to 3,800 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Dixaleta and similar soils: 65 percent
Rock outcrop: 30 percent
Contrasting inclusions: 5 percent

Typical Profile

Dixaleta

Rock fragments on surface: 75 percent channers
0 to 1 inch—light brown very channery sandy loam
1 to 8 inches—light brown very channery sandy loam
8 to 21 inches—weathered bedrock that has calcium carbonate coats in the fractures

Figure 10.—Typical landscape of Far-Spudrock-Rock Outcrop complex, 35 to 85 percent slopes.

21 inches—unweathered schist bedrock

Soil Properties and Qualities

Dixaleta

Parent material: slope alluvium and colluvium from schist
Depth class: very shallow
Depth to weathered bedrock: 5 to 10 inches
Depth to unweathered bedrock: 20 to 30 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 5 to 10 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: 3 to 10 percent
Corrosivity: steel—high, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, massive flags and nearly vertical cliffs of schist and slates that contain small areas of gneiss. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near the hilltops and mountaintops.

Inclusions

Contrasting inclusions:
- Vado-like soils that are very deep and on the lower slopes
- Delthorny soils that are very shallow and shallow to a hardpan over bedrock

Similar inclusions:
- Soils that are moderately deep to bedrock
- Cellar soils that are noncalcareous to bedrock

Use and Management

Major current use: rangeland

Soil-related factors: very shallow to bedrock, slope, droughtiness, content of rock fragments

Rangeland

Dominant vegetation on the Dixaleta soil:
- Potential plant community—paloverde, bush muhly, slim tridens, threeawns, clubmoss
- Present plant community—paloverde, triangle bursage, white brittlebush

General management considerations:
- This soil produces forage for year round-use by livestock.
- Steep slopes, rocky surfaces and areas of rock outcrop limit access and result in poor grazing distribution.

Suitable management practices:
- Overcome grazing distribution problems by using grazing management practices, including fencing, livestock water developments and construction of trails to permit more animals to graze in smaller areas for shorter periods of time.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Dixaleta soil—VIIe nonirrigated

Range site:
Dixaleta soil—Gravelly Hills, 10-13" p.z.

22—Far-Spudrock-Rock outcrop complex, 35 to 85 percent slopes

Setting

Landform: mountains (fig. 10)
Slope range: 35 to 85 percent
Elevation: 5,300 to 7,500 feet
Mean annual precipitation: 20 to 24 inches
Mean annual air temperature: 52 to 57 degrees F.
Frost-free period: 160 to 195 days

Composition

Far and similar soils: 40 percent
Spudrock and similar soils: 30 percent
Rock outcrop and similar soils: 25 percent
Contrasting inclusions: 5 percent

Typical Profile

Far

2 to 0 inches—pine and oak litter
0 to 8 inches—brown to dark brown very gravelly sandy loam
8 to 16 inches—brown to dark brown very gravelly sandy loam
16 inches—unweathered granite bedrock

Spudrock

2 to 0 inches—pine and oak litter
0 to 3 inches—very dark grayish brown stony fine sandy loam
3 to 15 inches—brown to dark brown extremely gravelly loamy fine sand
15 to 36 inches—very pale brown and yellowish brown very gravelly fine sandy loam
36 to 60 inches—weathered granite (grus)

Soil Properties and Qualities

Far

Parent material: slope alluvium and colluvium from granite and gneiss
Depth class: very shallow and shallow
Depth to unweathered bedrock: 5 to 20 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 5 to 20 inches
Runoff: very rapid
Hazard of erosion by water: severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Corrosivity: steel—moderate, concrete—low

Spudrock

Parent material: slope alluvium, colluvium and residuum from gneiss and granite
Depth class: moderately deep
Depth to weathered bedrock: 30 to 60 inches
Depth to unweathered bedrock: greater than 60 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low

Potential rooting depth: 30 to 60 inches
Runoff: very rapid
Hazard of erosion by water: severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Corrosivity: steel—moderate, concrete—moderate

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, massive boulder piles, and vertical cliffs of granite, gneiss, and schist. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of the Rock outcrop is in areas near the mountain tops.

Inclusions

Contrasting inclusions:
- Soils that have higher clay percentage
- Soils that are deep and very deep
- Soils that have less than 35 percent rock fragments

Similar inclusions:
- Soils that have less organic matter
- Soils that contain flagstones
- Soils that are strongly acid or very strongly acid
- Far soils that have loam surface textures
- Spudrock soils that have surface textures of sandy loam

Use and Management

Major current uses: rangeland and woodland:

Soil-related factors: slope, content of rock fragments, depth to bedrock

Rangeland and Woodland

Dominant vegetation on the Far soil:
- Potential plant community—Mexican blue oak, Arizona white oak, Emory oak, sideoats grama, hairy grama, plains lovegrass, bullgrass, and Texas bluestem
- Present plant community—Mexican blue oak, Arizona white oak, and Emory oak, sideoats grama, hairy grama, plains lovegrass, bullgrass, Texas bluestem

Dominant vegetation on the Spudrock soil:
- Potential plant community—Mexican blue oak, Arizona white oak, silverleaf oak, Emory oak, alligator juniper, Mexican pinyon, sideoats grama, hairy grama, plains lovegrass, and bullgrass
- Present plant community—Mexican blue oak, Arizona white oak, silverleaf oak, Emory oak, alligator juniper, Mexican pinyon, sideoats grama, hairy grama, plains lovegrass, bullgrass, Texas bluestem

General management considerations:
- This unit produces forage for year-round use.
- Steep slopes, rocky surfaces and areas of rock outcrop limit access and result in poor grazing distribution.
- Overcome grazing distribution problems by using grazing management practices, such as fencing, livestock water developments, and trail construction, that will permit more animals to graze in smaller areas for shorter periods of time.
- Controlled burning and brush management helps improve grazing distribution and range conditions.

Suitable management practices:
- Use stocker-type cattle on rough slopes that cows with calves will avoid.
- Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Far
Desertic herbaceous plants: well suited
Desertic shrubs and trees: well suited
Riparian shrubs, trees, and vines: suited

Spudrock
Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Riparian shrubs, trees, and vines: poorly suited

Interpretive Groups

Land capability classification:
Far and Spudrock soils—VIIe nonirrigated

Woodland site:
Far and Spudrock soils—Granitic Hills, 20-24" p.z.

23—Gachado-Lomitas-Rock outcrop complex, 15 to 45 percent slopes

Setting

Landform: hills
Slope range: 15 to 45 percent
Elevation: 1,400 to 2,600 feet

Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Gachado and similar soils: 45 percent
Lomitas and similar soils: 30 percent
Rock outcrop: 15 percent
Contrasting inclusions: 10 percent

Typical Profile

Gachado

0 to 2 inches—brown extremely gravelly sandy loam
2 to 8 inches—strong brown very gravelly loam
8 to 18 inches—brown extremely gravelly loam
18 inches—unweathered rhyolite bedrock

Lomitas

0 to 2 inches—brown extremely gravelly loam
2 to 12 inches—brown extremely gravelly loam
12 inches—unweathered rhyolite bedrock

Soil Properties and Qualities

Gachado

Parent material: slope alluvium and residuum from rhyolite and andesite
Depth class: very shallow and shallow
Depth to unweathered bedrock: 7 to 20 inches
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 7 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate: coatings on the fractures
Corrosivity: steel—high, concrete—low

Lomitas

Parent material: slope alluvium and colluvium from rhyolite and andesite
Depth class: shallow
Depth to unweathered bedrock: 10 to 20 inches
Drainage class: somewhat excessively drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate: coatings on the fractures
Corrosivity: steel—high, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, massive boulders, and vertical cliffs of rhyolite and andesite. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The high percentage of the Rock outcrop is in areas near the hilltops.

Inclusions

Contrasting inclusions:
- Guvo soils that are very shallow and shallow to a hardpan on lower slopes

Similar inclusions:
- Slopes less than 15 percent
- Slopes greater than 45 percent
- Gachado soils that have surface textures of clay loam, loam or fine sandy loam
- Lomitas soils that have surface textures of fine sandy loam or sandy loam
- Soils that are noncalcareous

Use and Management

Major current use: rangeland

Soil-related factors: steep slopes, content of rock fragments, droughtiness, depth to bedrock

Rangeland

Dominant vgetation on the Gachado soil:
- Potential plant community—paloverde, triangle bursage, cacti, bush muhly, slim tridens, desert globemallow, white brittlebush, creosotebush
- Present plant community—paloverde, triangle bursage, cacti, bush muhly, slim tridens, desert globemallow

Dominant vegetation on the Lomitas soil:
- Potential plant community—paloverde, triangle bursage, cacti, bush muhly, slim tridens, desert globemallow, creosotebush
- Present plant community—paloverde, triangle bursage, cacti, bush muhly, slim tridens, desert globemallow

General management considerations:
- Potential vegetation is dominated by desert shrubs.
- The majority of perennial forage is provided by seasonally available browse.

• Production on this site is limited by shallow soils.
• Livestock movement is hindered by steep cobbly slopes.
• Proper grazing distribution is difficult on these soils because of steep slopes and the unavailability of water.
• Overgrazing reduces the plant cover and increases the rate of erosion

Suitable management practices:
• Improve distribution and utilization by concentrating a higher number of livestock on the area for a short period of time.
• Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Gachado and Lomitas soils—VIIe nonirrigated

Range site:
Gachado and Lomitas soils—Shallow Hills, 7-10" p.z.

24—Gadsden silty clay loam, 0 to 1 percent slopes

Setting

Landform: flood plains
Hazard of flooding: occasional
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,100 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Gadsden and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 4 inches—light brown silty clay loam
4 to 20 inches—dark brown silty clay
20 to 38 inches—dark brown silty clay
38 to 60 inches—light brown clay loam

Soil Properties and Qualities

Parent material: mixed alluvium
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: high
Salinity: none to slight
Calcium carbonate equivalent: less than 10 percent
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Glenbar soils that have less clay

Use and Management

Major current use: rangeland

Soil-related factors: slow permeability, hazard of flooding

Rangeland

Dominant vegetation on the Gadsden soil:
• Potential plant community—tobosa, perennial grasses and forbs, vine mesquite, annual grasses and forbs
• Present plant community—tobosa, mesquite

General management considerations:
• These areas produce sufficient forage for year-round use.
• Use management practices that permit efficient use of annual forage and meet the need of the perennial plants and the animals on the range.
• Facilities needed to improve grazing or livestock management such as water development and fencing can apply to this unit.
• This unit will not respond to improved grazing in a reasonable length of time.

Suitable management practices:
• Livestock prefer this unit to most others in the survey area because of its accessibility and the availability of water.
• This results in overgrazing and subsequent deterioration of the vegetation.
• Periodic flooding increases the amount of forage available on the unit.

Cropland

General management considerations:
• These soils have a hazard of flooding.

• A tillage pan forms easily if this soil is tilled when wet.
• Intake rates can affect uniform distribution of irrigation water.
• To sustain soil productivity, maintain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
• Slow permeability can cause ponding of water, which can damage crops.

Suitable management practices:
• The risk of flooding can be reduced by the use of levees, dikes and diversions.
• Ripping or chiseling when the soil is dry to break up tillage pans will increase the effective rooting depth, enhance root development, and improve internal drainage.
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• Return all crop residue to the soil and use a cropping system that includes grasses, legumes, or grass-legume mixtures to help maintain fertility and tilth.
• When designing irrigation systems on soils that have slow permeability rates, protect crops from damage by adjusting the length of runs so that they allow infiltration but do not permit water to stand on the soil surface.

Wildlife Habitat Suitability

Desertic herbaceous plants: moderately well suited
Desertic shrubs and trees: moderately well suited
Desertic riparian herbaceous plants: moderately well suited
Desertic riparian shrubs and trees: moderately well suited
Grain and seed crops, irrigated: moderately well suited
Domestic grasses and legumes, irrigated: moderately well suited

Interpretive Groups

Land capability classification:
Gadsden soil—IIIw irrigated and VIIw nonirrigated

Range site:
Gadsden soil—Clayey Bottom, 7-10" p.z.

25—Gilman very fine sandy loam, 0 to 1 percent slopes

Setting

Landform: flood plains and alluvial fans
Hazard of flooding: rare to occasional
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,000
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Gilman and similar soils: 70 percent
Contrasting inclusions: 30 percent

Typical Profile

0 to 1 inch—pale brown very fine sandy loam
1 to 9 inches—yellowish brown silt loam
9 to 16 inches—brown very fine sandy loam
16 to 60 inches—yellowish brown stratified silt loams to very fine sandy loams

Soil Properties and Qualities

Parent material: mixed stream alluvium
Depth class: very deep
Drainage class: well
Permeability: moderate
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: moderate
Shrink-swell potential: low
Salinity: none to slight
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Glenbar and Ginland soils that have more than 18 percent clay
• Soils that have gravelly or sandy subhorizons

Similar inclusions:
• Sasco soils that have silt loam textures

• Gilman soils that have fine sandy loam, loam, clay loam, or silt loam surface textures

Use and Management

Major current use: rangeland

Soil-related factors: hazard of flooding, erosion and seepage, piping.

Rangeland

Dominant vegetation on the Gilman soil:
• Potential plant community—bush muhly, big galleta, threeawns, dropseeds, mesquite, annuals
• Present plant community—mesquite, creosotebush, annual grasses and forbs

General management considerations:
• This soil is easily traversed by livestock.
• It produces forage for year-round use.
• Livestock prefer this soil because of availability of shade, easy access and seasonal water from flooding of shallow drainageways.
• When the protective plant cover is depleted by overgrazing the soil is susceptible to rill and gully erosion.

Suitable management practices:
• Grazing management utilizing fencing can help improve the use of forage produced after flooding and maintain the plant cover.
• Brush management is needed to keep mesquite from dominating the soil.
• Other suitable range management practices to improve grazing distribution and range condition include livestock water development, range seeding, gully control and water spreading systems.

Cropland

General management considerations:
• These soils have a hazard of flooding.
• Excessive cultivation can result in the formation of a tillage pan.
• To sustain soil productivity, maintain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
• Intake rates and slope can affect uniform distribution of irrigation water.

Suitable management practices:
• The risk of flooding can be reduced by the use of levees, dikes and diversions.
• Tillage pans can be broken by ripping when the soil is dry. This increases the effective rooting depth, enhances root development, and improves internal drainage. Roots are not restricted and can easily grow in all directions.
• Return all crop residue to the soil and use a cropping system that includes grasses, legumes, or grass-legume mixtures to help maintain fertility and tilth.
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: poorly suited
Desertic riparian shrubs and trees: poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Gilman soil—IIw irrigated and VIIw nonirrigated

Range site:
Gilman soil—Loamy Bottom, 7-10" p.z.

26—Ginland silty clay, 0 to 1 percent slopes

Setting

Landform: flood plains
Hazard of flooding: occasional
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Ginland and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 3 inches—pale brown silty clay
3 to 31 inches—grayish brown and yellowish brown silty clay
31 to 60 inches—brown and light brown sandy clay loam

Soil Properties and Qualities

Parent material: mixed stream alluvium
Depth class: very deep

Drainage class: well
Permeability: slow
Available water capacity: moderate to high
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: high
Calcium carbonate equivalent: less than 15 percent
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Mohall and Casa Grande soils that have less than 35 percent clay
- Glenbar soils that have less than 35 percent clay and do not have a buried argillic horizon

Similar inclusions:
- Ginland soils that have silty clay loam or clay surface textures
- Soils that have more than 1 percent organic matter
- Soils that are deep to a buried argillic horizon

Use and Management

Major current use: rangeland

Soil-related factors: hazard of flooding, slow permeability

Rangeland

Dominant vegetation on the Ginland soil:
- Potential plant community—tobosa, vine mesquite, threeawn, perennial forbs and mesquite
- Present plant community—mesquite, burroweed, wolfberry, graythorn, bermuda grass, caniagre dock, annual grasses and forbs

General management considerations:
- This soil is easily traversed by livestock.
- It produces forage for year-round use.
- Livestock prefer this soil because of the availability of shade, easy access, and seasonal water from flooding of shallow drainageways.
- When the protective plant cover is depleted by overgrazing, the soil is susceptible to rill and gully erosion.

Suitable management practices:
- Grazing management utilizing fencing can help improve the use of forage produced after flooding and maintain the plant cover.
- Brush management is needed to keep mesquite from dominating the soil.
- Other suitable range management practices to

Figure 11.—Flooding hazard on Glenbar loam, 0 to 1 percent slopes.

improve grazing distribution and range condition include livestock water development, range seeding, gully control, and water spreading systems.

Cropland

General management considerations:
- Intake rates and slope can affect uniform distribution of irrigation water.
- Distribution of irrigation water is affected by contrasting textures and/or permeability rates.
- A tillage pan forms easily if this soil is tilled when wet.
- To maintain soil productivity, sustain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
- These soils have a hazard of flooding.
- Slow permeability can cause water to pond, which can damage crops.

Suitable management practices:
- Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
- Onsite investigations are needed to identify contrasting textures and/or permeability rates prior to land leveling fields to assure uniform irrigation water distribution.
- Ripping or chiseling when the soil is dry breaks up tillage pans, increasing the effective rooting depth, enhancing root development, and improving internal drainage.
- Crop rotation and the incorporation of crop residue in the soil or the regular addition of other organic matter improves fertility, increases the water intake rate and available water holding capacity.
- The risk of flooding can be reduced by the use of levees, dikes and diversions.
- When designing irrigation systems on soils that have slow permeability rates, protect crops from damage by adjusting length of runs to permit infiltration and prevent water from standing on the soil surface.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: poorly suited
Desertic riparian shrubs and trees: poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Ginland soil—IIIw irrigated and VIIw nonirrigated

Range site:
Ginland soil—Loamy Bottom, 7-10" p.z.

27—Glenbar loam, 0 to 1 percent slopes

Setting

Landform: flood plains
Hazard of flooding: occasionally (fig. 11)
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,200
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Glenbar and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 6 inches—light brown loam
6 to 14 inches—brown clay loam
14 to 45 inches—brown silty clay loam
45 to 53 inches—pinkish gray silty clay loam
53 to 60 inches—light brownish gray clay loam

Soil Properties and Qualities

Parent material: mixed stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: moderate
Hazard of wind erosion: moderate
Shrink-swell potential: moderate
Salinity: none to very slight
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Tatai soils that have silty textures over a buried argillic horizon
- Gilman soils that have less than 18 percent clay
- Wintersburg soils that have more than 15 percent calcium carbonate

Similar inclusions:
- Glenbar soils that have silty clay loam, clay loam or silt loam surface textures

• In some areas around the Santa Rosa and Vomari washes, Glenbar soils have saline-sodic properties
• Glenbar soils that have a buried argillic horizon below 25 inches

Use and Management

Major current use: rangeland

Soil-related factors: hazard of flooding and erosion, piping

Rangeland

Dominant vegetation on the Glenbar soil:
• Potential plant community—dropseeds, tobosa, bush muhly, threeawns, Arizona cottontop, mesquite, wolfberry, fourwing saltbush, big galleta
• Present plant community—mesquite, wolfberry, creosotebush, bermuda grass, fourwing saltbush, annual grasses and forbs

General management considerations:
• Livestock favor this unit because of its accessibility, the length of the forage season, and its proximity to water.
• Easy accessibility coupled with lack of management causes the depletion of native grasses and a subsequent increase in woody plants.
• Overgrazing of the plant cover leaves this soil susceptible to sheet and gully erosion.

Suitable management practices:
• Productivity can be improved by using erosion control measures, seeding, fencing, and developing watering facilities. This soil responds well to management practices such as deferred grazing and planned grazing systems.

Cropland

General management considerations:
• These soils have a hazard of flooding.
• To maintain soil productivity, sustain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
• A tillage pan forms easily if this soil is tilled when wet.
• Intake rates and slope can affect uniform distribution of irrigation water.
• Moderately slow permeability can cause water to pond, which can damage crops.

Suitable management practices:
• The risk of flooding can be reduced by the use of levees, dikes and diversions.
• Crop rotation and the incorporation of crop residue in the soil or the regular addition of other organic matter improves fertility, increases the water intake rate and available water holding capacity.
• Ripping or chiseling when the soil is dry breaks up tillage pans, increasing the effective rooting depth, enhancing root development, and improving internal drainage.
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• When designing irrigation systems on soils that have moderately slow permeability rates, protect crops from damage by adjusting the length of runs so that they allow infiltration but do not permit water to stand on the soil surface.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: poorly suited
Desertic riparian shrubs and trees: poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Glenbar soil—IIw irrigated and VIIw nonirrigated

Range site:
Glenbar soil—Loamy Bottom, 7-10" p.z.

28—Glendale clay loam, 0 to 2 percent slopes, flooded

Setting

Landform: flood plains
Hazard of flooding: occasional
Slope range: 0 to 2 percent
Elevation: 2,000 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

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

Typical Profile

0 to 11 inches—yellowish brown clay loam
11 to 32 inches—light yellowish brown silt clay loam
32 to 60 inches—yellowish brown clay loam

Soil Properties and Qualities

Parent material: mixed stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: moderate
Salinity: none to very slight
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Soils that have sandy loam subsoils
- Chutum soils that have more than 15 percent calcium carbonate
- Bucklebar soils that have loam, clay loam, and sandy clay loam textures and are not calcareous
- Gullied land

Similar inclusions:
- Grabe soils that have less than 18 percent clay
- Glendale soils that have surface textures of silt loam
- Around the village of Cowlic, along the Fresno and Vamori Wash, Glendale soils have saline-sodic properties.

Use and Management

Major current use: rangeland

Soil-related factors: hazard of flooding and erosion, piping

Rangeland

Dominant vegetation on the Glendale soil:
- Potential plant community—whiplash pappusgrass, vine-mesquite, threeawns, bush muhly, mesquite, fourwing saltbush
- Present plant community—mesquite, whitethorn, desert thorn, creosotebush, bermuda grass, johnsongrass

General management considerations:
- This soil is easily traversed by livestock.
- It produces forage for year-round use.
- Livestock prefer this soil because of availability of shade, easy access and seasonal water from flooding of shallow drainageways.
- When the protective plant cover is depleted by overgrazing the soil is susceptible to rill and gully erosion.

Suitable management practices:
- Grazing management utilizing fencing can help improve the use of forage produced after flooding and maintain the plant cover.
- Brush management is needed to keep mesquite from dominating the soil.
- Suitable range management practices to improve grazing distribution and range condition include livestock water development, range seeding, gully control and water spreading systems.

Cropland

General management considerations:
- These soils have a hazard of flooding.
- To maintain soil productivity proper soil conditions should be sustained, including good soil tilth, organic matter, aeration, and structure.
- A tillage pan forms easily if this soil is tilled when wet.
- Intake rates and slope can affect uniform distribution of irrigation water.
- Moderately slow permeability can cause ponding of water which can damage crops.

Suitable management practices:
- The risk of flooding can be reduced by the use of levees, dikes and diversions.
- Crop rotation and the incorporation of crop residue in the soil or the regular addition of other organic matter improves fertility, increases the water intake rate and available water holding capacity.
- Rip or chisel when the soil is dry to break up tillage pans. This increases the effective rooting depth, enhances root development, and improves internal drainage.
- Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
- When designing irrigation systems on soils that have moderately slow permeability rates, protect crops from damage by adjusting the length of runs so that they allow infiltration but do not permit water to stand on the soil surface.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: suited
Desertic riparian shrubs and trees: suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Glendale soil—IIw irrigated and VIIw nonirrigated

Range site:
Glendale soil—Loamy Bottom, 10-13" p.z.

29—Glendale silt loam, 1 to 3 percent slopes

Setting

Landform: stream terraces and alluvial fans
Hazard of flooding: rare
Slope range: 1 to 3 percent
Elevation: 2,000 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Glendale and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 3 inches—light brown silt loam
3 to 40 inches—brown silt loam
40 to 60 inches—light brown silt loam

Soil Properties and Qualities

Parent material: mixed stream alluvium and fan alluvium
Depth class: very deep
Drainage class: well
Permeability: moderately slow to moderate
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: moderate
Salinity: none to very slight
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Tubac soils that have more than 35 percent clay
- Chutum soils that have more than 15 percent calcium carbonate
- Gullied land

Similar inclusions:
- Grabe soils that have less than 18 percent clay
- Glendale soils that have higher flooding potential
- Glendale soils that have clay loam surface textures
- Around the village of Cowlic, along the Vamori Wash, Glendale soils have saline-sodic properties.

Use and Management

Major current use: rangeland

Soil-related factors: hazard of wind erosion and flooding, piping, droughtiness

Rangeland

Dominant vegetation on the Glendale soil:
- Potential plant community—creosotebush, bush muhly, whiplash pappusgrass, annual grasses and forbs
- Present plant community—creosotebush, mesquite, annual forbs and grasses

General management considerations:
- This soil is easily traversed by livestock.
- It produces a limited amount of forage for year round use.
- Forage production, consisting of annual forbs and grasses, can be very high in years of good winter and spring precipitation.

Suitable management practices:
- Grazing management should be focused on improving range condition in the drainageways within and adjacent to this unit.
- Other suitable range management practices to improve grazing distribution and range condition include fencing and livestock water developments.

Cropland

General management considerations:
- Intake rates and slope can affect uniform distribution of irrigation water.
- A hazard of wind erosion exists when the soil surface is disturbed or left unprotected by vegetation.
- A tillage pan forms easily if this soil is tilled when wet.
- To maintain soil productivity proper soil conditions should be sustained, including good soil tilth, organic matter, aeration, and structure.

Suitable management practices:
- Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.

• Wind erosion can be reduced by keeping the soil rough and cloddy when it is not protected by vegetation.
• Ripping or chiseling when the soil is dry breaks up tillage pans, increasing the effective rooting depth, enhancing root development, and improving internal drainage.
• Crop rotation and the incorporation of crop residue into the soil or the regular addition of other organic matter improves fertility, increases the water intake rate and available water holding capacity.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: suited
Desertic riparian shrubs and trees: suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Glendale soil—IIe irrigated and VIIe nonirrigated

Range site:
Glendale soil—Limy Fan, 10-13" p.z.

30—Glendale-Pajarito complex, 1 to 3 percent slopes

Setting

Landform: Glendale—stream terraces and alluvial fans, Pajarito—fan terraces
Hazard of flooding: Glendale—rare, Pajarito—none
Slope range: 1 to 3 percent
Elevation: 2,000 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Glendale and similar soils: 55 percent
Pajarito and similar soils: 40 percent
Contrasting inclusions: 5 percent

Typical Profile

Glendale

0 to 12 inches—light brown silt loam
12 to 60 inches—brown loam

Pajarito

0 to 2 inches—light brown gravelly fine sandy loam
2 to 22 inches—light brown fine sandy loam
22 to 30 inches—light brown fine sandy loam
30 to 60 inches—light brown gravelly sandy loam

Soil Properties and Qualities

Glendale

Parent material: mixed stream alluvium and fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: moderate
Shrink-swell potential: moderate
Salinity: none to very slight
Corrosivity: steel—high, concrete—low

Pajarito

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Calcium carbonate equivalent: less than 5 percent
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Agustin soils that have 15 to 35 percent rock fragments
• Bucklebar soils that have clay loam and sandy clay loam textures

Similar inclusions:
• Glendale soils that have a clay loam surface texture
• Glendale soils that have a higher frequency of flooding

Use and Management

Major current use: rangeland

Soil-related factors:
• Glendale soil—hazard of wind erosion and flooding
• Pajarito soil—hazard of wind erosion and seepage, droughtiness

Rangeland

Dominant vegetation on the Glendale soil:
• Potential plant community—creosotebush, bush muhly, whiplash pappusgrass, annual forbs and grasses
• Present plant community—creosotebush, annual forbs and grasses

Dominant vegetation on the Pajarito soil:
• Potential plant community—bush muhly, creosotebush, threeawns, whiplash pappusgrass, annual grasses and forbs
• Present plant community—triangle bursage, burroweed, mesquite, paloverde, annual grasses and forbs

General management considerations for the Glendale soil:
• This soil is easily traversed by livestock.
• Forage production, consisting of annual forbs and grasses, can be very high in years of good winter and spring precipitation.

Suitable management practices for the Glendale soil:
• Grazing management should be focused on improving range condition in the drainageways within and adjacent to this unit.
• Suitable range management practices to improve grazing distribution and range condition include fencing and livestock water developments.

General management considerations for the Pajarito soil:
• This soil is easily traversed by livestock.
• It produces forage for year-round use.
• Brush encroachment is a serious problem on much of this soil. The competition from woody plants must be reduced before this soil will respond to grazing management.

Suitable management practices for the Pajarito soil:
• Suitable range management practices to improve grazing distribution and range condition include fencing, livestock water developments, and range seeding.

Cropland

General management considerations for the Glendale soil:
• Intake rates and slope can affect uniform distribution of irrigation water.
• A hazard of wind erosion exists when soil surface is disturbed or left unprotected by vegetation.
• A tillage pan forms easily if this soil is tilled when wet.
• Maintain soil productivity by sustaining proper soil conditions, including good soil tilth, organic matter, aeration, and structure.

Suitable management practices for the Glendale soil:
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• Wind erosion can be reduced by keeping the soil rough and cloddy when it is not protected by vegetation.
• Ripping or chiseling when the soil is dry breaks up tillage pans, increasing the effective rooting depth, enhancing root development, and improving internal drainage.
• Rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis, to improve fertility and increase the water intake rate and available water holding capacity.

General management considerations for the Pajarito soil:
• Intake rates and slope can affect uniform distribution of irrigation water.
• Distribution of irrigation water is affected by contrasting textures and/or permeability rates.
• Excessive cultivation can result in the formation of a tillage pan.
• Moderately rapid permeability of this soil can cause deep percolation and result in the leaching of plant nutrients.
• A hazard of wind erosion exists when the soil surface is disturbed or left unprotected by vegetation.

Suitable management practices for the Pajarito soil:
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• Onsite investigations are needed to identify contrasting textures and/or permeability rates prior to land leveling fields to assure uniform irrigation water distribution.

• Tillage pans can be broken by ripping when the soil is dry. This increases the effective rooting depth, enhances root development, and improves internal drainage. Roots are not restricted and can easily grow in all directions.
• Application of irrigation water needs to be managed in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.
• Wind erosion can be reduced by keeping the soil rough and cloddy when it is not protected by vegetation.

Wildlife Habitat Suitability

Glendale
Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: suited
Desertic riparian shrubs and trees: suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Pajarito
Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Interpretive Groups

Land capability classification:
Glendale and Pajarito soils—IIe irrigated and VIIe nonirrigated

Range site:
Glendale and Pajarito soils—Limy Fan, 10-13" p.z.

31—Grabe-Vado complex, 1 to 5 percent slopes

Setting

Landform: Grabe—alluvial fans, Vado—fan terraces
Hazard of flooding: Grabe—rare, Vado—none
Slope range: Grabe—1 to 3 percent, Vado—1 to 5 percent
Elevation: 2,200 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Grabe and similar soils: 50 percent
Vado and similar soils: 40 percent
Contrasting inclusions: 10 percent

Typical Profile

Grabe

0 to 2 inches—yellowish brown fine sandy loam
2 to 60 inches—yellowish brown loam

Vado

0 to 6 inches—yellowish brown gravelly fine sandy loam
6 to 17 inches—yellowish brown gravelly sandy loam
17 to 51 inches—yellowish brown very gravelly sandy loam
51 to 60 inches—yellowish brown loam

Soil Properties and Qualities

Grabe

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of water erosion: slight
Hazard of wind erosion: moderately high
Shrink-swell potential: low
Corrosivity: steel—high, concrete—low

Vado

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: slight
Shrink-swell potential: low
Calcium carbonate equivalent: less than 5 percent
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Bucklebar soils that have sandy clay loam and clay loam textures
• Arizo soils in drainages that are sandy and flood
• Pajarito soils that have sandy loam and fine sandy loam textures

Similar inclusions:
- Agustin soils that have 15 to 35 percent rock fragments
- Grabe-like soils that have gravelly, loam, fine sandy loam or silt loam surface textures
- Grabe soils that are deep to a hardpan
- Glendale-like soils that have silty textures and flood

Use and Management

Major current use: rangeland

Soil-related factors:
- Grabe—droughtiness, hazard of flooding and wind erosion
- Vado—droughtiness, content of rock fragments, hazard of seepage

Rangeland

Dominant vegetation on the Grabe soil:
- Potential plant community—bush muhly, threeawns, spike dropseed, Arizona cottontop, whiplash pappusgrass, mesquite
- Present plant community—mesquite, creosotebush, annual grasses and forbs

Dominant vegetation on the Vado soil:
- Potential plant community—creosotebush, bush muhly, annual grasses and forbs
- Present plant community—creosotebush, cacti, annual grasses and forbs

General management considerations:
- This soil is easily traversed by livestock.
- It produces forage for year-round use.
- Livestock prefer this soil because of availability of shade, easy access and seasonal water from flooding of shallow drainageways.
- When the protective plant cover is depleted by overgrazing, this soil is susceptible to rill and gully erosion.

Suitable management practices:
- Grazing management utilizing fencing can help improve the use of forage produced after flooding and maintain the plant cover.
- Brush management is needed to keep mesquite from dominating the soil.
- Other suitable range management practices to improve grazing distribution and range condition include livestock water development, range seeding, gully control and water spreading systems.
- Control erosion and promote forage production with proper utilization.
- Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Grabe
Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: poorly suited
Desertic riparian shrubs and trees: poorly suited

Vado
Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Grabe soil—VIe nonirrigated
Vado soil—VIIs nonirrigated

Range site:
Grabe soil—Loamy Bottom, 10-13" p.z.
Vado soils—Limy Upland, Deep, 10-13" p.z.

32—Granolite-Rock outcrop complex, 15 to 65 percent slopes

Setting

Landform: hills and mountains
Slope range: 15 to 65 percent
Elevation: 2,000 to 3,600 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Granolite and similar soils: 40 percent
Rock outcrop: 30 percent
Contrasting inclusions: 30 percent

Typical Profile

Granolite

Rock fragments on surface: 80 percent igneous cobbles and gravel
0 to 2 inches—brown extremely cobbly fine sandy loam
2 to 15 inches—yellowish red extremely cobbly clay

15 to 22 inches—light gray weathered bedrock
22 inches—unweathered rhyolite bedrock

Soil Properties and Qualities

Granolite

Parent material: slope alluvium and residuum from rhyolite
Depth class: shallow
Depth to weathered bedrock: 10 to 20 inches
Depth to unweathered bedrock: 20 to 30 inches
Drainage class: well
Permeability: slow
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: very rapid
Hazard of water erosion: moderate to severe
Hazard of wind erosion: very slight
Shrink-swell potential: high
Calcium carbonate: coatings on fractures of bedrock
Corrosivity: steel—high, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, massive boulders, and nearly vertical cliffs of rhyolite and other igneous rock. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near the hilltops and mountaintops.

Inclusions

Contrasting inclusions:
- Soils that are moderately deep to bedrock
- Soils that have slopes of less than 15 percent
- Pantano soils that are calcareous
- Lajitas soils that are very shallow and shallow to unweathered bedrock

Similar inclusions:
- Anklam soils that have less than 35 percent clay
- Caracara soils that are moderately deep to a hardpan over bedrock
- Soils that have less than 35 percent rock fragments

Use and Management

Major current use: rangeland

Soil-related factors: slope, shallow to bedrock, droughtiness, slow permeability

Rangeland

Dominant vegetation on the Granolite soil:
- Potential plant community—bush muhly, threeawns, false-mesquite, jojoba, paloverde, slender grama, saguaro, club moss
- Present plant community—paloverde, jojoba, triangle bursage, saguaro, cacti

General management considerations:
- This soil produces forage for year round-use by livestock.
- Steep slopes, rocky surfaces and areas of Rock outcrop limit access and result in poor grazing distribution.

Suitable management practices:
- Grazing management practices to overcome poor grazing distribution include fencing, developing livestock water, and constructing trails to permit more animals to graze in smaller areas for shorter periods of time.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Interpretive Groups

Land capability classification:
Granolite soil—VIIe nonirrigated

Range site:
Granolite soil—Shallow Hills, 10-13" p.z.

33—Gunsight-Rillito complex, 1 to 8 percent slopes

Setting

Landform: fan terraces and stream terraces
Slope range: 1 to 8 percent
Elevation: 1,400 to 2,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Gunsight and similar soils: 55 percent
Rillito and similar soils: 30 percent
Contrasting inclusions: 15 percent

Typical Profile

Gunsight

Rock fragments on surface: 50 to 70 percent gravel
0 to 2 inches—pale brown very gravelly fine sandy loam
2 to 6 inches—pale brown extremely gravelly sandy loam, calcareous
6 to 60 inches—white extremely gravelly sandy loam, calcareous

Rillito

Rock fragments on surface: 30 to 50 percent gravel
0 to 3 inches—light yellowish brown gravelly fine sandy loam
3 to 13 inches—light yellowish brown gravelly fine sandy loam, calcareous
13 to 60 inches—very pale brown gravelly loam, calcareous

Soil Properties and Qualities

Gunsight

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: very slight
Shrink-swell potential: low
Salinity: very slight to moderate
Calcium carbonate equivalent: greater than 10 percent below 2 inches
Corrosivity: steel—high, concrete—low

Figure 12.—The results of a monsoon rain season on the Hantz clay loam, 0 to 1 percent slopes. These soils produce an abundance of tobosa grass.

Rillito

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderate
Available water capacity: moderate to high
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of water erosion: slight
Hazard of wind erosion: very slight
Shrink-swell potential: low
Salinity: none to slight
Calcium carbonate equivalent: greater than 5 percent below 3 inches
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Soils that have sandy textures and are in drainages
- Hickiwan and Guvo soils that are very shallow and shallow to hardpan
- Pinamt soils that have 18 to 35 percent clay
- Rock outcrop

Similar inclusions:
- Momoli soils that have less calcium carbonate
- Rillito soils that have surface textures of sandy loam
- Soils that have less than 15 percent rock fragments

Use and Management

Major current use: rangeland

Soil-related factors:
- Gunsight soil—droughtiness, small stones, hazard of seepage
- Rillito soil—droughtiness, hazard of seepage

Rangeland

Dominant vegetation on the Gunsight soil:
- Potential plant community—creosotebush, triangle bursage, white bursage, paloverde, fluffgrass
- Present plant community—creosotebush, triangle bursage, white bursage, paloverde, fluff grass

Dominant vegetation on the Rillito soil:
- Potential plant community—creosotebush, white bursage, bush muhly, annual grasses and forbs
- Present plant community—creosotebush, annual grasses and forbs

General management considerations for the Gunsight soil:
- This soil is easily traversed by livestock.
- Production of forage for livestock grazing is limited by low rainfall and unfavorable soil characteristics.
- Included soils within the drainageways produce most of the forage for livestock in this unit.

Suitable management practices for the Gunsight soil:
- Grazing management should be focused on improving the drainageways to increase total forage production.

General management considerations for the Rillito soil:
- This soil is easily traversed by livestock.
- Forage production, consisting of annual forbs and grasses, can be very high in years of good winter and spring precipitation.

Suitable management practices for the Rillito soil:
- Grazing management should be focused on improving range condition in the drainageways within and adjacent to this unit.
- Other suitable range management practices to improve grazing distribution and range condition include fencing and livestock water developments.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Gunsight and Rillito soils—VIIs nonirrigated

Range site:
Gunsight soil—Limy Upland, Deep, 7-10" p.z.
Rillito soil—Limy Fan, 7-10" p.z.

34—Hantz clay loam, 0 to 1 percent slopes

Setting

Landform: flood plains and alluvial fans (fig. 12)
Hazard of flooding: occasional
Slope range: 0 to 1 percent
Elevation: 2,000 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Hantz and similar soils: 95 percent
Contrasting inclusions: 5 percent

Typical Profile

0 to 3 inches—light brown clay loam
3 to 50 inches—brown to dark brown clay
50 to 60 inches—brown clay

Soil Properties and Qualities

Parent material: mixed stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of erosion by water: moderate
Hazard of erosion by wind: moderate
Shrink-swell potential: high
Salinity: none to slight
Sodicity: none to slight
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Chutum soils that have more than 15 percent calcium carbonate and a none to rare flooding frequency
• Soils that have greater than 1 percent organic matter
• Glendale soils that have silty textures

Similar inclusions:
• Hantz soils that have a silty clay loam surface texture

Use and Management

Major current use: rangeland

Soil-related factors: hazard of flooding and erosion, slow permeability, high shrink-swell potential

Rangeland

Dominant vegetation on the Hantz soil:
• Potential plant community—tobosa, vine mesquite, threeawns, perennial forbs and prickly pear
• Present plant community—mesquite, wolfberry, caniagre dock, tobosa grass, annual grasses and forbs

General management considerations:
• The Hantz soil can be extremely productive. Continuous grazing and the absence of natural fires have led to an increase in woody plants. The productivity of this unit depends on receiving seasonal floodwaters. Depleting the native plant cover accelerates erosion, which reduces the total amount of the area originally flooded. Productivity of the unit can be restored by controlling erosion and managing grazing. The plant cover can be protected by properly locating and fencing water developments to aid in the control of grazing.

Suitable management practices:
• Suitable range management practices are fencing, implementing planned grazing system, and developing water for livestock.

Cropland

General management considerations:
• Intake rates and slope can affect uniform distribution of irrigation water.
• These soils have a hazard of flooding.
• To sustain soil productivity, maintain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
• A tillage pan forms easily if this soil is tilled when wet.
• Slow permeability can cause ponding of water which can damage crops.

Suitable management practices:
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• The risk of flooding can be reduced by the use of levees, dikes, and diversions.
• Rotating crops and incorporating crop residue into the soil, or adding other organic matter on a regular basis, improves fertility, and increases the water intake rate and available water holding capacity.
• Ripping or chiseling when the soil is dry breaks up tillage pans. This increases the effective rooting depth, enhances root development, and improves internal drainage.
• When designing irrigation systems on soils that have slow permeability rates, protect crops from damage by adjusting the length of runs so that they allow infiltration but do not permit water to stand on the soil surface.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: suited

Desertic riparian shrubs and trees: suited
Grain and seed crops, irrigated: suited
Domestic grasses and legumes, irrigated: suited

Interpretive Groups

Land capability classification:
Hantz soil—IIIw irrigated and VIIw nonirrigated

Range site:
Hantz soil—Clayey Bottom, 10-13" p.z.

35—Hayhook sandy loam, 1 to 5 percent slopes

Setting

Landform: fan terraces
Slope range: 1 to 5 percent
Elevation: 2,000 to 3,200 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Hayhook and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—strong brown sandy loam
2 to 23 inches—brown sandy loam
23 to 39 inches—brown gravelly sandy loam
39 to 60 inches—brown sandy loam

Soil Properties and Qualities

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: low
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Bucklebar soils that have textures of sandy clay loam and clay loam
- Arizo soils in drainages that are sandy and flood

Similar inclusions:
- Agustin and Pajarito soils that are calcareous
- Soils that have more organic matter

Use and Management

Major current use: rangeland

Soil-related factors: droughtiness, hazard of wind erosion and seepage, piping

Rangeland

Dominant vegetation on the Hayhook soil:
- Potential plant community—mesquite, blue paloverde, bush muhly, Santa Rita threeawn, Rothrock grama, dropseeds
- Present plant community—mesquite, paloverde, triangle bursage, burroweed, cacti, annual grasses and forbs

General management considerations:
- This soil is easily traversed by livestock.
- It produces forage for year-round use.
- Brush encroachment is a serious problem on much of this soil. The competition from woody plants must be reduced before this soil will respond to grazing management.

Suitable management practices:
- Suitable range management practices to improve grazing distribution and range condition include fencing, livestock water developments, and range seeding.

Cropland

General management considerations:
- Intake rates and slope can affect uniform distribution of irrigation water.
- Distribution of irrigation water is affected by contrasting textures and/or permeability rates.
- A hazard of wind erosion exists when the soil surface is disturbed or left unprotected by vegetation.
- Moderately rapid permeability of this soil can cause deep percolation, which can result in the leaching of plant nutrients.
- To sustain soil productivity, maintain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.

Suitable management practices:
- Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
- Onsite investigations are needed to identify contrasting textures and/or permeability rates prior to land leveling fields to assure uniform irrigation water distribution.
- Wind erosion can be reduced by keeping the soil rough and cloddy when it is not protected by vegetation.

• Application of irrigation water needs to be managed in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.
• Return all crop residue to the soil and use a cropping system that includes grasses, legumes, or grass-legume mixtures to help maintain fertility and tilth.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Hayhook soil—IIIe irrigated and VIIe nonirrigated

Range site:
Hayhook soil—Sandy Loam, Deep, 10-13" p.z.

36—Hickiwan-Gunsight-Momoli complex, 3 to 15 percent slopes

Setting

Landform: Hickiwan—relict fan terraces and fan terraces, Gunsight and Momoli—fan terraces and stream terraces
Slope range: Hickiwan—3 to 15 percent, Gunsight—5 to 15 percent, Momoli—4 to 10 percent
Elevation: 1,400 to 2,200 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Hickiwan and similar soils: 45 percent
Gunsight and similar soils: 20 percent
Momoli and similar soils: 10 percent
Contrasting inclusions: 25 percent

Typical Profile

Hickiwan

Rock fragments on surface: 50 to 80 percent
0 to 2 inches—light brown very gravelly sandy loam
2 to 14 inches—light brown very gravelly sandy loam, calcareous
14 to 60 inches—indurated hardpan

Gunsight

Rock fragments on surface: 40 to 60 percent
0 to 3 inches—pink extremely gravelly sandy loam
3 to 60 inches—pinkish gray extremely gravelly sandy loam, calcareous

Momoli

Rock fragments on surface: 60 to 70 percent
0 to 1 inch—light yellowish brown extremely gravelly fine sandy loam
1 to 12 inches—light yellowish brown very gravelly fine sandy loam
12 to 60 inches—light yellowish brown very gravelly sandy loam

Soil Properties and Qualities

Hickiwan

Parent material: mixed fan alluvium
Depth class: very shallow and shallow (to a hardpan)
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 5 to 20 inches
Runoff: medium to rapid
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: greater than 3 percent below 4 inches
Corrosivity: steel—high, concrete—low

Gunsight

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: low to moderate
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Salinity: very slight to moderate
Calcium carbonate equivalent: greater than 10 percent below 3 inches
Corrosivity: steel—high, concrete—low

Momoli

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Salinity: none to very slight
Calcium carbonate equivalent: less than 5 percent
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Soils in drainages that are gravelly and sandy and that flood
- Ajo soils that have a hardpan at a moderate depth
- Pinamt soils that have 18 to 35 percent clay
- Soils that are shallow to moderately deep to bedrock

Similar inclusions:
- Hickiwan soils that have loam surface textures
- Rillito soils that have 15 to 35 percent rock fragments

Use and Management

Major current use: rangeland

Soil-related factors:
- Hickiwan—droughtiness, depth to hardpan, calcareous
- Gunsight—calcareous, droughtiness, hazard of seepage, excess salt content
- Momoli soils—droughtiness, content of rock fragments, hazard of seepage

Rangeland

Dominant vegetation on the Hickiwan soil:
- Potential plant community—creosotebush, threeawns, triangle bursage, white ratany, cacti, bush muhly, ocotillo
- Present plant community—creosotebush, triangle bursage, cacti, ocotillo

Dominant vegetation on the Gunsight soil:
- Potential plant community—creosotebush, triangle bursage, white bursage, paloverde, fluffgrass, saguaro
- Present plant community—creosotebush, triangle bursage, white bursage, paloverde, fluffgrass, saguaro

Dominant vegetation on the Momoli soil:
- Potential plant community—creosotebush, bush muhly, white ratany, triangle bursage, annual grasses and forbs
- Present plant community—creosotebush, white ratany, annual grasses and forbs

General management considerations:
- These soils are easily traversed by livestock.
- Production of forage for livestock grazing is limited by low rainfall and unfavorable soil characteristics.
- Included soils within the drainageways produce most of the forage for livestock in this unit.

Suitable management practices:
- Grazing management should be focused on improving the drainageways to increase total forage production.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Hickiwan, Gunsight, and Momoli soils—VIIs nonirrigated

Range site:
Hickiwan soil—Limy Upland, 7-10" p.z.
Gunsight and Momoli soils—Limy Upland, Deep, 7-10" p.z.

37—Hyder-Rock outcrop-Guvo complex, 10 to 45 percent slopes

Setting

Landform: hills
Slope range: Hyder—15 to 45 percent, Guvo—10 to 25 percent
Elevation: 1,400 to 2,500 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Hyder and similar soils: 40 percent

Figure 13.—Typical landscape of Keysto-Riverwash complex, 0 to 5 percent slopes, after a heavy rain.

Rock outcrop: 25 percent
Guvo and similar soils: 25 percent
Contrasting inclusions: 10 percent

Typical Profile

Hyder

Rock fragments on surface: 45 to 65 percent
0 to 1 inch—brown extremely cobbly fine sandy loam
1 to 7 inches—brown extremely cobbly loam
7 inches—unweathered basalt bedrock

Guvo

Rock fragments on surface: 45 to 60 percent
0 to 1 inch—brown very cobbly fine sandy loam
1 to 18 inches—brown very cobbly loam, calcareous
18 to 24 inches—indurated hardpan
24 inches—unweathered basalt bedrock

Soil Properties and Qualities

Hyder

Parent material: slope alluvium and colluvium from basalt
Depth class: very shallow and shallow
Depth to unweathered bedrock: 5 to 20 inches
Drainage class: somewhat excessively drained
Permeability: moderate

Available water capacity: very low
Potential rooting depth: 5 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: 3 to 10 percent
Corrosivity: steel—high, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, boulder piles, and nearly vertical cliffs of basalt. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near the hilltops.

Guvo

Parent material: slope alluvium from basalt
Depth class: very shallow and shallow (to a hardpan)
Depth to unweathered bedrock: 6 to 30 inches
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 5 to 20 inches
Runoff: medium to rapid
Hazard of erosion by water: slight to moderate
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: 1 to 40 percent
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Soils that are moderately deep to bedrock
- Gachado soils that have more than 18 percent clay
- Limestone rock outcrop

Similar inclusions:
- Stony areas of basalt
- Guvo soils that have a loam surface texture
- Guvo soils that have more than 25 percent clay content

Use and Management

Major current use: rangeland

Soil-related factors: slope, depth to hardpan or bedrock, droughtiness

Rangeland

Dominant vegetation on the Hyder and Guvo soils:
- Potential plant community—white brittlebush, bush muhly, triangle bursage, creosotebush, threeawns, paloverde, cacti, ocotillo, slender janusia
- Present plant community—paloverde, white brittlebush, triangle bursage, ocotillo, cacti

General management considerations:
- Potential vegetation is dominated by desert trees and shrubs.
- The majority of perennial forage is provided by seasonally available browse.
- Production on this site is limited by shallow soils.
- Proper grazing distribution is difficult on this unit because of steep slopes and the unavailability of water.
- Overgrazing reduces the plant cover and increases the rate of erosion.

Suitable management practices:
- Encourage uniform grazing on this unit by fencing and developing permanent water.
- Improve distribution and utilization by concentrating a high number of livestock on the area for a short period of time.
- Use stocker-type cattle on rough slopes that cows with calves will avoid.
- Control erosion and promote forage production with proper utilization.
- Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Hyder soils—VIIe nonirrigated
Guvo soils—VIIs nonirrigated

Range site:
Hyder and Guvo soils—Basalt Hills, 7-10" p.z.

38—Keysto-Riverwash complex, 0 to 5 percent slopes

Setting

Landform: alluvial fans and stream terraces (fig. 13)
Hazard of flooding: Keysto—none to rare, Riverwash—common
Slope range: 0 to 5 percent
Elevation: 3,000 to 5,000 feet
Mean annual precipitation: 12 to 16 inches

Mean annual air temperature: 63 to 67 degrees F.
Frost-free period: 215 to 250 days

Composition

Keysto and similar soils: 75 percent
Riverwash: 15 percent
Contrasting inclusions:10 percent

Typical Profile

Keysto

0 to 3 inches—dark brown very gravelly sandy loam
3 to 24 inches—dark brown extremely cobbly sandy loam
24 to 60 inches—brown to dark brown extremely cobbly loamy sand

Soil Properties and Qualities

Keysto

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: well
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 or more inches
Runoff: slow to medium
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate: coatings on the rock fragments in the lower part
Corrosivity: steel—moderate, concrete—low

Riverwash

Riverwash consists of very deep, excessively drained, stratified sands, gravel, cobbles, and stones from numerous sources. The materials are in the drainages of this unit. These materials are subject to common flooding and shifting.

Inclusions

Contrasting inclusions:
• Soils that have less organic matter
• Combate soils that have less than 35 percent rock fragments

Similar inclusions:
• Keysto soils that receive more precipitation and have cooler temperatures

Use and Management

Major current use: rangeland

Soil-related factors: content of rock fragments, hazard of seepage and flooding

Rangeland

Dominant vegetation on the Keysto soil:
• Potential plant community—Arizona cottontop, spike dropseed, sideoats grama, bush muhly, mesquite, blue paloverde, desert hackberry
• Present plant community—mesquite, paloverde, burroweed, cacti, Rothrock grama, Lehmann lovegrass, annual grasses and forbs

General management considerations:
• This soil is easily traversed by livestock.
• It produces forage for year-round use.
• Brush encroachment is a serious problem on this soil.
• Generally, in areas with less than 14 inches of average annual precipitation, competition from woody plants must be reduced before this soil will respond favorably to grazing management practices. In areas with higher precipitation, brush management is not required for effective vegetative cover.
• Changes in perennial grass cover are obvious in wet versus dry years because of the low water-holding capacity of the soil.

Suitable management practices:
• Controlled burning is effective in controlling poisonous half shrubs such as snakeweed and burroweed on this soil.
• Other suitable range management practices to improve grazing distribution and range condition include range seeding, fencing, livestock water developments and implementing planned grazing systems.
• Control erosion and promote forage production by proper utilization of the land.
• Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Desertic herbaceous plants: well suited
Desertic shrubs and trees: well suited

Interpretive Groups

Land capability classification:
Keysto soils—VIIs nonirrigated

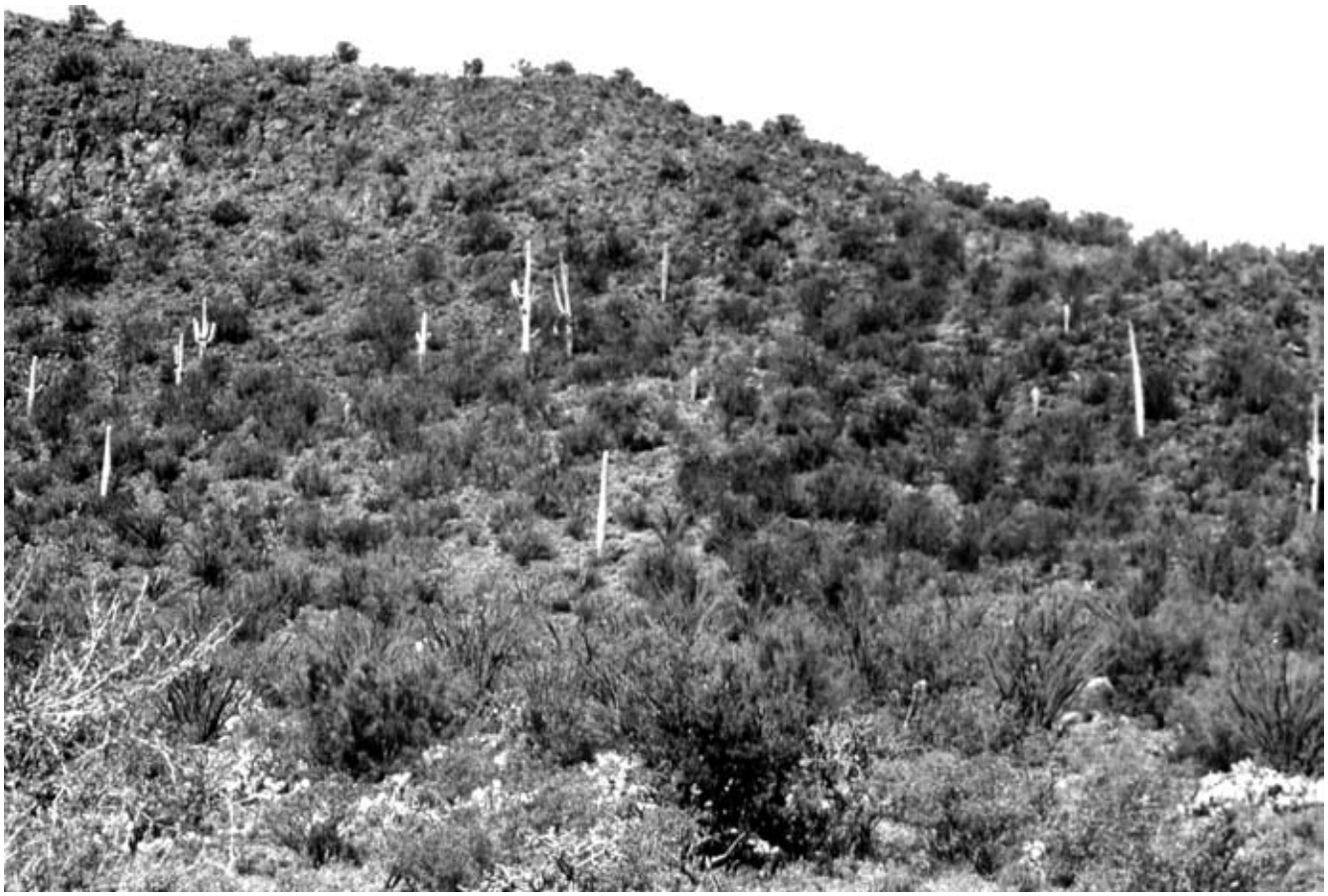

Figure 14.—Typical landscape of Lajitas-Bosa-Rock outcrop complex, 15 to 50 percent slopes. Vado-Agustin complex, 1 to 8 percent slopes, is in the foreground.

Range site:
Keysto soils—Sandy Bottom, 12-16" p.z.

39—Kohatk-Rock outcrop complex, 10 to 45 percent slopes

Setting

Landform: hills
Slope range: 10 to 45 percent
Elevation: 2,000 to 3,500 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Kohatk and similar soils: 65 percent
Rock outcrop and similar soils: 25 percent
Contrasting inclusions: 10 percent

Typical Profile

Kohatk
Rock fragments on surface: 35 to 45 percent gravel and cobbles
0 to 1 inch—light brown very cobbly fine sandy loam
1 to 10 inches—light brown very cobbly loam, calcareous
10 inches—unweathered limestone bedrock

Soil Properties and Qualities

Kohatk
Parent material: slope alluvium, residuum, and colluvium from limestone
Depth class: very shallow and shallow
Depth to unweathered bedrock: 6 to 20 inches
Drainage class: well drained
Permeability: moderate

Available water capacity: very low
Potential rooting depth: 6 to 20 inches
Runoff: rapid to very rapid
Hazard of erosion by water: slight to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: 15 to 60 percent
Corrosivity: steel—high, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges and nearly vertical cliffs of tilted and folded formations of limestone and other sedimentary rock. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near the hilltops.

Inclusions

Contrasting inclusions:
• Delthorny soils that are very shallow and shallow to a hardpan over bedrock on lower slopes

Use and Management

Major current use: rangeland

Soil-related factors: very shallow and shallow to bedrock, droughtiness, slope

Rangeland

Dominant vegetation on the Kohatk soil:
• Potential plant community—paloverde, slim tridens, red grama, desert zinnia, jojoba, white brittlebush, ocotillo
• Present plant community—paloverde, ocotillo, saguaro, slim tridens, fluffgrass, cacti

General management considerations:
• This soil produces forage for year round-use by livestock.
• Steep slopes, rocky surfaces and areas of rock outcrop limit access and result in poor grazing distribution.

Suitable management practices:
• Overcome grazing distribution problems by using grazing management practices, such as fencing, livestock water developments, and trail construction, that will permit more animals to graze in smaller areas for shorter periods of time.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Kohatk soil—VIIs nonirrigated

Range site:
Kohatk soil—Limestone Hills, 10-13" p.z.

40—Lajitas-Bosa-Rock outcrop-complex, 15 to 50 percent slopes

Setting

Landform: hills and mountains (fig. 14)
Slope range: Lajitas—20 to 50 percent, Bosa—15 to 35 percent
Elevation: 2,000 to 4,500 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Lajitas and similar soils: 35 percent
Bosa and similar soils: 30 percent
Rock outcrop: 25 percent
Contrasting inclusions: 10 percent

Typical Profile

Lajitas

0 to 6 inches—brown very gravelly fine sandy loam
6 inches—unweathered andesite bedrock

Bosa

0 to 1 inch—brown gravelly fine sandy loam
1 to 6 inches—reddish brown very gravelly loam
6 to 8 inches—weathered bedrock that has clay films on the fragments
8 inches—unweathered andesite bedrock

Soil Properties and Qualities

Lajitas

Parent material: slope alluvium from andesite
Depth class: very shallow and shallow

Depth to unweathered bedrock: 4 to 20 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate: some areas have coats on the fractures of the bedrock
Corrosivity: steel—moderate, concrete—low

Bosa

Parent material: residuum, colluvium, and slope alluvium from andesite
Depth class: very shallow and shallow
Depth to unweathered bedrock: 6 to 20 inches
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 6 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: slight
Shrink-swell potential: low
Calcium carbonate: some areas have coats on the fractures of the bedrock
Corrosivity: steel—high, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, massive boulders, and nearly vertical cliffs of andesite. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near the hilltops and mountaintops.

Inclusions

Contrasting inclusions:
- Delthorny soils that are very shallow and shallow to a hardpan over bedrock on the lower slopes
- Stagecoach soils that are very deep and calcareous
- Granolite soils that have over 35 percent clay
- Soils that are moderately deep to bedrock

Similar inclusions:
- Lajitas and Bosa soils that are calcareous
- Lajitas and Bosa soils that have surface textures of sandy loam

Use and Management

Major current use: rangeland

Soil-related factors: slopes, content of rock fragments, droughtiness

Rangeland

Dominant vegetation on the Lajitas soil:
- Potential plant community—creosotebush, shrubby buckwheat, brittlebush, paloverde, jojoba, club moss, bush muhly, sideoats and slender grama, threeawns, tanglehead, ocotillo
- Present plant community—creosotebush, shrubby buckwheat, brittlebush, paloverde, jojoba, bush muhly, sideoats grama, tanglehead, ocotillo

Dominant vegetation on the Bosa soil:
- Potential plant community—sideoats grama, slender grama, bush muhly, jojoba, paloverde, club moss, triangle bursage, ocotillo, cacti
- Present plant community—sideoats grama, slender grama, jojoba, paloverde, club moss, triangle bursage, ocotillo, cacti

General management considerations:
- This soil produces forage for year round-use by livestock.
- Steep slopes, rocky surfaces, and areas of rock outcrop limit access and result in poor grazing distribution.

Suitable management practices:
- Overcome grazing distribution problems by using grazing management practices, such as fencing, livestock water developments, and trail construction, that will permit more animals to graze in smaller areas for shorter periods of time.
- Use stocker-type cattle on rough slopes that cows with calves will avoid.
- Control erosion and promote forage production with proper utilization.
- Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Lajitas
Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Bosa
Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Interpretive Groups

Land capability classification:
Lajitas and Bosa soils—VIIe nonirrigated

Range site:
Lajitas and Bosa soils—Volcanic Hills, 10-13" p.z.

41—Lampshire-Pantak-Rock outcrop complex, 25 to 60 percent slopes

Setting

Landform: hills and mountains
Slope range: 25 to 60 percent
Elevation: 3,200 to 5,300 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 63 to 67 degrees F.
Frost-free period: 215 to 250 days

Composition

Lampshire and similar soils: 40 percent
Pantak and similar soils: 30 percent
Rock outcrop: 20 percent
Contrasting inclusions: 10 percent

Typical Profile

Lampshire

0 to 6 inches—dark grayish brown extremely gravelly sandy loam
6 inches—highly fractured bedrock in upper 2 inches, then unweathered andesite

Pantak

0 to 1 inch—brown to dark brown very gravelly sandy loam
1 to 4 inches—brown very gravelly sandy loam
4 to 14 inches—yellowish brown very gravelly sandy clay loam
14 inches—unweathered andesite bedrock

Soil Properties and Qualities

Lampshire

Parent material: slope alluvium and colluvium from andesite
Depth class: very shallow and shallow
Depth to unweathered bedrock: 4 to 20 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Corrosivity: steel—moderate, concrete—low

Pantak

Parent material: slope alluvium and residuum from igneous rock
Depth class: very shallow and shallow
Depth to unweathered bedrock: 4 to 20 inches
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate: some coatings on the fractures of the bedrock
Corrosivity: steel—moderate, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, massive boulders, and nearly vertical cliffs of andesite, granite, and schist. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near hilltops and mountaintops.

Inclusions

Contrasting inclusions:
- Chiricahua soils that have greater than 35 percent clay
- Soils moderately deep to bedrock

Similar inclusions:
- Soils with less organic matter
- Pantak soils that have a loam surface texture
- Lampshire and Pantak soils that receive more precipitation and are cooler

Use and Management

Major current use: rangeland

Soil-related factors: very shallow and shallow to bedrock, slope, content of rock fragments

Rangeland

Dominant vegetation on the Lampshire soil:
- Potential plant community—shrubby buckwheat, plains lovegrass, cane beardgrass, ocotillo, sideoats grama, jojoba
- Present plant community—mesquite, jojoba, sideoats grama, slender grama, snakeweed

Dominant vegetation on the Pantak soil:
• Potential plant community—sideoats grama, purple grama, cane beardgrass, plains lovegrass
• Present plant community—curly mesquite, Schott's agave, mesquite, prickly pear, snakeweed

General management considerations:
• This unit produces forage for year-round use.
• Steep slopes, rocky surfaces and areas of rock outcrop limit access and result in poor grazing distribution.
• Overcome grazing distribution problems by using grazing management practices, such as fencing, livestock water developments, and trail construction, that will permit more animals to graze in smaller areas for shorter periods of time.
• Improve grazing distribution and range conditions by controlled burning and brush management.

Suitable management practices:
• Use stocker-type cattle on rough slopes that cows with calves will avoid.
• Control erosion and promote forage production with proper utilization.
• Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Interpretive Groups

Land capability classification:
Lampshire and Pantak soils—VIIe nonirrigated

Range site:
Lampshire and Pantak soils—Volcanic Hills, 12-16" p.z.

42—Mohall loam, 0 to 2 to percent slopes

Setting

Landform: fan terraces
Slope range: 0 to 2 percent
Elevation: 1,600 to 1,900 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300

Composition

Mohall and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 3 inches—light brown loam
3 to 21 inches—reddish brown clay loam
21 to 42 inches—reddish brown and white loam, calcareous
42 to 60 inches—pink and white sandy clay loam, calcareous

Soil Properties and Qualities

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: high
Potential rooting depth: 60 or more inches
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderate
Shrink-swell potential: moderate
Salinity: none to very slight
Calcium carbonate equivalent: greater than 15 percent below 20 inches
Corrosivity: steel—high concrete—low

Inclusions

Contrasting inclusions:
• Denure soils that have fine sandy loam textures
• Vecont soils in drainages that have fine textures and flood

Use and Management

Major current use: rangeland

Soil-related factors: hazard of wind erosion and seepage, droughtiness

Rangeland

Dominant vegetation on the Mohall soil:
• Potential plant community—bush muhly, big galleta, threeawn, annuals
• Present plant community—creosotebush, triangle bursage, scattered mesquite, annual grasses

General management considerations:
• This soil is easily traversed by livestock.
• It produces forage for year-round use.
• Carrying capacities are generally low except in years of good winter and spring precipitation.

Suitable management practices:
• This soil will respond to grazing management.

• Grazing management to improve grazing distribution is most economically practiced by turning livestock water developments on and off.

Cropland

General management considerations:
• A tillage pan forms easily if this soil is tilled when wet.
• Intake rates and slope can affect uniform distribution of irrigation water.
• Moderately slow permeability can cause water to pond, damaging crops.

Suitable management practices:
• Ripping or chiseling when the soil is dry breaks up tillage pans. This increases the effective rooting depth, enhances root development, and improves internal drainage.
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• When designing irrigation systems on soils that have slow permeability rates, protect crops from damage by adjusting the length of runs so that they allow infiltration but do not permit water to stand on the soil surface.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Mohall soil—I irrigated and VIIc nonirrigated

Range site:
Mohall soil—Loamy Upland, 7-10" p.z.

43—Mohall-Pahaka complex, 1 to 3 percent slopes

Setting

Landform: fan terraces
Slope range: Mohall—1 to 3 percent, Pahaka—1 to 2 percent
Elevation: 1,400 to 2,400 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Mohall and similar soils: 40 percent
Pahaka and similar soils: 40 percent
Contrasting inclusions: 20 percent

Typical Profile

Mohall

0 to 16 inches—yellowish brown fine sandy loam
16 to 29 inches—strong brown sandy clay loam
29 to 53 inches—light yellowish brown loam, calcareous
53 to 60 inches—light yellowish brown fine sandy loam, calcareous

Pahaka

0 to 3 inches—yellowish brown sandy loam
3 to 14 inches—brown sandy loam
14 to 25 inches—yellowish brown sandy loam
25 to 30 inches—strong brown sandy loam
30 to 60 inches—yellowish red and light brown clay loam

Soil Properties and Qualities

Mohall

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: moderate
Calcium carbonate equivalent: greater than 15 percent below 20 inches
Salinity: none to very slight
Corrosivity: steel—high, concrete—low

Pahaka

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid in the upper part and moderately slow in the lower part
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high

Shrink-swell potential: moderate in the lower part
Calcium carbonate equivalent: less than 5 percent
Salinity: none to very slight
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Denure soils that have sandy loam textures throughout
• Valencia soils that receive extra runoff water

Similar inclusions:
• Pahaka soils that have loam surface textures

Use and Management

Major current use: rangeland

Soil-related factors: hazard of wind erosion and seepage, droughtiness, piping

Rangeland

Dominant vegetation on the Mohall soil:
• Potential plant community—white bursage, bush muhly, threeawns, annual grasses and forbs
• Present plant community—creosotebush, mesquite, triangle bursage, annual grasses and forbs

Dominant vegetation on the Pahaka soil:
• Potential plant community—bush muhly, threeawns, big galleta, creosotebush, white bursage, triangle bursage, annual grasses and forbs
• Present plant community—creosotebush, mesquite, triangle bursage, annual grasses and forbs

General management considerations:
• These soils are easily traversed by livestock.
• They produce forage for year-round use.
• Carrying capacities are generally low except in years of good winter and spring precipitation.

Suitable management practices:
• These soils will respond to grazing management.
• Grazing management to improve grazing distribution is most economically practiced by turning livestock water developments on and off.

Cropland

General management considerations for the Mohall soil:
• Intake rates and slope can affect uniform distribution of irrigation water.
• Moderately slow permeability can cause ponding of water which can damage crops.
• To sustain soil productivity, maintain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
• A tillage pan forms easily if this soil is tilled when wet.
• A hazard of wind erosion exists when the soil surface is disturbed or left unprotected by vegetation.

Suitable management practices for the Mohall soil:
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• When designing irrigation systems on soils that have slow permeability rates, protect crops from damage by adjusting the length of runs so that they allow infiltration but do not permit water to stand on the soil surface.
• Rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis, to improve fertility and increase the water intake rate and available water holding capacity.
• Ripping or chiseling when the soil is dry breaks up tillage pans. This increases the effective rooting depth, enhances root development, and improves internal drainage.
• Wind erosion can be reduced by keeping the soil rough and cloddy when it is not protected by vegetation.

General management considerations for the Pahaka soil:
• Intake rates and slope can affect uniform distribution of irrigation water.
• Excessive cultivation can result in the formation of a tillage pan.
• To sustain soil productivity, maintain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
• A hazard of wind erosion exists when the soil surface is disturbed or left unprotected by vegetation.

Suitable management practices for the Pahaka soil:
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• Tillage pans can be broken by ripping when the soil is dry. This increases the effective rooting depth, enhances root development, and improves internal drainage. Roots are not restricted and can easily grow in all directions.
• Maintain fertility and tilth by returning all crop residue to the soil and using a cropping system that includes grasses, legumes or grass-legume mixtures.

• Wind erosion can be reduced by keeping the soil rough and cloddy when it is not protected by vegetation.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Mohall soil—IIe irrigated and VIIe nonirrigated
Pahaka soil—IIe irrigated and VIIe nonirrigated

Range site:
Pahaka and Mohall soils—Sandy Loam Upland, 7-10" p.z.

44—Mohall-Trix complex, 0 to 1 percent slopes

Setting

Landform: Mohall—fan terraces and stream terraces, Trix—alluvial fans
Hazard of flooding: Mohall—none, Trix—rare to occasional
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,200 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Mohall and similar soils: 50 percent
Trix and similar soils: 40 percent
Contrasting inclusions: 10 percent

Typical Profile

Mohall

0 to 6 inches—strong brown sandy loam
6 to 20 inches—reddish brown clay loam
20 to 40 inches—reddish brown clay loam, calcareous
40 to 60 inches—light reddish brown clay loam, calcareous

Trix

0 to 11 inches—strong brown very fine sandy loam
11 to 22 inches—brown loam
22 to 60 inches—yellowish red and reddish yellow sandy clay loam

Soil Properties and Qualities

Mohall

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: moderate to high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: moderate
Calcium carbonate equivalent: greater than 15 percent below 20 inches
Salinity: none to very slight
Corrosivity: steel—high, concrete low

Trix

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate in the upper part and moderately slow in the lower part
Available water capacity: moderately high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: moderate
Calcium carbonate: less than 15 percent in the upper part and greater than 15 percent in the lower part
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Tucson soils that have desert pavement and gravelly surface textures
• Casa Grande soils that are saline-sodic

Similar inclusions:
• Pahaka and Valencia soils that have a thicker surface horizon of sandy loam material
• Wintersburg soils that are calcareous
• Mohall soils that have surface textures of very fine sandy loam or loam
• Trix soils that have silty clay loam textures in the lower part

Use and Management

Major current use: rangeland

Soil-related factors:
- Mohall soil—hazard of wind erosion and seepage
- Trix soil—hazard of flooding, piping

Rangeland

Dominant vegetation on the Mohall soil:
- Potential plant community—white bursage, bush muhly, threeawns, annuals
- Present plant community—mesquite, creosotebush, annual grasses and forbs

Dominant vegetation on the Trix soil:
- Potential plant community—bush muhly, threeawns, dropseeds, big galleta, Arizona cottontop, mesquite
- Present plant community—mesquite, wolfberry, Rothrock grama, annuals

General management considerations for the Mohall soil:
- This soil is easily traversed by livestock.
- It produces forage for year-round use.
- Carrying capacities are generally low except in years of good winter and spring precipitation.

Suitable management practices for the Mohall soil:
- This soil will respond to grazing management.
- Grazing management to improve grazing distribution is most economically practiced by turning livestock water developments on and off.

General management considerations for the Trix soil:
- This soil is easily traversed by livestock.
- It produces forage for year-round use.
- Livestock prefer this soil because of the availability of shade, easy access, and seasonal water from flooding of shallow drainageways.
- When the protective plant cover is depleted by overgrazing, the soil is susceptible to rill and gully erosion.

Suitable management practices for the Trix soil:
- Grazing management utilizing fencing can help improve the use of forage produced after flooding and maintain the plant cover.
- Brush management is needed to keep mesquite from dominating the soil.
- Other suitable range management practices to improve grazing distribution and range condition include livestock water development, range seeding, gully control and water spreading systems.

Cropland

General management considerations for the Mohall soil:
- Intake rates and slope can affect uniform distribution of irrigation water.
- Moderately slow permeability can cause water to pond, damaging crops.
- To sustain soil productivity, maintain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
- A tillage pan forms easily if this soil is tilled when wet.
- Hazard of wind erosion exists when the soil surface is disturbed or left unprotected by vegetation.

Suitable management practices for the Mohall soil:
- Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
- When designing irrigation systems on soils that have slow permeability rates, protect crops from damage by adjusting the length of runs so that they allow infiltration but do not permit water to stand on the soil surface.
- Rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis, to improve fertility and increase the water intake rate and available water holding capacity.
- Ripping or chiseling when the soil is dry breaks up tillage pans. This increases the effective rooting depth, enhances root development, and improves internal drainage.
- Reduce wind erosion by keeping the soil rough and cloddy when it is not protected by vegetation.

General management considerations for the Trix soil:
- Intake rates and slope can affect uniform distribution of irrigation water.
- These soils have a hazard of flooding.
- Moderate permeability in the upper part of this soil can cause deep percolation, which can result in the leaching of plant nutrients.
- Moderately slow permeability in the lower part of this soil can cause water to pond, damaging crops.
- To maintain soil productivity, sustain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
- Distribution of irrigation water is affected by contrasting textures and/or permeability rates.

Suitable management practices for the Trix soil:
- Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
- The risk of flooding can be reduced by the use of levees, dikes and diversions.
- Apply irrigation water in amounts sufficient to wet the root zone but small enough to minimize the leaching of plant nutrients.
- When designing irrigation systems on soils that have slow permeability rates, protect crops from damage by adjusting the length of runs so that they allow infiltration but do not permit water to stand on the soil surface.
- Onsite investigations are needed to identify contrasting textures and/or permeability rates prior to land leveling fields to assure uniform irrigation water distribution.

Wildlife Habitat Suitability

Mohall
Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Trix
Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: poorly suited
Desertic riparian shrubs and trees: poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Mohall soil—IIe irrigated and VIIe nonirrigated
Trix soil—IIw irrigated and VIIw nonirrigated

Range site:
Mohall soil—Sandy Loam Upland, 7-10" p.z.
Trix soil—Loamy Bottom, 7-10" p.z.

45—Nahda-Stagecoach complex, 1 to 15 percent slopes

Setting

Landform: fan terraces
Slope range: Nahda—1 to 15 percent, Stagecoach—3 to 15 percent and above 2,000 feet
Elevation: 1,800 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Nahda and similar soils: 50 percent
Stagecoach and similar soils: 40 percent
Contrasting inclusions: 10 percent

Typical Profile

Nahda

Rock fragments on surface: 50 percent
0 to 2 inches—light brown extremely gravelly sandy loam
2 to 12 inches—yellowish red extremely gravelly sandy clay
12 to 36 inches—red extremely gravelly sandy clay, calcareous
36 to 60 inches—indurated hardpan

Stagecoach

Rock fragments on surface: 45 percent
0 to 2 inches—brown very gravelly sandy loam
2 to 23 inches—brown very gravelly sandy loam
23 to 38 inches—reddish yellow extremely gravelly sandy loam, calcareous
38 to 60 inches—light brown very gravelly sandy loam, calcareous

Soil Properties and Qualities

Nahda

Parent material: mixed fan alluvium
Depth class: moderately deep (to a hardpan)
Depth to unweathered bedrock: greater than 60 inches
Drainage class: well drained
Permeability: slow
Available water capacity: low
Potential rooting depth: 20 to 40 inches
Runoff: slow to medium
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: moderate
Calcium carbonate equivalent: greater than 15 percent in the lower part
Salinity: none to very slight
Corrosivity: steel—high, concrete—low

Stagecoach

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid

Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: greater than 5 percent below 10 inches
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Delnorte soils that are shallow to a hardpan
- Arizo soils in drainages that are sandy and gravelly and flood
- Bucklebar soils are very deep and have sandy clay loam and clay loam textures

Similar inclusions:
- Soils that are high in clay and have less than 35 percent rock fragments and a hardpan
- Soils that are high in clay and shallow to a hardpan
- Nahda soils that have surface textures of fine sandy loam
- Caracara soils that have bedrock under the hardpan

Use and Management

Major current use: rangeland

Soil-related factors:
- Nahda—clayey texture, depth to hardpan, slow permeability, droughtiness
- Stagecoach—slope, calcareous, hazard of seepage, droughtiness

Rangeland

Dominant vegetation on the Nahda soil:
- Potential plant community—paloverde, ironwood, mesquite, bush muhly, threeawns, black grama, triangle bursage, plains bristlegrass, Arizona cottontop
- Present plant community—creosotebush, ocotillo, paloverde, triangle bursage, ironwood

Dominant vegetation on the Stagecoach soil:
- Potential plant community—creosotebush, bush muhly, red grama, slim tridens, threeawns, desert zinnia, coldenia, paloverde
- Present plant community—creosotebush, paloverde, triangle bursage, white ratany, ocotillo, fluffgrass, ironwood, saguaro, cholla, annual grasses and forbs

General management considerations for the Nahda soil:
- This soil is easily traversed by livestock.
- It produces forage for year-round use.
- Brush encroachment is a serious problem on much of this soil. The competition from woody plants must be reduced before this unit will respond to grazing management.
- This area has inclusions of Clayey Upland Range Sites.

Suitable management practices for the Nahda soil:
- Suitable range management practices to improve grazing distribution and range condition include fencing, livestock water developments, and range seeding.

General management considerations for the Stagecoach soil:
- Included soils in drainageways in this unit produce most of the forage used by livestock.

Suitable management practices for the Stagecoach soil:
- Grazing management should be focused on improving forage production in these drainageways.
- Other suitable range management practices to improve grazing distribution and range condition include fencing and livestock water development.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Nahda and Stagecoach soils—VIIs nonirrigated

Range site:
Nahda soil—Loamy Upland, 10-13" p.z.
Stagecoach soil—Limy Upland, Deep, 10-13" p.z.

46—Oracle-Romero-Rock outcrop complex, 5 to 35 percent slopes

Setting

Landform: hills
Slope range: Oracle—5 to 15 percent, Romero—5 to 35 percent
Elevation: 3,000 to 4,200 feet
Mean annual precipitation: 12 to 16 inches

Mean annual air temperature: 63 to 67 degrees F.
Frost-free period: 215 to 250 days

Composition

Oracle and similar soils: 40 percent
Romero and similar soils: 40 percent
Rock outcrop: 10 percent
Contrasting inclusions: 10 percent

Typical Profile

Oracle

Rock fragments on surface: 30 percent gravel and a few scattered cobbles and stones
0 to 1 inch—yellowish brown gravelly sandy loam
1 to 5 inches—brown gravelly sandy loam
5 to 13 inches—reddish brown gravelly sandy clay loam
13 to 20 inches—weathered bedrock that has clay films on the rock fragments
20 to 60 inches—weathered granite (grus)

Romero

Rock fragments on surface: 40 percent gravel and about 5 to 10 percent cobbles and stones
0 to 1 inch—dark brown very gravelly sandy loam
1 to 7 inches—dark brown very gravelly sandy loam
7 to 60 inches—weathered granite (grus)

Soil Properties and Qualities

Oracle

Parent material: slope alluvium and residuum from granite
Depth class: shallow
Depth to weathered bedrock: 10 to 20 inches
Depth to unweathered bedrock: greater than 60 inches
Drainage class: well drained
Permeability: moderately slow
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to rapid
Hazard of erosion by water: slight
Hazard of erosion by wind: slight
Shrink-swell potential: moderate
Corrosivity: steel—moderate, concrete—low

Romero

Parent material: slope alluvium and residuum from granite
Depth class: very shallow and shallow
Depth to weathered bedrock: 6 to 20 inches
Depth to unweathered bedrock: greater than 60 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 6 to 20 inches
Runoff: medium to very rapid
Hazard of erosion by water: slight to medium
Hazard of erosion by wind: slight
Shrink-swell potential: low
Corrosivity: steel—moderate, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, boulders, and nearly vertical cliffs of granite and gneiss. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near the hilltops.

Inclusions

Contrasting inclusions:
- Combate soils that are moderately deep or deep to bedrock
- Keysto soils in drainages that are sandy and gravelly and flood

Similar inclusions:
- Soils that have slopes greater than 35 percent or less than 5 percent
- Lampshire soils that are very shallow and shallow to unweathered bedrock
- Romero soils that have a loam surface texture

Use and Management

Major current use: rangeland

Soil-related factors: depth to bedrock, slope

Rangeland

Dominant vegetation on the Oracle soil:
- Potential plant community—sideoats grama, hairy grama, slender grama, sprucetop grama, black grama, plains lovegrass, false mesquite, shrubby buckwheat, cane beardgrass
- Present plant community—mesquite, sideoats grama, slender grama, false mesquite

Dominant vegetation on the Romero soil:
- Potential plant community—sideoats, slender and black grama, bush muhly, plains lovegrass, shrubby buckwheat, dahlia

• Present plant community—sideoats, ocotillo, bush muhly, mesquite, catclaw acacia, wait-a-bit mimosa

General management considerations:
• This unit is easily traversed by livestock.
• It produces forage for year-round use.
• Livestock prefer this unit to adjacent hills and mountains.

Suitable management practices:
• Grazing management, utilizing fencing and livestock water developments to control grazing use, will result in range improvement.
• Other suitable range management practices to improve range condition include brush management and range seeding.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Interpretive Groups

Land capability classification:
Romero and Oracle soils—VIs nonirrigated

Range site:
Romero and Oracle soils—Shallow Upland, 12-16" p.z.

47—Pajarito-Sahuarita complex, 1 to 3 percent slopes

Setting

Landform: fan terraces (fig. 15)
Slope range: 1 to 3 percent
Elevation: 2,000 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Pajarito and similar soils: 75 percent
Sahuarita and similar soils: 20 percent
Contrasting inclusions: 5 percent

Typical Profile

Pajarito

0 to 4 inches—brown sandy loam
4 to 17 inches—brown fine sandy loam
17 to 60 inches—strong brown sandy loam

Sahuarita

0 to 4 inches—light brown sandy loam
4 to 18 inches—brown sandy loam
18 to 30 inches—light brown fine sandy loam
30 to 34 inches—brown loam
34 to 60 inches—reddish brown sandy clay loam

Soil Properties and Qualities

Pajarito

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: low
Calcium carbonate equivalent: less than 5 percent
Corrosivity: steel—high, concrete—low

Sahuarita

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate in the upper part and moderately slow in the lower part
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: low in the upper part and moderate in the lower part
Calcium carbonate equivalent: less than 5 percent in the upper part and less than 15 percent in the lower part
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Soils that have textures of sandy loam and are in drainageways that flood
• Stagecoach and Vado soils that have more than 35 percent rock fragments and are calcareous
• Arizo soils in drainages that are sandy and flood
• Bucklebar soils that have textures of sandy clay loam and clay loam

Figure 15.—Typical landscape of Pajarito-Sahuarita complex, 1 to 3 percent slopes.

Similar inclusions:
- Hayhook soils that are not calcareous in the upper part
- Agustin soils that have 15 to 35 percent rock fragments and less than 18 percent clay

Use and Management

Current use: rangeland

Soil-related factors: droughtiness, hazard of wind erosion, piping

Rangeland

Dominant vegetation on Pajarito and Sahuarita soils:
- Potential plant community—creosotebush, bush muhly, whitestem paperflower, threeawn, whiplash pappusgrass
- Present plant community—creosotebush, triangle bursage, mesquite, annual forbs and grasses

General management considerations:
- Areas of these soils are easily traversed by livestock. They produce a limited amount of forage for year-round use. Forage production, consisting of annual forbs and grasses, can be very high in years of good winter and spring precipitation.

Suitable management practices:
- Grazing management should be focused on improving range condition in the drainageways within and adjacent to these soils. Other suitable range management practices to improve grazing distribution and range condition include fencing and livestock water developments.

Cropland

General management considerations:
- Intake rates and slope can affect uniform distribution of irrigation water.
- To sustain soil productivity, maintain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
- A hazard of wind erosion exists when the soil surface is disturbed or left unprotected by vegetation.
- Excessive cultivation can result in the formation of a tillage pan.

Suitable management practices:
- Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
- Rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis, to improve fertility and increase the water intake rate and available water holding capacity.
- Wind erosion can be reduced by keeping the soil rough and cloddy when it is not protected by vegetation.
- Tillage pans can be broken by ripping when the soil is dry. This increases the effective rooting depth, enhances root development, and improves internal drainage. Roots are not restricted and can easily grow in all directions.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited
Desertic riparian herbaceous plants: suited
Desertic riparian shrubs and trees: poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: suited

Interpretive Groups

Land capability classification
Pajarito soil—IIe irrigated and VIIe nonirrigated
Sahuarita soil—IIe irrigated and VIIe nonirrigated

Range site:
Pajarito and Sahuarita soils—Limy Fan, 10-13" p.z.

48—Pantano-Granolite complex, 5 to 25 percent slopes

Setting

Landform: hills
Slope range: 5 to 25 percent
Elevation: 2,000 to 3,600 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Pantano and similar soils: 45 percent
Granolite and similar soils: 40 percent
Contrasting inclusions: 15 percent

Typical Profile

Pantano

Rock fragments on surface: 50 percent gravel, 10 percent cobbles
0 to 2 inches—pale brown extremely gravelly fine sandy loam
2 to 11 inches—light brown very gravelly sandy loam, calcareous
11 to 16 inches—light brown extremely gravelly sandy loam, calcareous
16 to 22 inches—weathered bedrock that has calcium carbonate coats on the rock fragments
22 inches—unweathered diorite bedrock

Granolite

Rock fragments on surface: 50 percent gravel, 15 percent cobble
0 to 2 inches—reddish brown extremely gravelly sandy loam
2 to 16 inches—dark reddish brown and dark yellowish brown extremely gravelly sandy clay
16 to 24 inches—weathered bedrock that has clay films and calcium carbonate coats on the rock fragments
24 inches—unweathered rhyolite bedrock

Soil Properties and Qualities

Pantano

Parent material: slope alluvium from diorite
Depth class: shallow
Depth to weathered bedrock: 10 to 20 inches
Depth to unweathered bedrock: 20 to 30 inches
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: rapid to very rapid
Hazard of erosion by water: slight to moderate
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: greater than 5 percent below 2 inches

Corrosivity: steel—high, concrete—low

Granolite

Parent material: slope alluvium and residuum from rhyolite
Depth class: shallow
Depth to weathered bedrock: 10 to 20 inches
Depth to unweathered bedrock: 20 to 30 inches
Drainage class: well drained
Permeability: slow
Available water capacity: very low
Potential rooting depth: 10 to 20 inches
Runoff: medium to rapid
Hazard of erosion by water: slight to moderate
Hazard of erosion by wind: very slight
Shrink-swell potential: high
Calcium carbonate: coatings on the fractures of the bedrock
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Stagecoach-like soils that are moderately deep and deep to bedrock
- Arizo soils in drainages that are gravelly and sandy and that flood
- Rock outcrop
- Delnorte soils that are shallow to a hardpan

Similar inclusions:
- Soils that are very shallow to a hardpan over bedrock
- Anklam soils that have less than 35 percent clay
- Slopes greater than 25 percent and less than 5 percent
- Pantano soils that have sandy loam or loam surface textures

Use and Management

Major current use: rangeland

Soil-related factors:
- Pantano soils—depth to bedrock, calcareous, droughtiness
- Granolite soils—clayey texture, slopes, depth to bedrock

Rangeland

Dominant vegetation on the Pantano soil:
- Potential plant community—creosotebush, whitethorn acacia, bush muhly, threeawns, ocotillo, paloverde, slim tridens, red grama, cacti
- Present plant community—creosotebush, whitethorn acacia, ocotillo, cacti

Dominant vegetation on the Granolite soil:
- Potential plant community—bush muhly, threeawns, false mesquite, jojoba, paloverde, saguaro, cacti
- Present plant community—paloverde, triangle bursage, saguaro, cacti

General management considerations:
- This unit is easily traversed by livestock.
- The Granolite soil produces forage for year-round use. It will respond to good grazing management.
- Production of forage for livestock grazing on the Pantano soil is limited by unfavorable soil characteristics.

Suitable management practices:
- Suitable range management practices to improve grazing distribution and range condition include fencing, livestock water developments, brush management, and range seeding.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Pantano and Granolite soils—VIIs nonirrigated

Range site:
Pantano soil—Limy Upland, 10-13" p.z.
Granolite soil—Shallow Upland, 10-13" p.z.

49—Pinamt-Momoli complex, 1 to 10 percent slopes

Setting

Landform: Pinamt—fan terraces, Momoli—fan terrace and stream terraces
Slope range: Pinamt—1 to 5 percent, Momoli—1 to 10 percent
Elevation: 1,400 to 2,200 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Pinamt and similar soils: 45 percent
Momoli and similar soils: 40 percent

Contrasting inclusions: 15 percent

Typical Profile

Pinamt

Rock fragments on surface: 80 percent gravel and 5 percent cobble
0 to 2 inches—light yellowish brown extremely gravelly loam
2 to 11 inches—reddish brown very gravelly clay loam
11 to 20 inches—reddish brown very gravelly sandy clay loam, calcareous
20 to 30 inches—light brown very gravelly sandy clay loam, calcareous
30 to 60 inches—light brown very gravelly sandy loam, calcareous

Momoli

Rock fragments on surface: 60 percent gravel
0 to 2 inches—brown very gravelly coarse sandy loam
2 to 12 inches—strong brown gravelly coarse sandy loam
12 to 22 inches—light brown very gravelly coarse sandy loam
22 to 60 inches—light brown very gravelly coarse sandy loam

Soil Properties and Qualities

Pinamt

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: low
Potential rooting depth: 60 inches or more but severely restricted by a very hard layer at 8 to 17 inches
Runoff: slow to medium
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Salinity: slight to moderate in the lower part
Calcium carbonate equivalent: greater than 15 percent in lower part
Corrosivity: steel—high, concrete—low

Momoli

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Salinity: none to very slight
Calcium carbonate equivalent: less than 5 percent
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Guvo soils that are very shallow and shallow to a hardpan over bedrock
- Soils in drainages that are sandy and flood
- Gunsight soils that are calcareous
- Soils that have conglomerate bedrock that is deep to very deep

Similar inclusions:
- Denure soils that have gravelly sandy loam textures
- Slopes greater than 10 percent
- Pinamt soils that have sandy loam surface textures
- Soils that have an argillic horizon less than 25 inches thick

Use and Management

Major current use: rangeland

Soil-related factors: droughtiness, content of rock fragments, hazard of seepage

Rangeland

Dominant vegetation on the Pinamt soil:
- Potential plant community—creosotebush, bush muhly, triangle bursage, white ratany, buckhorn cholla
- Present plant community—creosotebush, triangle bursage, white ratany, ocotillo, buckhorn cholla

Dominant vegetation on the Momoli soil:
- Potential plant community—bush muhly, creosotebush, triangle bursage, white ratany, annual grasses and forbs
- Present plant community—creosotebush, triangle bursage, white ratany, annual grasses and forbs

General management considerations:
- This unit is easily traversed by livestock.
- Production of forage for livestock grazing is limited by low rainfall and unfavorable soil characteristics.
- Included soils within the drainageways produce most of the forage for livestock in this unit.

Suitable management practices:
• Grazing management should be focused on improving the drainageways to increase total forage production.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Pinamt and Momoli soils—VIIs nonirrigated

Range site:
Pinamt and Momoli soils—Limy Upland, Deep, 7-10" p.z.

50—Quilotosa extremely gravelly coarse sandy loam, 3 to 15 percent slopes

Setting

Landform: hills
Slope range: 3 to 15 percent
Elevation: 1,800 to 2,400 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Quilotosa and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 8 inches—light brown extremely gravelly coarse sandy loam
8 to 10 inches—weathered bedrock with calcium carbonate coats on the rock fragments
10 inches—unweathered granite bedrock

Soil Properties and Qualities

Parent material: mixed slope alluvium and residuum
Depth class: very shallow and shallow
Depth to unweathered bedrock: 8 to 20 inches
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 8 to 20 inches
Runoff: medium to rapid
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: less than 5 percent
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Momoli soils that are very deep
• Vaiva soils that have more than 20 percent clay
• Soils in drainages that are sandy and gravelly and that flood
• Rock outcrop

Similar inclusions:
• Slopes greater than 15 percent
• Quilotosa soils that have fine sandy loam surface textures

Use and Management

Major current use: rangeland

Soil-related factors: depth to bedrock, content of rock fragments, droughtiness, hazard of seepage

Rangeland

Dominant vegetation on the Quilotosa soil:
• Potential plant community—paloverde, bush muhly, threeawns, white bursage, white ratany, triangle bursage, ironwood, creosotebush, saguaro, ocotillo, cacti
• Present plant community—paloverde, triangle bursage, saguaro, ocotillo, and cacti

General management considerations:
• Potential vegetation is dominated by desert shrubs.
• The majority of perennial forage is provided by seasonally available browse.
• Production on this site is limited by shallow soils.
• Proper grazing distribution is difficult on these soils because of the unavailability of water.
• Overgrazing reduces the plant cover and increases the rate of erosion.

Suitable management practices:
• Encourage uniform grazing on these soils by fencing and developing permanent water.
• Improve distribution and utilization by concentrating a high number of livestock on the area for a short period of time.
• Use stocker-type cattle on rough slopes that cows with calves will avoid.
• Concentrate management on included soils in drainageways where the majority of forage is produced.

• Control erosion and promote forage production with proper utilization.
• Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Quilotosa soil—VIIs nonirrigated

Range site:
Quilotosa soil—Shallow Upland, 7-10" p.z.

51—Quilotosa-Rock outcrop-Vaiva complex, 15 to 45 percent slopes

Setting

Landform: hills and mountains
Slope range: Quilotosa—15 to 45 percent, Vaiva—15 to 40 percent
Elevation: 1,500 to 3,200 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Quilotosa and similar soils: 40 percent
Rock outcrop and similar soils: 30 percent
Vaiva and similar soils: 25 percent
Contrasting inclusions: 5 percent

Typical Profile

Quilotosa

0 to 1 inch—strong brown very gravelly sandy loam
1 to 9 inches—strong brown very gravelly sandy loam
9 inches—unweathered granite bedrock

Vaiva

Rock fragments on surface: 15 percent cobble and 30 percent gravel
0 to 1 inch—yellowish brown very gravelly loam
1 to 13 inches—reddish brown very gravelly sandy clay loam
13 to 19 inches—extremely gravelly sandy clay loam
19 inches—unweathered granite bedrock

Soil Properties and Qualities

Quilotosa

Parent material: slope alluvium and residuum from granite
Depth class: very shallow and shallow
Depth to unweathered bedrock: 8 to 20 inches
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 8 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: less than 5 percent
Corrosivity: steel—high, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, massive boulders, and nearly vertical cliffs of granite. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near hilltops and mountaintops.

Vaiva

Parent material: slope alluvium and residuum from granite
Depth class: very shallow and shallow
Depth to unweathered bedrock: 4 to 20 inches
Drainage class: well drained
Permeability: moderate
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Pinamt and Momoli soils that are very deep and are on the lower slopes of the hills
• Soils in drainages that are gravelly and sandy and that flood

Similar inclusions:
• Soils that are moderately deep to bedrock
• Quilotosa and Vaiva soils that have surface textures of fine sandy loam or sandy loam

Use and Management

Major current use: rangeland

Soil-related factors: depth to bedrock, slope, content of rock fragments, droughtiness

Rangeland

Dominant vegetation on the Quilotosa and Vaiva soils:
• Potential plant community—paloverde, bush muhly, threeawns, triangle bursage, white brittlebush, white ratany, ironwood, big galleta, saguaro, ocotillo, cacti
• Present plant community—paloverde, triangle bursage, saguaro, ocotillo, cacti

General management considerations:
• Potential vegetation is dominated by desert shrubs.
• The majority of perennial forage is provided by seasonally available browse.
• Production on this site is limited by shallow soils.
• Livestock movement is hindered by steep, cobbly slopes.
• Proper grazing distribution is difficult on these soils because of steep slopes and lack of water.
• Overgrazing reduces plant cover and increases the rate of erosion.

Suitable management practices:
• Encourage uniform grazing on these soils by fencing and developing permanent water.
• Improve distribution and utilization by concentrating a high number of livestock on the area for a short period of time.
• Use stocker-type cattle on rough slopes that cows with calves will avoid.
• Concentrate management on included soils in drainageways where most of the forage is produced.
• Control erosion and promote forage production with proper utilization.
• Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Desertic herbaceous plants: very poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Quilotosa and Vaiva soils—VIIe nonirrigated

Range site:
Quilotosa and Vaiva soils—Shallow Hills, 7-10" p.z.

52—Romero-Lampshire-Rock outcrop complex, 15 to 65 percent slopes

Setting

Landform: mountains
Slope range: 15 to 65 percent
Elevation: 3,200 to 5,300 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 63 to 67 degrees F.
Frost-free period: 215 to 250 days

Composition

Romero and similar soils: 35 percent
Lampshire and similar soils: 30 percent
Rock outcrop: 30 percent
Contrasting inclusions: 5 percent

Typical Profile

Romero

Rock fragments on surface: 40 percent gravel and about 5 to 10 percent stones and boulders
0 to 2 inches—brown to dark brown very gravelly sandy loam
2 to 7 inches—brown to dark brown very gravelly sandy loam
7 to 60 inches—weathered granite (grus)

Lampshire

0 to 2 inches—very dark grayish brown very gravelly sandy loam
2 to 8 inches—very dark gray very gravelly sandy loam
8 inches—unweathered granite bedrock

Soil Properties and Qualities

Romero

Parent material: slope alluvium and residuum from granite
Depth class: very shallow and shallow
Depth to weathered bedrock: 6 to 20 inches
Depth to unweathered bedrock: greater than 60 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 6 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: slight
Shrink-swell potential: low
Corrosivity: steel—moderate, concrete—low

Lampshire

Parent material: slope alluvium and colluvium from igneous and metamorphic rock
Depth class: very shallow and shallow
Depth to unweathered bedrock: 4 to 20 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: very rapid
Hazard of erosion by water: moderate to severe
Hazard of erosion by wind: slight
Shrink-swell potential: low
Corrosivity: steel—moderate, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, massive boulders, and nearly vertical cliffs of gneiss and granite. Rock outcrop also includes areas where the depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near the mountaintops.

Inclusions

Contrasting inclusions:
• Combate-like soils that are moderately deep and deep to bedrock

Similar inclusions:
• Slope less than 15 percent and greater than 65 percent
• Romero soils that have a loam surface texture
• Soils that have less organic matter

Use and Management

Major current use: rangeland

Soil-related factors: depth to bedrock, slope, content of rock fragments

Rangeland

Dominant vegetation on the Romero and Lampshire soils:
• Potential plant community—sideoats grama, slender grama, hairy grama, and black grama, shrubby buckwheat, plains lovegrass, tanglehead, cane beardgrass
• Present plant community—sideoats grama, bush muhly, catclaw acacia, shrubby buckwheat, and ocotillo

General management considerations:
• This unit produces forage for year-round use.
• Steep slopes, rocky surfaces and areas of rock outcrop limit access, resulting in poor grazing distribution.

Suitable management practices:
• Overcome grazing distribution problems by using grazing management practices, such as fencing, livestock water developments, and trail construction, that will permit more animals to graze in smaller areas for shorter periods of time.
• Controlled burning and brush management help improve grazing distribution and range conditions.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Interpretive Groups

Land capability classification:
Romero soil—VIIe nonirrigated
Lampshire soil—VIIe nonirrigated

Range site:
Romero and Lampshire soils—Granitic Hills, 12-16" p.z.

53—Romero-Rock outcrop complex, 10 to 40 percent slopes

Setting

Landform: mountains and hills
Slope range: 10 to 40 percent
Elevation: 3,200 to 5,000 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 63 to 67 degrees F.
Frost-free period: 215 to 250 days

Composition

Romero and similar soils: 55 percent
Rock outcrop and similar soils: 25 percent
Contrasting inclusions: 20 percent

Typical Profile

Romero

0 to 2 inches—pale brown extremely channery sandy loam
2 to 7 inches—pale brown extremely channery sandy loam
7 to 20 inches—highly fractured schist
20 inches—unweathered schist bedrock

Soil Properties and Qualities

Romero

Parent material: slope alluvium from schist
Depth class: very shallow and shallow
Depth to weathered bedrock: 4 to 20 inches
Depth to unweathered bedrock: 20 to 25 inches
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: very low
Potential rooting depth: 4 to 20 inches
Runoff: rapid to very rapid
Hazard of erosion by water: slight to severe
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Corrosivity: steel—moderate, concrete—low

Rock Outcrop

Rock outcrop consists of barren rock that occurs as ledges, massive flags and nearly vertical cliffs of schist. Rock outcrop also includes areas where depth to bedrock is less than 4 inches. The higher percentage of Rock outcrop is in areas near the hilltops and mountaintops.

Inclusions

Contrasting inclusions:
- Soils that are calcareous
- Soils that contain a higher percentage of clay

Similar inclusions:
- Slopes less than 10 percent and greater than 40 percent

Use and Management

Major current use: rangeland

Soil-related factors: depth to bedrock, droughtiness, slopes

Rangeland

Dominant vegetation on the Romero soil:
- Potential plant community—sideoats grama, black grama, slender grama, ocotillo, false mesquite, ratany, tanglehead, mat muhly
- Present plant community—snakeweed, mesquite, ocotillo, false mesquite, fluffgrass, slender grama

General management considerations:
- This unit produces forage for year-round use.
- Steep slopes, rocky surfaces and areas of rock outcrop limit access and result in poor grazing distribution.
- Overcome grazing distribution problems by using grazing management practices, such as fencing, livestock water developments, and trail construction, that will permit more animals to graze in smaller areas for shorter periods of time.
- Controlled burning and brush management help improve grazing distribution and range conditions.

Suitable management practices:
- Control erosion and promote forage production with proper utilization.
- Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Romero soil—VIs nonirrigated

Range site:
Romero soil—Granitic Hills, 12-16" p.z.

54—Rositas loamy fine sand, 2 to 5 percent slopes

Setting

Landform: dunes
Slope range: 2 to 5 percent
Elevation: 1,400 to 2,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Rositas and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 1 inch—light yellowish brown loamy fine sand
1 to 60 inches—light yellowish brown fine sand

Soil Properties and Qualities

Parent material: eolian sands
Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: very slow

Hazard of erosion by water: slight
Hazard of erosion by wind: high
Shrink-swell potential: low
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Denure soils that have sandy loam textures
- Sasco soils that have silt loam textures
- Soils that are sandy to moderate depths over loamy textures

Similar inclusions:
- Rositas soils that have fine sand or sand surface textures

Use and Management

Major current use: rangeland

Soil-related factors: droughtiness, hazard of wind erosion

Rangeland

Dominant vegetation on the Rositas soil:
- Potential plant community—big galleta, Santa Rita threeawns, dropseeds, Mormon tea, annual grasses and forbs
- Present plant community—creosotebush, birdcage primrose, big galleta, mesa dropseed, annual grasses and forbs

General management considerations:
- This soil is not easily traversed, as loose sands hinder livestock movement.
- It does produce forage for year-round use.
- Grazing must be managed to maintain perennial grass cover, as this soil is very susceptible to wind erosion.

Suitable management practices:
- Livestock water developments and fencing are very important to management of grazing on this soil.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Rositas—VIIe nonirrigated

Range site:
Rositas soil—Sandy Upland, 7-10" p.z.

The dunes in this area have formed perpendicular to the westerlies. The dunes are stabilized by vegetation, mainly creosotebush.

55—Sasco loam, 0 to 1 percent slopes

Setting

Landform: stream terraces
Hazard of flooding: none to rare
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Sasco and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 5 inches—pale brown loam
5 to 15 inches—pale brown silt loam
15 to 19 inches—very pale brown silt loam
19 to 60 inches—pale brown and light yellowish brown silt loam

Soil Properties and Qualities

Parent material: mixed stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderate
Available water capacity: high
Potential rooting depth: 60 or more inches
Runoff: slow
Hazard of erosion by water: moderate
Hazard of erosion by wind: moderate
Shrink-swell potential: low
Salinity: none to very slight
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Glenbar soils that have more than 18 percent clay
- Rositas soils that have a sandy texture
- Small areas in which the subsoil averages more than 18 percent clay

Similar inclusions:
- Gilman-like soils that have textures of fine sandy loam and loam
- Sasco soils that have a surface texture of fine sandy loam

Use and Management

Major current use: rangeland

Soil-related factors: hazard of erosion and seepage, piping

Rangeland

Dominant vegetation on the Sasco soil:
• Potential plant community—creosotebush, bush muhly, mesquite, annual grasses and forbs
• Present plant community—creosotebush, Indianwheat, Coulter mallow, fiddleneck, filaree

General management considerations:
• This soil is easily traversed by livestock.
• Production of forage for livestock grazing is limited by low rainfall.
• Forage production, consisting of annual forbs and grasses, can be high in years of good winter and spring precipitation.

Suitable management practices:
• Grazing management to improve grazing distribution is most economically practiced by turning livestock water developments on and off.

Cropland

General management considerations:
• Intake rates and slope can affect uniform distribution of irrigation water.
• To sustain soil productivity, proper soil conditions should be maintained, including good soil tilth, organic matter, aeration, and structure.
• Excessive cultivation can result in the formation of a tillage pan.

Suitable management practices:
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• Help maintain fertility and tilth by returning all crop residue to the soil and using a cropping system that includes grasses, legumes or grass-legume mixtures.
• Tillage pans can be broken by ripping when the soil is dry. This increases the effective rooting depth, enhances root development, and improves internal drainage. Roots are not restricted and can easily grow in all directions.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: poorly suited
Desertic riparian shrubs and trees: poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Sasco soil—IIe irrigated and VIIe nonirrigated

Range site:
Sasco soil—Limy Fan, 7-10" p.z.

56—Soledad-Topawa complex, 1 to 5 percent slopes

Setting

Landform: fan terraces
Slope range: 1 to 5 percent
Elevation: 2,000 to 3,200 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Soledad and similar soils: 40 percent
Topawa and similar soils: 40 percent
Contrasting inclusions: 20 percent

Typical Profile

Soledad

0 to 3 inches—brown gravelly loamy sand
3 to 13 inches—yellowish red gravel sandy loam
13 to 27 inches—yellowish red very gravelly sandy loam
27 to 60 inches—reddish yellow very gravelly sandy loam

Topawa

0 to 2 inches—brown very gravelly sandy loam
2 to 8 inches—reddish brown extremely gravelly sandy loam
8 to 18 inches—reddish brown very gravelly sandy clay loam
18 to 37 inches—yellowish red extremely cobbly sandy clay loam
37 to 60 inches—yellowish red gravelly sandy loam

Soil Properties and Qualities

Soledad

Parent material: mixed fan alluvium
Depth class: very deep

Drainage class: well drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: less than 10 percent
Corrosivity: steel—high, concrete—low

Topawa

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: moderate
Calcium carbonate equivalent: less than 10 percent
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Vado soils that do not have an argillic horizon
- Stagecoach soils that are calcareous
- Arizo soils in drainages that are sandy and flood
- Nadha soils that have more than 35 percent clay and a hardpan at moderate depths
- Delthorny and Caracara soils that have a hardpan over bedrock

Similar inclusions:
- Hayhook soils that have less than 15 percent rock fragments
- Soils that are calcareous in the lower part
- Slopes greater than 5 percent
- Soledad and Topawa soils that have surface textures of sandy loam, loam, or fine sandy loam

Use and Management

Major current use: rangeland

Soil-related factors: hazard of seepage, content of rock fragment, droughtiness

Rangeland

Dominant vegetation on the Soledad and Topawa soils:
- Potential plant community—bush muhly, threeawns, Arizona cottontop, plains bristlegrass, black grama, Rothrock grama, mesquite, paloverde, ironwood, cacti
- Present plant community—triangle bursage, paloverde, ironwood, cacti

General management considerations:
- This unit is easily traversed by livestock.
- It produces forage for year-round use.
- Brush encroachment is a serious problem on much of this unit. The competition from woody plants must be reduced before this unit will respond to grazing management.

Suitable management practices:
- Suitable range management practices to improve grazing distribution and range condition include fencing, livestock water developments, range seeding, proper grazing use, and planned grazing systems.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Interpretive Groups

Land capability classification:
Soledad and Topawa soils—VIIs nonirrigated

Range site:
Soledad soils—Sandy Loam Upland, 10-13" p.z.
Topawa soils—Loamy Upland, 10-13" p.z.

57—Tatai silt loam, 0 to 2 percent slopes

Setting

Landform: flood plains
Hazard of flooding: rare
Slope range: 0 to 2 percent
Elevation: 1,400 to 2,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Tatai and similar soils: 85 percent
Contrasting inclusions: 15 percent

Typical Profile

0 to 24 inches—light brown silt loam
24 to 36 inches—reddish brown clay loam, calcareous, saline-sodic

36 to 60 inches—brown clay loam, calcareous, saline- sodic

Soil Properties and Qualities

Parent material: mixed stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: moderate
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: moderate
Hazard of erosion by wind: moderate
Shrink-swell potential: moderate
Salinity: slight to moderate in the upper part and moderate to strong in the lower part
Sodicity: slight in the upper part and moderate to strong in the lower part
Calcium carbonate equivalent: 5 to 15 percent in the upper part and greater than 15 percent in the lower part
Corrosivity: steel—high, concrete—moderate

Inclusions

Contrasting inclusions:
- Glenbar soils that have silty textures
- Casa Grande soils that are saline-sodic
- Rositas soils that have sandy textures

Similar inclusions:
- Tatai soils that have surface textures of clay loam

Use and Management

Major current use: rangeland

Soil-related factors: hazard of erosion and flooding, shrink-swell potential, piping

Rangeland

Dominant vegetation on the Tatai soil:
- Potential plant community—threeawns, tobosa, mesquite, twoflower trichloris, desert saltbush, bush muhly, annual grasses and forbs
- Present plant community—mesquite, creosotebush, annual grasses and forbs

General management considerations:
- This soil is easily traversed by livestock.
- It produces forage for year-round use.
- Livestock prefer this soil because of availability of shade, easy access and seasonal water from flooding of shallow drainageways.
- When the protective plant cover is depleted by overgrazing the soil is susceptible to rill and gully erosion.

Suitable management practices:
- Grazing management utilizing fencing can help improve the use of forage produced after flooding and maintain the plant cover.
- Brush management is needed to keep mesquite from dominating the soil.
- Other suitable range management practices to improve grazing distribution and range condition include livestock water development, range seeding, gully control, and water spreading systems.

Cropland

General management considerations:
- Intake rates and slope can affect uniform distribution of irrigation water.
- The subsoil and substratum have a high content of calcium carbonate, salts and sodium, which reduces the permeability and the availability of nutrients.
- Distribution of irrigation water is affected by contrasting textures and/or permeability rates.
- These soils have a hazard of flooding.
- A tillage pan forms easily if this soil is tilled when wet.
- To maintain soil productivity proper soil conditions should be sustained, including good soil tilth, organic matter, aeration, and structure.
- Moderately slow permeability can cause water to pond, damaging crops.
- The sodium content causes this soil to disperse and/or compact.

Suitable management practices:
- Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
- Salt-tolerant crops should be selected and properly designed irrigation systems installed to assure uniform application of irrigation water and to control salt movement.
- Onsite investigations are needed to identify contrasting textures and/or permeability rates prior to land leveling fields to assure uniform irrigation water distribution.
- The risk of flooding can be reduced by the use of levees, dikes and diversions.
- Ripping or chiseling when the soil is dry breaks up tillage pans. This increases the effective rooting depth, enhances root development, and improves internal drainage.
- Rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis,

to improve fertility and increase the water intake rate and available water holding capacity.
• When designing irrigation systems on soils that have slow permeability rates, protect crops from damage by adjusting the length of runs so that they allow infiltration but do not permit water to stand on the soil surface.
• The effects of sodium can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Effects of compaction can be controlled by not tilling when the soil is wet. Compaction can be broken up by ripping when the soil is dry.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: poorly suited
Desertic riparian shrubs and trees: poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Tatai soil—IIIs irrigated and VIIs nonirrigated

Range site:
Tatai soil—Saline Bottom, 7-10" p.z.

58—Tubac complex, 0 to 2 percent slopes

Setting

Landform: basin floors
Hazard of flooding: none to rare
Slope range: 0 to 2 percent
Elevation: 2,000 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Tubac loam and similar soils: 40 percent
Tubac sandy loam and similar soils: 30 percent
Contrasting inclusions: 30 percent

Typical Profile

Tubac loam

0 to 1 inch—brown loam
1 to 3 inches—brown clay loam
3 to 28 inches—reddish brown clay
28 to 48 inches—reddish brown sandy clay loam
48 to 60 inches—strong brown fine sandy loam

Tubac sandy loam

0 to 2 inches—brown sandy loam
2 to 5 inches—reddish brown sandy loam
5 to 20 inches—yellowish red clay
20 to 42 inches—reddish brown sandy clay loam
42 to 60 inches—reddish brown sandy clay loam

Soil Properties and Qualities

Tubac

Parent material: mixed stream alluvium
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 erosion by water: slight
Hazard of erosion by wind: moderate to moderately high
Shrink-swell potential: high
Calcium carbonate equivalent: less than 15 percent
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Soils that have a hardpan above 40 inches
• Bucklebar soils that have sandy clay loam and clay loam textures
• Hayhook soils that have sandy loam textures
• Arizo soils in drainages that are gravelly and sandy and flood

Similar inclusions:
• Tubac soils that have gravelly surface textures
• Around the village of Cowlic, along the Fresnal and Vamori Washes, Tubac soils have saline-sodic properties

Use and Management

Current use: rangeland

Soil-related factors: shrink-swell potential, slow permeability

Rangeland

Dominant vegetation on the Tubac soil:
• Potential plant community—Rothrock grama, Arizona cottontop, threeawns, tobosa, bursage, mesquite

• Present plant community—mesquite, snakeweed, prickleypear, staghorn cholla, annual grasses and forbs

General management considerations:
• This unit is easily traversed by livestock.
• It produces forage for year-round use.
• Brush encroachment is a serious problem on much of this unit. The competition from woody plants must be reduced before this unit will respond to grazing management.

Suitable management practices:
• Suitable range management practices to improve grazing distribution and range condition include fencing, livestock water developments, and range seeding.

Cropland

General management considerations:
• Intake rates and slope can affect uniform distribution of irrigation water.
• A tillage pan forms easily if this soil is tilled when wet.
• Slow permeability can cause ponding of water, which can damage crops.
• To maintain soil productivity proper soil conditions should be sustained, including good soil tilth, organic matter, aeration, and structure.

Suitable management practices:
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• Ripping or chiseling when the soil is dry breaks up tillage pans. This increases the effective rooting depth, enhances root development, and improves internal drainage.
• When designing irrigation systems on soils that have slow permeability rates, protect crops from damage by adjusting the length of runs so that they allow infiltration but do not permit water to stand on the soil surface.
• Rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis, to improve fertility and increase the water intake rate and available water holding capacity.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited
Desertic riparian herbaceous plants: poorly suited
Desertic riparian shrubs and trees: poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Tubac loam soil—IIIc irrigated and VIIs nonirrigated
Tubac sandy loam soil—IIIc irrigated and VIIe nonirrigated

Range site:
Tubac loam soil—Clay Loam Upland, 10—13" p.z.
Tubac sandy loam soil—Sandy Loam Upland, 10—13" p.z.

59—Tucson-Mohall-Valencia complex, 1 to 3 percent slopes

Setting

Landform: Tucson and Mohall—basin floors, Valencia—flood plains and alluvial fans
Hazard of flooding: Tucson and Mohall—none, Valencia—occasional
Slope range: Tucson and Mohall—1 to 3 percent, Valencia—1 to 2 percent
Elevation: 1,400 to 2,200 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Tucson and similar soils: 50 percent
Mohall and similar soils: 20 percent
Valencia and similar soils: 15 percent
Contrasting inclusions: 15 percent

Typical Profile

Tucson

Surface: desert pavement (fig. 16)
0 to 1 inch—light brown gravelly fine sandy loam
1 to 14 inches—reddish brown sandy clay loam
14 to 21 inches—light reddish brown sandy clay loam, calcareous
21 to 60 inches—light reddish brown loam, calcareous

Mohall

0 to 1 inch—yellowish red sandy loam
1 to 24 inches—yellowish red sandy clay loam
24 to 41 inches—yellowish red sandy clay loam, calcareous
41 to 60 inches—yellowish red clay loam, calcareous

Figure 16.—Typical landscape of Tucson gravelly fine sandy loam in an area of Tucson-Mohall-Valencia complex, 1 to 3 percent slopes. Desert pavement covers the surface.

Valencia

0 to 2 inches—light yellowish brown fine sandy loam
2 to 15 inches—yellowish brown fine sandy loam
15 to 25 inches—yellowish brown sandy loam
25 to 60 inches—buried strong brown clay loam, calcareous

Soil Properties and Qualities

Tucson

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: moderate to high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: moderate
Salinity: very slight to moderate
Sodicity: slight to moderate
Calcium carbonate equivalent: 10 to 30 percent in the lower part
Corrosivity: steel—high, concrete—high

Mohall

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: moderate
Salinity: none to very slight
Calcium carbonate equivalent: greater than 15 percent below 20 inches
Corrosivity: steel—high, concrete—low

Valencia

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid in the upper part and moderately slow in the lower part
Available water capacity: high
Potential rooting depth: 60 inches or more

Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderately high
Shrink-swell potential: low in upper part, moderate in lower part
Calcium carbonate equivalent: less than 5 percent in the upper part
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Gunsight soils that have greater than 35 percent rock fragments and are calcareous
• Casa Grande soils that are strongly saline-sodic
• Momoli soils that have sandy loam textures and more than 35 percent rock fragment
• Pinamt soils that have greater than 35 percent rock fragments

Similar inclusions:
• Wintersburg soil that are calcareous
• Denure soils that have sandy loam textures
• Trix soils that have a buried argillic horizon
• Tucson soils that have clay loam textures and desert pavement
• Valencia soils that have sandy loam surface textures
• Soils that do not have calcic horizons or have more than 15 percent gravel

Use and Management

Major current use: rangeland

Soil-related factors:
• Tucson soil—droughtiness, excess salt, piping
• Mohall soil—hazard of wind erosion and seepage
• Valencia soil—hazard of flooding, wind erosion, and seepage

Rangeland

Dominant vegetation on the Tucson soil:
• Potential plant community—turkshead
• Present plant community—turkshead

Dominant vegetation on the Mohall soil:
• Potential plant community—bush muhly, threeawn, mesquite, triangle bursage, white bursage, annual grasses and forbs
• Present plant community—creosotebush, mesquite, annual grasses and forbs, triangle bursage

Dominant vegetation on the Valencia soil:
• Potential plant community—bush muhly, threeawns, wolfberry, mesquite, dropseeds, Arizona cottontop, paloverde
• Present plant community—creosotebush, paloverde, wolfberry, bush muhly, mesquite, annual grasses and forbs.

General management considerations:
• Livestock favor the Valencia soil because of its accessibility, the length of the forage season, and its proximity to water. Easy accessibility coupled with lack of management causes the depletion of the native grasses and a subsequent increase in woody plants. Depletion of the plant cover leaves this soil susceptible to sheet and gully erosion.
• The Mohall soil can produce high amounts of annual forage plants in dry average winter and/or summer seasons. Grazing management should be used which permits efficient use of annual forages and meets the need of the perennial forage species and the animals.

Suitable management practices:
• Suitable range management practices are fencing, implementing planned grazing systems, and developing water for livestock.

Cropland

General management considerations for the Tucson soil:
• The subsoil and substratum have a high content of calcium carbonate, salts and sodium, which reduce the permeability and the availability of nutrients.
• The sodium content causes this soil to disperse and/or compact.
• Intake rates and slope can affect uniform distribution of irrigation water.
• Distribution of irrigation water is affected by contrasting textures and/or permeability rates.
• Excessive cultivation can result in the formation of a tillage pan.
• Moderately slow permeability can cause ponding of water, which can damage crops.

Suitable management practices for the Tucson soil:
• Salt-tolerant crops should be selected and properly designed irrigation systems installed to assure uniform application of irrigation water and to control salt movement.
• The effects of sodium can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil. Effects of compaction can be controlled by not tilling when the soil is wet. Compaction can be broken up by ripping when the soil is dry.

• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• Onsite investigations are needed to identify contrasting textures and/or permeability rates prior to land leveling fields to assure uniform irrigation water distribution.
• Tillage pans can be broken by ripping when the soil is dry. This increases the effective rooting depth, enhances root development, and improves internal drainage. Roots are not restricted and can easily grow in all directions.
• When designing irrigation systems on soils that have slow permeability rates, protect crops from damage by adjusting the length of runs so that they allow infiltration but do not permit water to stand on the soil surface.

General management considerations for the Mohall soil:
• Intake rates and slope can affect uniform distribution of irrigation water.
• Moderately slow permeability can cause water to pond, damaging crops.
• To maintain soil productivity, sustain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
• A tillage pan forms easily if this soil is tilled when wet.
• A hazard of soil blowing exists when soil surface is disturbed or left unprotected by vegetation.

Suitable management practices for the Mohall soil:
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• When designing irrigation systems on soils that have slow permeability rates, protect crops from damage by adjusting the length of runs so that they allow infiltration but do not permit water to stand on the soil surface.
• Rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis, to improve fertility and increase the water intake rate and available water holding capacity.
• Ripping or chiseling when the soil is dry breaks up tillage pans. This increases the effective rooting depth, enhances root development, and improves internal drainage.
• Wind erosion can be reduced by keeping the soil rough and cloddy when it is not protected by vegetation.

General management considerations for the Valencia soil:
• Intake rates and slope can affect uniform distribution of irrigation water.
• These soils have a hazard of flooding.
• To sustain soil productivity, proper soil conditions should be maintained, including good soil tilth, organic matter, aeration, and structure.
• A hazard of wind erosion exists when soil surface is disturbed or left unprotected by vegetation.

Suitable management practices for the Valencia soil:
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• The risk of flooding can be reduced by the use of levees, dikes and diversions.
• Returning all crop residue to the soil and using a cropping system that includes grasses, legumes or grass-legume mixtures will help maintain fertility and tilth.
• Wind erosion can be reduced by keeping the soil rough and cloddy when it is not protected by vegetation.

Wildlife Habitat Suitability

Tucson
Desertic herbaceous plants: very poorly suited
Desertic shrubs and trees: very poorly suited

Mohall
Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Valencia
Desertic herbaceous plants: well suited
Desertic shrubs and trees: well suited
Desertic riparian herbaceous plants: poorly suited
Desertic riparian shrubs and trees: poorly suited

Interpretive Groups

Land capability classification:
Tucson soil—IIIs irrigated and VIIs nonirrigated
Mohall soil—IIe irrigated and VIIe nonirrigated
Valencia soil—IIe irrigated and VIIw nonirrigated

Range site:
Tucson soil—Nonrange Site
Mohall soil—Sandy Loam Upland, 7-10" p.z.
Valencia soil—Loamy Bottom, 7-10" p.z.

60—Vado-Agustin complex, 1 to 8 percent slopes

Setting

Landform: fan terraces
Slope range: Vado—1 to 8 percent, Agustin—1 to 5 percent
Elevation: 2,000 to 3,000 feet
Mean annual precipitation: 10 to 12 inches
Mean annual air temperature: 67 to 70 degrees F.
Frost-free period: 240 to 260 days

Composition

Vado and similar soils: 60 percent
Agustin and similar soils: 30 percent
Contrasting inclusions: 10 percent

Typical Profile

Vado

0 to 5 inches—brown gravelly sandy loam
5 to 16 inches—brown gravelly sandy loam
16 to 42 inches—brown extremely gravelly sandy loam
42 to 60 inches—brown gravelly sandy loam

Agustin

0 to 8 inches—brown gravelly sandy loam
8 to 33 inches—brown gravelly sandy loam
33 to 42 inches—brown very gravelly sandy loam
42 to 60 inches—brown gravelly sandy loam

Soil Properties and Qualities

Vado

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of erosion by water: slight
Hazard of erosion by wind: very slight
Shrink-swell potential: low
Calcium carbonate equivalent: less than 5 percent
Corrosivity: steel—high, concrete—low

Agustin

Parent material: mixed fan alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Available water capacity: low
Potential rooting depth: 60 inches or more
Runoff: slow to medium
Hazard of erosion by water: slight
Hazard of erosion by wind: slight
Shrink-swell potential: low
Calcium carbonate equivalent: less than 5 percent
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
- Arizo soils in drainages that are gravelly and sandy and flood
- Bucklebar soils that have sandy clay loam and clay loam textures
- Hayhook and Pajarito soils that have less than 15 percent rock fragments and are not calcareous
- Stagecoach soils that are calcareous

Similar inclusions:
- Soledad soils that have less calcium carbonate

Use and Management

Major current use: rangeland

Soil-related factors: droughtiness, hazard of seepage, content of rock fragments

Rangeland

Dominant vegetation on the Vado soil:
- Potential plant community—bush muhly, ratany, creosotebush, cacti
- Present plant community—creosotebush, cacti, ratany

Dominant vegetation on the Agustin soil:
- Potential plant community—creosotebush, bush muhly, whitestem paperflower, threeawn
- Present plant community—creosotebush, triangle bursage, mesquite, scattered annual forbs and grasses

General management considerations:
- This unit easily traversed by livestock.
- This unit produces a limited amount of forage for year-round use.
- In years of good winter and spring precipitation, production of annual forbs and grasses on the Agustin soil is high. Production of forage for livestock on the Vado soil is limited by the unfavorable soil characteristics.

• Grazing management should be focused on improving the range condition in drainageways within and adjacent to this unit.
• Other suitable range management practices to improve grazing distribution and range condition include fencing and livestock water developments.

Suitable management practices:
• Control erosion and promote forage production with proper utilization.
• Provide periodic rest during the growing season to maintain plant vigor and production.

Wildlife Habitat Suitability

Desertic herbaceous plants: suited
Desertic shrubs and trees: suited

Interpretive Groups

Land capability classification:
Vado and Agustin soils—VIIs nonirrigated

Range site:
Vado soil—Limy Upland, Deep, 10-13" p.z.
Agustin soil—Limy Fan, 10-13" p.z.

61—Vecont clay loam, 0 to 1 percent slopes

Setting

Landform: basin floors
Hazard of flooding: rare
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Vecont and similar soils: 80 percent
Contrasting inclusions: 20 percent

Typical Profile

0 to 2 inches—yellowish brown clay loam
2 to 18 inches—dark yellowish brown clay loam
18 to 35 inches—yellowish brown clay loam
35 to 60 inches—brown clay loam

Soil Properties and Qualities

Parent material: mixed stream alluvium
Depth class: very deep
Drainage class: well
Permeability: slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: medium
Hazard of erosion by water: slight
Hazard of erosion by wind: moderate
Shrink-swell potential: high
Salinity: none to very slight
Calcium carbonate equivalent: less than 15 percent
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Mohall soils that have 18 to 35 percent clay
• Glenbar soils that have silty textures

Similar inclusions:
• Vecont soils that have surface textures of silty clay loam and silt loam

Use and Management

Major current use: rangeland

Soil-related factors: hazard of flooding, shrink-swell potential, slow permeability, low load-supporting capacity

Rangeland

Dominant vegetation on the Vecont soil:
• Potential plant community—tobosa, vine mesquite, annual grasses and forbs, mesquite, cacti
• Present plant community—tobosa, annuals, mesquite, cacti.

General management considerations:
• Livestock prefer this soil because it has a long green season and because water is seasonally available.
• This soil is very susceptible to gully erosion when the protective plant cover has been removed.
• This soil is a highly productive range site. Managing grazing by the use of fencing and livestock water developments will help livestock effectively use the coarse vegetation, such as tobosa, this soil produces.
• Other suitable range management practices to improve grazing distribution and range condition are brush management and range seeding.

Suitable management practices:
• Control erosion and promote forage production by using the soil properly.

• Provide periodic rest during the growing season to maintain plant vigor and production.

Cropland

General management considerations:
• Intake rates and slope can affect uniform distribution of irrigation water.
• To maintain soil productivity, sustain proper soil conditions, including good tilth, organic matter, aeration, and structure.
• A tillage pan forms easily if this soil is tilled when wet.
• Slow permeability can cause water to pond, damaging crops.

Suitable management practices:
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• Crop rotation and incorporating crop residue into the soil, or adding other organic matter on a regular basis, will improve fertility and increases the rate of water intake and the available water holding capacity.
• Break up tillage pan by ripping or chiseling when the soil is dry to increase the effective rooting depth, enhance root development, and improve internal drainage.
• When designing irrigation systems on soils that have slow permeability rates, adjust the length of runs to allow infiltration and prevent water from standing on the soil's surface, which can damage crops.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited
Desertic riparian herbaceous plants: poorly suited
Desertic riparian shrubs and trees: poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Vecont soil—IIIw irrigated and VIIw nonirrigated

Range site:
Vecont soil—Clayey Bottom, 7-10" p.z.

62—Wintersburg loam, 0 to 1 percent slopes

Setting

Landform: fan terraces and stream terraces
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,000 feet
Mean annual precipitation: 7 to 10 inches
Mean annual air temperature: 70 to 73 degrees F.
Frost-free period: 250 to 300 days

Composition

Wintersburg and similar soils: 75 percent
Contrasting inclusions: 25 percent

Typical Profile

0 to 2 inches—light brown loam
2 to 13 inches—light brown loam
13 to 21 inches—light brown loam, calcareous
21 to 51 inches—light brown clay loam, calcareous
51 to 60 inches—light brown loam, calcareous

Soil Properties and Qualities

Parent material: mixed fan alluvium and stream alluvium
Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Available water capacity: high
Potential rooting depth: 60 inches or more
Runoff: slow
Hazard of erosion by water: slight
Hazard of erosion by wind: moderate
Shrink-swell potential: moderate
Salinity: none to slight
Calcium carbonate equivalent: greater than 15 percent below 10 inches
Corrosivity: steel—high, concrete—low

Inclusions

Contrasting inclusions:
• Dateland soils that have fine sandy loam and loam textures
• Gunsight and Rillito soils that have more than 15 percent rock fragments

Similar inclusions:
• Wintersburg soils that have a gravelly surface texture
• Mohall soils that have an argillic horizon
• Glenbar soils that have silty textures and that flood
• Soils that have less than 18 percent clay
• Some areas receive extra runoff water, which results in a higher vegetation production

Use and Management

Major current use: rangeland

Soil-related factors: calcareous, piping, hazard of erosion

Rangeland

Dominant vegetation on the Wintersburg soil:
• Potential plant community—creosotebush, bush muhly, threeawns, white ratany, annual grasses and forbs
• Present plant community—creosotebush, annual grasses and forbs

General management considerations:
• This soil is easily traversed by livestock.
• Production of forage for livestock grazing is limited by low rainfall.
• Forage production, consisting of annual forbs and grasses, can be high in years of good winter and spring precipitation.

Suitable management practices:
• Grazing management to improve grazing distribution is most economically practiced by turning livestock water developments on and off.

Cropland

General management considerations:
• Intake rates and slope can affect uniform distribution of irrigation water.
• The subsoil and substratum have a high content of calcium carbonate, salts and sodium. This reduces the soil's permeability and the availability of nutrients.
• To maintain soil productivity, sustain proper soil conditions, including good soil tilth, organic matter, aeration, and structure.
• Excessive cultivation can result in the formation of a tillage pan.
• Moderately slow permeability can cause water to pond, damaging crops.

Suitable management practices:
• Leveling this soil to a uniform or flat grade permits more uniform application of irrigation water.
• Salt-tolerant crops should be selected and properly designed irrigation systems installed to assure uniform application of irrigation water and to control salt movement.
• Rotate crops and incorporate crop residue into the soil, or add other organic matter on a regular basis, to improve fertility and increase the water intake rate and available water holding capacity.
• Tillage pans can be broken by ripping when the soil is dry. This increases the effective rooting depth, enhances root development, and improves internal drainage. Roots are not restricted and can easily grow in all directions.
• When designing irrigation systems on soils that have slow permeability rates, protect crops from damage by adjusting the length of runs so that they allow infiltration but do not permit water to stand on the soil surface.

Wildlife Habitat Suitability

Desertic herbaceous plants: poorly suited
Desertic shrubs and trees: poorly suited
Grain and seed crops, irrigated: well suited
Domestic grasses and legumes, irrigated: well suited

Interpretive Groups

Land capability classification:
Wintersburg soil—IIIs irrigated and VIIs nonirrigated

Range site:
Wintersburg soil—Limy Fan, 7-10" 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, and parks and other recreational facilities.It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock 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.

Prime and Unique Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forest land, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. Prime farmland has an adequate and dependable supply of moisture from irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. The slope ranges mainly from 0 to 3 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

The map units in the survey area that are considered prime and unique farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. On some soils included in the list, measures that overcome a hazard or limitation, such as flooding, wetness, and droughtiness, are needed. Onsite evaluation is needed to determine whether or not the hazard or limitation has been overcome by corrective measures. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Unique farmland is land other than prime farmland

that is used for the production of specific high value food and fiber crops. It has the special combination of soil qualities, location, growing season, and moisture supply needed to economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods. For example, cotton grown on salt-affected soils requires a high level of management, including irrigation water management and conservation crop rotation. Map units that are considered unique farmland are listed in table 6.

Irrigated Cropland

Donald L. Walther, cropland specialist, helped prepare this section.

This section suggests general management needed for irrigated crops. It identifies the major crops grown in the area, describes types of irrigation systems, discusses factors that affect crop growth, explains the land capability classification used by the Natural Resources Conservation Service, and lists the estimated yields of the main crops for each prime and unique farmland soil.

The survey area has the potential to produce a wide variety of food and fiber crops. The major crops grown in the area are cotton, small grains, and alfalfa hay. Other potential crops are table grapes, broccoli, lettuce, melons, safflower, and pecans. All crops grown within the survey area must be irrigated because of insufficient rainfall to supply adequate moisture for plant growth. An adequate water supply is the main limitation for irrigated agriculture.

The area's irrigation water comes from wells and the Central Arizona Project. The lirnited availability of water requires the use of high-efficiency irrigation systems and a high degree of management.

The type of surface irrigation system used depends on soil textures and farm economics. Natural field slope irrigation uses the land's natural slope to run the water downhill. This system requires the least amount of field preparation. Uniform leveling removes surface slope irregularities and may reduce both end fall and side fall. It improves water distribution and helps increase irrigation efficiencies. Level basin systems remove all slope from the furrow or border systems and allow a maximum amount of water to stay in the fields by eliminating runoff. Level basin irrigation systems are best suited when a large volume of water is available and soil textures are fine to medium. Soils having intake rates greater than 1.5 inches per hour are not well suited for level basins, except on smaller fields.

Trickle irrigation systems are designed to apply water to the soil at rates and quantities close to the daily water requirements of the plant. These systems apply water in small amounts and at frequent intervals. Trickle systems have a high initial installation cost and high maintenance costs and require intensive management. They are best suited for use where the water supply is limited, water costs are high, soil limitations exist, or high-value crops are grown. In all cases, the degree of management will determine the efficiency of the irrigation system being used.

Water delivery is a very important part of any irrigation system. Pipelines, concrete-lined ditches, and earthen ditches are the most commonly used conveyance methods. Water is run from wells through pipelines to irrigation ditches, which deliver water to the field. Earthen ditches are less efficient than concrete ditches because of water losses caused by seepage and evaporation, and because of the maintenance needed to control weeds and occasionally to reshape and rebuild the ditches.

Conservation cropping sequences consist of cultural and management measures needed for optimum long-term crop production. The system selected is influenced by the needs and desires of the farmer, his or her ability to finance the production of a particular crop, government commodity programs, and the effectiveness of the cropping sequence in controlling diseases, insects, and weeds while maintaining good soil condition. In parts of the survey area, erosion controls must be considered when planning a conservation cropping sequence. Some common cropping sequences in the area are (1) cotton for 1 year and small grain for 1 year, (2) cotton for 2 years and small grain for 1 year, and (3) continuous cotton with an application of manure between crops.

Salinity and sodicity are problems in some soils such as the Casa Grande and Kamato series. The limitation of salinity can be corrected or reduced by changing either the frequency or the amount of water applied. The objective is to provide enough moisture for plant utilization and to control the amount of salt concentration in the root zone. With more frequent, lighter irrigation applications, soluble soil salts are moved lower in the soil profile, making water more available to the plants. Salts can be flushed or leached beyond the root zone of the plants.

Sodicity can commonly be reduced by using soil amendments such as gypsum, sulphur, or sulfuric acid. These amendments allow the sodium to be easily leached beyond the root zone. The amount of amendments needed or required is based on soil samples that are tested for sodium content.

Crops on most of the soils in the area respond well to fertilizers. The supply of potassium, calcium, magnesium and iron is adequate in most soils. High

amounts of calcium carbonate in soils such as Trix, Wintersburg, and Gilman prevent the uptake of iron in some crops, causing iron chlorosis. Variability in soil type, type of crop, cropping history, and management require further soil tests to determine the proper combinations and application rates of fertilizers.

Most of the soils in the area are low in organic matter content. The incorporation of crop residue increases organic matter, which improves the water intake characteristics and available water holding capacity, increases soil aeration and soil biological activity, improves soil structure, and increases the number of nutrients available to plants. Crop residues somewhat lessen the negative impacts of tillage operations and help to control water erosion and reduce the hazard of wind erosion.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 7. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include erosion control and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, manure, and green manure crops.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 7 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

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. Table 8 identifies the extent and location of potentially irrigable soils. This identification is useful in the planning, management and maintenance of this resource base.

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; 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 class or subclass classification of each map unit is given in the section "Detailed Soil Map Units." Table 8 gives acres, by county, for each capability class.

Rangeland

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 9 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 9 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.

Rangeland in the Survey Area

Dan Robinett, range conservationist, prepared this section.

There are approximately 2,845,000 acres of rangeland on the Tohono O'odham Nation. Native people have used this rangeland for several hundred years. Small populations have successfully used the plant, animal, soil, and water resources of this diverse land without major impacts until recent times.

Prior to European contact, the Tohono O'odham people lived scattered throughout the Sonoran Desert

in both Mexico and Arizona. They lived in the harsh interior surrounded by the Piman and Coloradan tribes along the wet river valleys to the east, north, and west. Village groups were semi-nomadic, moving from the winter villages in the hills and mountains (the well—Vaya) to the summer villages in the alluvial valleys (the field—Oidak) (Hastings 1965). In the summer they practiced, "akchin," or arroyo mouth, agriculture. They cleared, plowed, and planted flood plain fields to native crops of corn, squash, and beans, and diverted summer floods from the washes onto the fields to irrigate the quick-growing varieties (Bryan 1925).

The Tohono O'odham people also used wild annual plants that grew among the crops. Species such as pigweed (chelite), pursley (verdolaga), devilsclaw, and annual panicgrass were not weeded from the field but were used for seed and greens. Also from the summer villages, they harvested the various cactus fruits: saguaro, prickly pear, and pitahaya (organpipe). Mesquite beans (wihog) were another important food supply. These summer villages relied on runoff water trapped in small, natural charcos or waterholes on the flood plain for their water supply. When these supplies dried up, the women would have to carry water in ollas from the springs in the hills and mountains, miles away, to the "field" villages (Tatom 1975). In the fall after harvest, the village group would move to the winter villages where permanent waters (springs, tinajas, seeps, etc.) could be found. Hunting for meat, tallow, and hides was an important activity of the "well" villages.

Commerce consisted of annual treks to the Gulf of California for salt and to the areas of Pima agriculture along the Gila River where the Tohono O'odham would trade such things as saguaro fruit, chilitepenes, bellotas (acorns), baskets and fibers, dried meats, buckskin, tallows, salt, and red and yellow ochre in return for cotton blankets and fiber, rings of willow splints, devils claw, and dried beans, corn, squash, and pumpkin (Bryan 1925).

The nature of this existence, in a land where drought is a common natural feature, was precarious. If the summer season of planting, harvesting, and gathering was a failure, the following winter was one of starvation (Bryan 1925). Whole villages would move without hesitation toward better water supplies or to villages where crops had been good (Bryan 1925).

Examples of the paired villages included the summer (field) village of Kaka used by the winter villages of Moi Vaya and Chiulikam, Hickiwan (field) used by the winter village of Sikort Chuapo, Choulic (field) used by the winter villages of Chutum Vaya and Chui Vaya, and Pisinimo (field) used by the winter village of Stoa Vaya (Bryan 1925).

Change for the people and the rangeland of the Nation began in 1697 when the Jesuit missionary, Father Kino, first established contact and introduced new species of plants and animals to the Sonoran Desert. During several trips through this region from 1698 to 1706, Kino visited remote villages such as Pozo Verde, Fresnal, Vamori, Comobabi, Ko Vaya, Ak Chin, Gu Vo, Vaiva Vo, Kohakt, Anegam, and Kaka (Barnes 1979). He distributed small gifts of cattle, horses, and chickens as well as seed for wheat, melons, tobacco, and fruit varieties. At San Xavier, his gifts of cattle, sheep, horses, and goats established large herds along the Santa Cruz River (Bryan 1925 and Hastings 1965).

With Kino's death in 1711, the mission activity declined in the northern areas of New Spain, and the herds of livestock largely went wild. In 1765, the Franciscans took over the Sonoran missions and ranches in present day Arizona (Bryan 1925 and Hastings 1965). The wild herds of cattle were, at the time, viewed as game and hunted by the Tohono O'odham. In some instances, they were caught and teamed and used to plow fields in the manner taught at the missions.

Not long after the first Spanish incursions, the Apaches began to move into the area. They arrived in southeastern Arizona sometime in the 1680s and had raided as far west as Tohono O'odham territory by the early 1700s (Bahre 1991). A series of Apache wars began which lasted into the 1860s. With the Gadsden Purchase in 1853, and Anglo settlement in earnest for mining and ranching from 1860 to 1880, the Apache were slowly contained by the U.S. Army (Hastings 1965). A testimony to the long-standing animosity between the Tohono O'odham and the Apache is the ease with which nearly 100 Tohono O'odham were enlisted for a raid on a band of Pinal Apaches led by Chief Eskiminzin in Aravaipa Canyon in 1871 (Roberts 1992). This raid, which resulted in the massacre of nearly all of the women, chidren, and elderly men in this Aravaipa Apache village, was in retaliation for many recent raids and murders of settlers in the region (Roberts 1992). The Tohono O'odham made peace with the Apaches later that year after 170 years of warring but periodically held Apache scalp dances as a reminder of this era (Tatom 1975).

It was during this period of American settlement in the mid to late-1800s that cattle began to play a more important part in the Tohono O'odham economy.

Prior to this time, the one or two appointed hunters in the Tohono O'odham village or family groups brought

in 10 to 15 deer, antelope, or bighorn a year to provide for their group (Bauer 1968). As their country began to be taken up by settlers, the population and their demands on the land increased. The mines at Weldon, between the South Mountain and Ben Nevis Mountain, alone had a peak population of 11,000 for a year or two (Barnes 1979 and Bryan 1925). Other mines such as Vekol, the Allison in Fresnal Canyon, and the Growler and Gunsight Mines had a similar impact. The deer and antelope became scarce, and family group hunters had to hunt and kill half-wild cattle to provide for their village needs (Bauer 1968).

For this reason, the Anglo and Mexican cattleman who encroached on Tohono O'odham lands had largely abandoned their operations by the early 1900s (Bryan 1925). Ranches such as the Santa Rosa, owned by West Coast Cattle Company; the Fresnal Ranch, owned by Maish and Driscoll; the Marstellar at San Vincente; Bernarbe Robles from Three Points to San Xavier (Blaine 1981 and Hornady 1983); Ed Vail along the west slopes of the Baboquivaris (Griffiths 1904); and Sabine Otero around the Allison Mine, all employed and trained Tohono O'odham vaqueros to tend their herds (Bryan 1925). Even in the driest valleys of the west, cattleman, such as the Serventi Brothers on the Great Plains; Daniels, Wall, and Haynes around Gunsight Mines; Tom Childs in the Saucedas; and the Redondos at Sikort Chuapo (Barnes 1979), tried to make a go of it on the Tohono O'odham lands.

As these operations were abandoned and as mines played out, Tohono O'odham who had learned the husbandry of cattle and horses, began to form herds of their own and use the water sources that had been developed (Bryan 1925).

Cattle hunting became cattle grazing; the roles changed but the social structure remained the same (Bauer 1968). The men were in charge of the cattle and the family head directed their care. He designated one of his sons as a cowboy, just as, in former times, one was the hunter. Cattle grazing had the same structure as hunting, and village units used the neighboring rangelands for grazing their livestock, just as they once used those lands for hunting (Bauer 1968). Cattle grazing became more and more important. From 1900 to 1925, many new Indian ranches were started. Deep wells were drilled for permanent water supplies during this period, first by Anglo and Mexican ranchers and then by the Indian Service (Bauer 1968). In 1915, the Indian Service drilled and equipped deep wells at Chui Chu, Vaiva Vo, Tat Momoli, Komelik, Topawa, Santa Rosa, Anegam, and two years later, at San Miguel (Bryan 1925).

In addition, Tohono O'odham had learned from the cattlemen the techniques of digging wells in spring areas and of using fresnos and slips to dig shallow ponds (repressos) in the clayey flood plains to provide additional water (Bryan 1925). Deep wells in the summer villages turned them into permanent settlements and lessened the use of winter villages, leading to the abandonment of many (Bryan 1925). More villages were abandoned as a result of the forced resettlement of hundreds of Tohono O'odham from their ancestral lands near Arivaca and Tucson to the main reservation in 1909 (Wilbur-Cruce 1987). During this period, the main body of the Nation was reserved by law for the Tohono O'odham People. Though the reserve at San Xavier was established as long ago as 1874 and the reserve at Gila Bend in 1882, it was from 1911 to 1917 that the main area was reserved (Tatom 1975).

A tremendous boom in the number of cattle and horses accompanied this period of development of permanent water supplies in the once-dry valleys. By 1919, there was an estimated 30,000 head of cattle and 30,000 head of horses on the main reservation (Bauer 1968 and Wagoner 1949). The arid, desert rangeland was being subjected to grazing pressure of unnatural proportions. The large, wild herbivores native to the area (deer, antelope, and bighorn) were few in number and small in size, and exerted very little grazing and browsing pressure on the rangeland plants. The huge herds of large non-native herbivores (cattle, horses, burros) stripped the rangeland bare of its protective cover of grasses and shrubs.

Developing beef markets during WWI resulted in tremendous overstocking of southern Arizona ranges, which had already been heavily grazed for the previous 30 years. After the war, the collapse of these markets was followed by the drought of 1921. Cattle could not be sold and thus stayed on the range and died in great numbers (Wagoner 1949). Grasslands on the Tohono O'odham Nation became barren, and erosion set in. It was estimated that about three inches of topsoil was lost on a million acres, and nine inches lost on another quarter million acres by 1940 (Bauer 1968).

Photographic evidence shows gullies forming out of once-grassy plains and bottoms (Humphrey 1987). Although many large stream systems had discontinuous gullies in their reaches (Vamori, San Simon, and Santa Rosa washes), before the overgrazing of the early days (Cooke 1976), erosion in these reaches seemed to have increased greatly in the last 60 years. Present day headcuts proceed unchecked and threaten some of the last intact flood plains in southern Arizona.

Vegetative changes, especially in the wetter eastern parts of the Tohono O'odham Nation, have been pronounced. This change is well documented by photographs taken in 1893-94 of the international boundary monuments as they were erected. Monuments numbered 141 to 164 were placed along the border. Although heavily grazed, even in 1893, grassland areas were open and uneroded. Present-day photos taken of the same scenes at monuments 141 to 144 show these areas now as mesquite-burroweed-snakeweed areas with much erosion (Humphrey 1987). Upper Sonoran lands once had grass under the tree cover of mesquite, paloverde, and ironwood, whereas now these same areas have only bursage or burroweed growing under the trees. Only in Lower Sonoran areas to the west do the 1893 and present-day photographs look the same (Humphrey 1987).

Heavy, unrelenting grazing played a major role in the changes, but other things may have contributed as well. Natural fires which used to sweep grasslands have not been able to burn in the last 90 years, as the grass needed to carry the fire is grazed off before the period of dry lightning storms in June and July. Both wildfires and fires deliberately set by Native Americans, including the Tohono O'odham, were common in pre-settlement Arizona (Bahre 1991). These fires may have helped keep these ranges open and free of shrubs, although there is some evidence that periods of subtle changes in rainfall patterns may have coincided with periods of heavy grazing; and the combined action resulted in the rapid loss of plant cover, increased runoff, and erosion (Hastings 1965).

The plant communities that have replaced the grasslands and grass understories consist of plants that are not grazed by livestock. Many of these plants are protected by thorns or spines such as mesquite, catclaw, cholla, and prickly pear. Other species, such as bursage, burroweed, and snakeweed, have turpentine-like substances in their foliage and are poisonous to livestock. As the forage species were removed by heavy, continuous grazing and drought, these species were able to come in and occupy the vacant spaces left.

The carrying capacity of the main body of the Tohono O'odham Nation has been estimated at between 10,500 and 12,000 cow units (Bauer 1968). Efforts by the Indian Service over the years to reduce livestock numbers have always been viewed with suspicion and met with stiff resistance (Bauer 1968 and Blaine 1981). Such efforts were taken as direct threats against the Tohono O'odham way of life. Cattle had become so ingrained in the local economy that they served as a reserve or bank to the small cattleowner. The need to be able to sell, trade, or consume livestock throughout the year was woven into Tohono O'odham social, economic, and ceremonial life. Even as the subsistence-and-barter economy changed to one of cash, the need for livestock remained the same (Bauer 1968).

As large cattle owners began raising cattle as an industry, they clung to the early methods of Anglo and Mexican cattlemen. Female stock were never sold. Only steers were sold. This practice insured that during the good years there would be plenty of animals on the range to use the abundant feed and in droughts, the large cattlemen would stay in business even if half the cows died. The practice continues today but is slowly changing.

The only checks on the herd size through the years have been drought and disease. Dourine venereal disease reduced the horse herd from an estimated 20,000 in 1941 to 7,500 by 1949. Similarly successive droughts reduced cattle numbers from 27,000 to about 13,000 in mid-1950s (Bauer 1968 and Blaine 1981).

In 1933 and 1934, O'odham crews of the Civilian Conservation Corps (CCC) fenced the boundaries of the main body of the Tohono O'odham Nation. In 1935 and 1936, the nine grazing districts were fenced by crews of the Emergency Conservation Work Programs (ECWP). In addition, the ECWP crews developed and constructed 6 wells, 41 storage tanks, 76 charcos, 18 masonry dams, and 9 springs and seeded several thousand acres of flood plain land to Johnson grass and chamiso (fourwing saltbush) (Bauer 1968).

Additional water developments and dikes to control gully erosion and spread floodwater came in the 1940's with the Agriculture Adjustments Act. The Bureau of Indian Affairs' Soil Conservation Program of Land Operations, begun in 1954, continued this development for the next 20 years. All of this occurred without any management of grazing or numbers of animals and resulted in near-total exploitation of the rangelands on the Tohono O'odham Nation (Bauer 1968). Tohono O'odham cattleowners, who felt their way of life threatened by any action to limit their animals, could not see that what really threatened their way of life was the deterioration of the land.

In recent times, little has changed on these rangelands. Herd size grows in successive wet years and is reduced in drought years as animals die off or fail to reproduce. The land continues to deteriorate, and as it does so, it can support fewer grazing animals, less wildlife, and even fewer people. Any consumptive use of rangeland resources needs to be managed. It is the nature of humans to exploit these resources for

their benefit and survival. This worked centuries ago when there were few human beings and much land, but in modern times the reverse is true. The harvest of forage, wildlife, and wood products from the land must be managed in such a way that these products can renew themselves. If they cannot, they will disappear.

Plants are the primary producers in the web of life on earth. They nourish themselves through their green leaves. Green leaves transform minerals and water from the soil and carbon dioxide from the air into plant food and energy in the photosynthetic process. Sun energy is captured and transformed into chemical energy. When a grazing animal removes some of the green leaves from a plant, it hurts the plant's ability to nourish itself and survive.

Plants can be grazed for a period of time and may actually thrive if they are left alone for another period of time to recover from the grazing. This is grazing management. The amount of grazing that plants can withstand and the length of time they need to recover depend on many factors, including the species or type of plant, the rainfall of the area, the soils the plants are growing in, temperatures, and length of the growing season. Understanding these factors and how they relate to livestock grazing in specific areas is the science and art of range management.

Most of the rangelands in southern Arizona have changed dramatically since the introduction of livestock. It is important to know what potential exists for these rangelands to recover and improve. The potential of a range to produce certain kinds of plants depends on soils, climate, and natural factors that have an impact (fires, flooding, drought). The basis for range inventory is to identify the different types of rangeland and their potential to produce plants. Identified range sites consist of similar soils in a defined climatic area which are capable of producing a certain amount and kind of vegetation. The relationship between soils and vegetation was established during the course of this soil survey. Range sites can be determined from the soils map and legend. In addition, table 9 shows the potential vegetation and herbage production for each soil series or phase.

Two broad climatic areas characterized by distinctive vegetation occur on the Tohono O'odham Nation. The first and largest area is the Sonoran Desert, which covers over 90 percent of the land in the Nation. The Sonoran Desert can be broken into two subdivisions for the purpose of range classification.

The first subdivision is the Lower Sonoran Desert (MLRU 40-2AZ). This is the hottest and driest country in the Tohono O'odham Nation. Rainfall averages from 7 to 10 inches per year. Elevations range from 1,400 to 2,000 feet. It occupies about 40 percent of the survey area and occurs in the low valleys such as the Santa Rosa and Quijotoa valleys and the Great Plain. Upland sites are characterized by shrubby vegetation such as creosotebush, bursage, and desert saltbush. Grassy sites in this region are limited to small bottoms and the large flood plains that drain the valleys.

The second subdivision is the Upper Sonoran Desert (MLRU 40-1AZ). This area covers 50 percent of the survey area at elevations from 2,000 to 2,900 feet. The average rainfall is 10 to 12 inches. The small valleys and all of the large mountain ranges except the Baboquivaris occur in this region. Upland sites are characterized by paloverde, ironwood, mesquite, and saguaro forests with bursage, burroweed, and snakeweed underneath. These sites have the potential to support grass instead of the half-shrubs that are currently present. In addition, both the bottom sites and the hill (mountain) sites in this region have the potential to support grasses and other forage species in their plant communities.

The other broad climatic area on the Tohono O'odham Nation is the Desert Grassland. This area occurs on less than 10 percent of the land area and includes the Baboquivari Mountain Range, a flank of land around it and the top of the Comobabi Ranges. It also is broken into two subdivisions for the sake of range classification.

The first subdivision is the Desert Grassland (MLRU 41-3AZ). This area, once characterized by open grasslands, occurs at elevations from 2,900 to 5,000 feet and has an average rainfall of 12 to 16 inches. It is the lower slopes of the Baboquivaris and the adjacent flats. Upland sites that were once unbroken, grassy plains now have covers of mesquite, snakeweed, burroweed, and cacti. All of these sites still retain their grassland potential. Natural fires were important in maintaining these grasslands.

The second subdivision is the Oak Woodland - Grass Savannah (MLRU 41-1AZ), which occurs only along the top of the Baboquivari Mountains and Kitt Peak. This area is characterized by an average annual rainfall of 16 to 24 inches and elevations from 5,000 to 7,500 feet. These are all hill sites in this area and are characterized by grassy slopes with varying cover of live oak and juniper species. At the highest elevation, the cover of oak and juniper thickens to form woodland. This area is little changed from past times, as most of this country is so steep and rugged that overgrazing has not been much of a problem. Natural fires have been important in the development of these plant communities both in the past and present.

For each of these zones on the Tohono O'odham

rangeland, range sites have been identified and potential plant communities described. In a range survey, the existing plant communities are compared to the potential plant community, and range condition is rated based upon its departure from potential. Range site and condition inventories determine the status of the land at a particular time and help the manager and rancher set reasonable objectives and chart realistic courses of action to achieve them.

The rangeland in the Upper Sonoran Desert and Desert Grassland regions has great potential to change and improve. Grazing management alone will do a great deal to restore perennial grass cover on the land. Two village-based groups which have fenced and crossfenced and begun to rotate their herds in the southern area of the Nation have proven how quickly the land can respond to care and wise use. These and other examples prove that the land can be grazed and produce beef, hide, and bone, as well as wood and wildlife, and at the same time actually improve in condition if such uses are managed wisely.

The rangelands on the Tohono O'odham Nation are a tremendous resource for the people. The results of their decimation can be seen and felt everywhere: deserted villages, eroded bottom lands, dying animals and trees, flooding and droughts. Yet the potential to improve exists and these lands can become fruitful again.

Woodland Management and Productivity

Table 10 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 and D, restricted rooting depth. If a soil has more than one limitation, the priority is as follows: R, D.

In table 10, *slight, moderate,* and *severe* 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.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

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 *volume 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 *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

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 11 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 11 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.

Woodland in the Survey Area

Dan Robinett, range conservationist, prepared this section.

About 7,600 acres of woodland is in the survey area. Two woodland sites are represented. One is the mesquite forest (bosque) of the Santa Cruz River terraces in San Xavier District, and the other is the mixed oak, pinyon and juniper woodland on the top of the Quinlan and Baboquivari Mountains.

Many thousands of acres of lands at lower elevations in the soil survey area resemble woodland, but the density of mesquite is unnaturally high for a variety of reasons and the potential plant communities are savannah or grassland. These areas are considered rangeland and are discussed in the rangeland section of this manuscript.

Woodland is land where the potential plant community is made up of trees with canopy covers exceeding 20 percent.

The mixed evergreen oak woodland occurs at elevations ranging from 5,400 feet on steep north slopes to 6,880 feet on top of Kitt Peak and over 7,500 feet on top of Baboquivari Peak. The major tree species include silverleaf oak, Arizona white oak, Emory oak, Mexican blue oak, alligator juniper, and Mexican pinyon. Common associated shrubs are silktassel, manzanita, mountainmahogany, snowberry,

skunkbush sumac, sacahuista, and Arizona rosewood. The important species in the understory are bullgrass, Texas bluestem, wooly bunchgrass, crinkleawn, prairie junegrass, bouvardia, California brickelbush, creeping daisy, plains lovegrass, and dryland sedges.

Except for pinyon, the major tree species sprout vigorously after wildfire or wood cutting. Evergreen oak species are fast growing for their first 20 to 25 years. Heart rot usually sets in about this age and then growth and productivity decline dramatically. Twelve-inch diameter trees range in age between 60 and 70 years, and the average lifespans for the oaks and pinyon are probably over 100 years. If a wood-cutting cycle can manage growth before the onset of heart rot, productivity of the oak species can be from 15 to 25 cubic feet of wood per acre per year. Average productivity of old trees (70-80 years) is only 3 to 5 cubic feet of wood per acre per year.

Naturally occurring wildfire was very important in the evolution of these plant communities. Fire-free intervals in this woodland were probably long (over 20 years). These woodlands are characterized by high fuel moisture content in the June-July wildfire season, very little herbaceous understory, and moderate numbers of fire-sensitive species such as Mexican pinyon. After fire, woody fuels take 20 to 25 years to recover to the condition at which fire can recur. Much of this woodland in the survey area is ripe for wildfire. Kitt Peak last burned in 1955, and the area of this woodland site around Baboquivari Peak have not burned since the 1930's.

Historically, these mixed evergreen woodlands in the soil survey area were used mainly for food gathering, fiber products, grazing, and mining. Important foods from these woodland areas were acorns (bellotas), manzanita and juniper berries, and meat (bighorn sheep and whitetail deer). Fibers for basket making were mainly sacahuista (beargrass) and Schott's and banana yucca roots (red bark). All these tree species provided fuelwood for winter villages and for ranching and mining operations. Posts and timbers were harvested and used in the mines and early ranching operations.

Presently, these evergreen woodlands are used for hunting, recreation and astronomy (Kitt Peak National Observatory). Beargrass is still harvested from the Kitt Peak area for basketmaking.

The mesquite woodland which historically occurred on the terraces of the Santa Cruz River near San Xavier is largely gone. This plant community depends upon shallow groundwater (30-50 feet) tables. Groundwater pumping for mining, urban uses, and agriculture lowered the water table out of reach of mesquite roots, and by 1960 the bosque was dying. Historically, this site was very important. Wild foods and fibers included coyote melon, buffalo gourd, wild cucumber, mesquite beans, hog potato, pigweed, verdolaga (pursley), devilsclaw, coyote tobacco (Juan loco), and canaigre for tanning hides. The best building timbers and unlimited firewood supplies of mesquite were found on this site. It was also the premier nesting site for mourning and whitewing dove in this part of the southwest. This site may no longer have the potential to produce mesquite "bosque" woodland because groundwater is too deep.

Areas of Loamy Bottom range site along the major drainages such as the Vamori, Fresnal, and San Simon washes resemble mesquite woodland in places. Although these areas once were more open and grassy, they should be managed as woodlands now because of their importance for wildlife and wood products.

Recreation

The soils of the survey area are rated in Table 12 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 12, 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 12 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in

Table 14 and interpretations for dwellings without basements and for local roads and streets in Table 13.

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 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 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 firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

John C. York, biologist, helped to prepare this section.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

The capacity of an area to produce vegetation determines the kind of wildlife that live in the area. This section discusses some of the factors that limit the production of vegetation. Because the existence of all wildlife depends in some way on vegetation, it is necessary for land managers to know how they can best manage that vegetation.

The kinds and populations of animals that live in the desert are determined by evolution and climate, provided there is a suitable soil on which usable vegetation can grow. Animal populations fluctuate with the amount of moisture received in the survey area because the amount of vegetation fluctuates with moisture. The kinds of animals are relatively fixed, barring human interference, and the mixes are determined by the kinds and amounts of vegetation.

In the "Detailed Soil Map Units," the soils in the survey area are rated to reflect the soils' suitability for maintenance, improvement, or creation of specific wildlife habitat elements. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

Ratings are based on the existence of limitations in the soil, such as the available moisture capacity, content of rock fragments, depth to bedrock or hardpan, and soil reaction. The ratings are expressed as well suited, suited, and poorly suited. A rating of well suited indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of suited indicates that the element or kind of habitat can be established, improved, or maintained, in most places. Soil limitations are moderate. Moderately intensive management is required for satisfactory results. A rating of poorly suited indicates that limitations are severe for the designated element or kind of habitat. Soil limitations are severe. Habitats can be created, improved, or maintained in most places, but management is difficult and must be intensive.

The elements of wildlife habitat are described in the following paragraphs.

Desertic herbaceous plants are herbaceous plants that are adapted to growing in desert climates. Soil properties and features that affect the growth of desertic herbaceous plants are surface texture, available water capacity, soil reaction, salinity, sodicity, and content of rock fragments. Soil temperature and soil moisture are also considerations. Examples of desertic herbaceous plants are threeawn species, grama species, bush muhly, curly mesquite, Arizona cottontop, zinnia species, false mesquite, lovegrass, buckwheat, triangle bursage, brittlebush, and ratany.

Desertic shrubs and trees make up a diverse shrub and tree community that is suited to a desert

environment that is dryer than is common in moist riparian zones. Soil properties and features that affect the growth of desertic shrubs and trees are surface texture, available water capacity, soil reaction, salinity, sodicity, and content of rock fragments. Soil temperature and soil moisture are also considerations. Examples of desertic shrubs and trees are mesquite, paloverde, ironwood, whitethorn, fourwing saltbush, yucca, mimosa, jojoba, saguaro, wolfberry, creosotebush, and acacia.

Desertic riparian herbaceous plants are suited to wetter soil conditions than is common in the dryer upland areas. Soil properties and features that affect the growth of riparian herbaceous plants are surface texture, flooding hazard and duration, salinity, sodicity, and content of rock fragments. Soil temperature and soil moisture are also considerations. Examples of desertic riparian herbaceous plants are wheatgrass, sacaton, tobosa, broom snakeweed, pappasgrass, caniagre dock, and Bermuda grass.

Desertic riparian shrubs and trees are suited to wetter soil conditions than is common in the dryer upland areas. Soil properties and features that affect the growth of desertic riparian shrubs and trees are available water capacity, salinity, sodicity, and flood hazard and duration. Soil temperature and soil moisture are also considerations. Examples of desertic riparian shrubs and trees are mesquite, desertwillow, greythorn, big bursage, wolfberry, and desert hackberry.

Domestic grasses and legumes—irrigated are domestic perennial grasses and herbaceous legumes that must be irrigated to survive in this climate. Soil properties and features that affect the growth of domestic grasses and legumes—irrigated are surface texture, content of rock fragments, available water capacity, depth to bedrock or hardpan, flood hazard, permeability, percent slope, salinity, sodicity, and erosional factors. Soil temperature and soil moisture are also considerations. Examples of domestic grasses and legumes—irrigated are Lehmann lovegrass, clovers, and alfalfa.

Grain and seed crops—irrigated are grain and seed crops that require irrigation to survive in this climate. Soil properties and features that affect the growth of grain and seed crops—irrigated are surface texture, content of rock fragments, available water capacity, depth to bedrock or hardpan, flood hazard, permeability, percent slope, salinity, sodicity, and erosional factors. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops—irrigated, are wheat, barley, and sorghum.

Vertebrate animals live throughout the survey area. Highly mobile species use all available spaces, and specialized species are restricted to one or two habitat types. Examples of the mobile species are bats, birds, mule deer, whitetail deer, desert bighorn sheep, javelina, cottontail rabbits, jackrabbits, coyotes, gray fox, coatis, porcupines, bobcats, skunks, and raccoons. Some snakes, such as rattlesnakes, bullsnakes, coachwhips, and king snakes, also have a fairly wide range. Deer, javelina, and sheep are restricted to areas of free water. Even though they have mobility, that action is controlled by the need for water. Animals that do not have mobility are rats and mice, gophers, lizards, skinks, toads, quail, most snakes, geckoes, and ground squirrels. These animals are usually nonspecific in the vegetation they eat, require no free water to survive, are mainly nocturnal, and are small—all characteristics of animals that live in harsh, hot dry climates.

Birds Sighted During the Course of the Survey

Cathy E. McGuire, soil scientist, prepared this section.

During the course of the soil survey field work the following birds were positively identified. This is not a complete list of all the birds in the Tohono O'odham Nation. This is a list of the more common and spectacular birds that were observed, usually around water, while the field work was being completed. It is presented here to show the great diversity of the bird species on the Nation.

The birds sighted include plain titmouse, verdin, bushtit, cactus wren, black-tailed gnatcatcher, mountain bluebird, varied thrush, hermit thrush, Northern mockingbird, Bendire's thrasher, curvebill thrasher, phainopepla, loggerhead shrike, European starling, yellow warbler, yellow-rumped warbler, Willson warbler, hepatic tanager, lark bunting, brown towhee, rufous-sided towhee, white-crowned sparrow, black-chinned sparrow, dark-eyed junco, red-winged blackbird, Western meadowlark, great-tailed grackle, brown-headed cowbird, hooded oriole, Northern finch, Cassin's finch, Inca dove, white-wing dove, mourning dove, greater roadrunner, barn owl, great horned owl, lesser nighthawk, broad-tailed hummingbird, belted kingfisher, white-breasted nuthatch, Gila woodpeckers, acorn woodpeckers, Northern flickers, dusky flycatchers, Western flycatchers, vermillion flycatchers, ash-throated flycatchers, Weid's crested flycatchers, Western kingbird, purple martin, tree swallow, bank swallow, white-throated swifts, scrub jay, Mexican jay, common raven, turkey vulture, black vulture, caracara, red-tailed hawks, sharp-shin

hawks, Harris hawks, marsh hawks, Cooper's hawks, American eagle, American kestrel, Peregrine falcon, prairie falcon, Gambel's quail, scale quail, California quail, green-winged teal, cinnamon teal, blue-winged teal, mallards, Northern pintail, redhead ducks, ring-neck ducks, common goldeneye ducks, bufflehead, American coots, snow goose, brown bobbies, great blue heron, green heron, great egret, cattle egret, snowy egret, sandhill crane, killdeer, black-necked stilt, American avocet, lesser yellowlegs, greater yellowlegs, solitaire sandpiper, least sandpiper, willet, California gull, brown pelican, and American white pelican.

Engineering

Jack W. Elder, area engineer, helped review this section.

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties and Qualities"section of the Detailed Soil Map Units.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 13 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 susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture.

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. Flooding, shrinking and swelling, and organic layers can cause the movement of footings. 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, 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,and frost action potential 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, 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, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 14 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered slight if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; moderate if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and severe if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 14 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 60 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, 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, and if slope is excessive. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 14 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, 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 groundwater pollution. Ease of excavation and revegetation should be considered.

The ratings in Table 14 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, rock 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, or a cemented pan 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 15 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 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 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 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. 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. 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 may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing.

They are used in many kinds of construction. Specifications for each use vary widely. In Table 15, 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. 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 and are naturally fertile or respond well to fertilizer.

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.

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, and have slopes of more than 15 percent.

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 16 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect irrigation and terraces and diversions.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and *levees* are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium.

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 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, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

Engineering Index Properties

Table 17 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 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 18 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of 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 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, and loamy very fine sands.
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 very slightly erodible because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In Table 18, 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 19 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall is not considered flooding.

Table 19 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.

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 or hardpan 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.

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

Soils are classified so that we can more easily remember significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their responses to manipulation. Through classification and then the use of soil maps, we can apply our knowledge of soils to specific areas.

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 20 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 Aridisols.

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 Argids (*Arg*, meaning argillic, plus *id*, from Aridisols).

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 Haplargids (*Hapl*, meaning minimal horizonation, plus *argids*, the suborder of the Aridisols that has an argillic horizon).

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 Haplargids.

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 loamy-skeletal, mixed, thermic Typic Haplargids.

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. An example is the Topawa series, which is loamy-skeletal, mixed, thermic Typic Haplargids.

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, typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(USDA, 1993)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(USDA, 1975)*. Unless otherwise indicated, 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."

Agustin Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: mixed fan alluvium
Slope range: 1 to 5 percent
Elevation: 2,000 to 3,000 feet
Classification: Coarse-loamy, mixed, thermic Typic Camborthids

Typical Pedon

Agustin gravelly sandy loam in an area of Vado-Agustin complex, 1 to 8 percent slopes, located at a latitude of 32 degrees, 04 minutes, 45 seconds N. and a longitude of 112 degrees, 02 minutes, 00 seconds W.

A1—0 to 1 inch; brown (7.5YR 5/4) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; many very fine and fine roots; many fine interstitial pores; 15 percent gravel; mildly alkaline (pH 7.6); clear smooth boundary.

A2—1 to 8 inches; brown (7.5YR 5/4) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure parting to weak medium granular; soft, very friable, nonsticky, nonplastic; common very fine and fine and few medium roots; common fine interstitial pores; 15 percent gravel; noneffervescent; mildly alkaline (pH 7.6); clear smooth boundary.

Bk1—8 to 19 inches; brown (7.5YR 5/4) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak fine angular blocky structure; soft, very friable, nonsticky, nonplastic; common very fine, fine, and medium roots; common very fine and fine interstitial and tubular pores; few distinct calcium carbonate coats on rock fragments; 25 percent gravel; strongly effervescent; mildly alkaline (pH 7.8); clear smooth boundary.

Bk2—19 to 33 inches; brown (7.5YR 5/4) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; common very fine and fine roots; common very fine and fine interstitial and tubular pores; common distinct calcium carbonate coats on rock fragments; 25 percent gravel; violently effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk3—33 to 42 inches; brown (7.5YR 5/4) very gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; massive; hard, friable, nonsticky, nonplastic; common very fine and fine and few medium roots; few fine interstitial pores; common distinct calcium carbonate coats on rock fragments; 35 percent gravel; violently effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bk4—42 to 60 inches; brown (7.5YR 5/4) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; few very fine and fine roots; common very fine and fine interstitial and tubular pores; common distinct calcium carbonate coats on rock fragments; 25 percent gravel; violently effervescent; moderately alkaline (pH 8.0).

Range in Characteristics

Rock fragments: average 15 to 35 percent gravel in the control section
Reaction: mildly to moderately alkaline
Calcium carbonate equivalent: less than 5 percent

A horizon
Hue—7.5YR, 10YR
Value—5 through 7 dry, 4 or 5 moist
Chroma—2 through 4, dry or moist

Bk horizon
Hue—5YR through 10YR
Value—5 through 7 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Texture—sandy loam, loam

Ajo Series

Depth class: moderately deep (to a hardpan)
Drainage class: well drained
Permeability: moderately slow
Landform: relict fan terrace
Parent material: mixed fan alluvium
Slope range: 3 to 10 percent
Elevation: 1,600 to 2,200 feet
Classification: Loamy-skeletal, mixed, hyperthermic Petrocalcic Paleargids

Typical Pedon

Ajo extremely gravelly loam, in an area of Ajo-Pinamt, deep, complex, 3 to 15 percent slopes, located at a latitude of 32 degrees, 35 minutes, 20 seconds N. and a longitude of 111 degrees, 53

minutes, 08 seconds W.; about 2,300 feet E. and 1,860 feet S. of the NW corner of sec. 6, T. 10 S., R. 5 E.

A—0 to 2 inches; light brown (7.5YR 6/4) extremely gravelly loam, brown to dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky, plastic; common fine roots; common fine vesicular pores; 70 percent gravel; noneffervescent; mildly alkaline (pH 7.6); abrupt wavy boundary.

Btk1—2 to 8 inches; yellowish red (5YR 5/6) extremely gravelly sandy clay loam, yellowish red (5YR 4/6) moist; moderate fine subangular blocky structure; soft, very friable, sticky, plastic; common fine roots; few fine tubular pores; very few continuous calcium carbonate coats in root channels and pores, and few faint clay films on ped faces; 70 percent gravel; slightly effervescent; mildly alkaline (pH 7.8); clear wavy boundary.

Btk2—8 to 17 inches; reddish brown (2.5YR 4/4) very gravelly clay loam, dark red (2.5YR 3/6) moist; moderate very fine subangular blocky structure; soft, very friable, sticky, plastic; few fine roots; few fine tubular pores; common distinct calcium carbonate coats in root channels and pores, and many faint clay films on ped faces and in pores; common fine iron-manganese concretions; 15 percent cobbles and 35 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

Btk3—17 to 25 inches; red (2.5YR 5/6) extremely cobbly clay loam, dark red (2.5YR 3/6) moist; moderate very fine subangular blocky structure; soft, friable, sticky, plastic; few very fine roots; few fine tubular pores; common continuous calcium carbonate coats in root channels and pores, and many faint clay films on ped faces and in pores; few fine gypsum crystals; 55 percent cobbles and 30 percent gravel; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

Btk4—25 to 30 inches; reddish brown (5YR 5/4) extremely gravelly clay loam, reddish brown (5YR 4/4) moist; moderate very fine subangular blocky structure; very hard, firm, very sticky, plastic; few fine roots; few fine tubular pores; common calcium carbonate coats in root channels and pores and many distinct clay films on ped faces and in pores; 75 percent gravel; strongly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

Bkm—30 to 60 inches; indurated petrocalcic horizon.

Range in Characteristics

Rock fragments: 30 to 75 percent gravel and/or cobbles
Depth to petrocalcic horizon: 20 to 40 inches, but dominantly 22 to 35 inches
Reaction: mildly to moderately alkaline
Surface is covered with closely packed desert pavement.

A horizon
Value—3 through 6 dry, 3 or 4 moist
Chroma—3 or 4, dry or moist
Organic matter—less than 0.5 percent

Btk horizon
Hue—2.5YR, 5YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—4 through 6, dry or moist
Texture—sandy clay loam, clay loam
Calcium carbonate equivalent—less than 15 percent

Bkm horizon
Cementation—moderate to strong
Laminar cap—moderately thick to thick

Anklam Series

Depth class: shallow
Drainage class: well drained
Permeability: moderately slow
Landform: hills and mountains
Parent material: slope alluvium and residuum from igneous rock
Slope range: 3 to 35 percent
Elevation: 2,200 to 3,800 feet
Classification: Loamy-skeletal, mixed, thermic, shallow Typic Haplargids

Typical Pedon

Anklam extremely gravely sandy loam in an area of Anklam-Cellar-Rock outcrop complex, 15 to 55 percent slopes, located at a latitude of 32 degrees, 12 minutes, 00 seconds N. and a longitude of 112 degrees, 09 minutes, 45 seconds W.; in the Brownell Valley.

A—0 to 2 inches; brown (7.5YR 5/4) extremely gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; few fine tubular pores; 90 percent

gravel; noneffervescent; neutral (pH 7.2); abrupt smooth boundary.
Bt—2 to 10 inches; yellowish red (5YR 4/6) extremely gravelly sandy clay loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; hard, firm, sticky, plastic; common very fine and fine roots matted around stones; few fine tubular pores; common distinct clay films on ped faces and in pores; 85 percent gravel; noneffervescent; mildly alkaline (pH 7.4); abrupt irregular boundary.
Crt—10 to 20 inches; highly fractured granite; extremely hard, extremely firm; common fine roots in cracks; common distinct clay films on rock fragments and in fractures.
R—20 inches; granite.

Range in Characteristics

Rock fragments: 35 to 90 percent
Depth to weathered bedrock: 10 to 20 inches
Depth to unweathered bedrock: 20 to 25 inches
Reaction: neutral to mildly alkaline
Organic matter: less than 1 percent

A horizon
Hue—5YR, 7.5YR
Value—5 or 6 dry, 3, 4, or 6 moist
Chroma—4 or 6, dry or moist

Bt horizon
Hue—2.5YR, 5YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—4 or 6, dry or moist
Texture—sandy clay loam, clay loam (18 to 35 percent clay)

Arizo Series

Depth class: very deep
Drainage class: excessively drained
Permeability: rapid
Landform: alluvial fans and flood plains
Parent material: mixed fan alluvium and stream alluvium
Slope range: 0 to 3 percent
Elevation: 2,000 to 3,200 feet
Classification: Sandy-skeletal, mixed, thermic Typic Torriorthents

Typical Pedon

Arizo gravelly loamy sand, in an area of Arizo-Riverwash complex, 0 to 3 percent slopes, located at a latitude of 32 degrees, 26 minutes, 35 seconds N. and a longitude of 112 degrees, 6 minutes, 20 seconds W.; sec. 30, T. 11 S., R. 3 E.

A—0 to 1 inch; yellowish brown (10YR 5/6) gravelly loamy sand, dark yellowish brown (10YR 4/4) moist; weak coarse platy structure; loose, nonsticky, nonplastic; few fine roots; few fine vesicular pores; 20 percent gravel; noneffervescent; mildly alkaline (pH 7.6); abrupt wavy boundary.
A/C—1 to 18 inches; yellowish brown (10YR 5/4) gravelly loamy sand, dark yellowish brown (10YR 4/4) moist; single grain; loose, nonsticky, nonplastic; few fine roots; common fine interstitial pores; 20 percent gravel; noneffervescent; mildly alkaline (pH 7.6); clear wavy boundary.
C1—18 to 33 inches; light yellowish brown (10YR 6/4) very gravelly loamy sand, yellowish brown (10YR 5/4) moist; single grain; loose, nonsticky, nonplastic; few fine roots; common fine interstitial pores; 35 percent gravel; slightly effervescent; mildly alkaline (pH 7.8); clear wavy boundary.
C2—33 to 52 inches; light yellowish brown (10YR 6/4) very gravelly loamy sand, yellowish brown (10YR 5/4) moist; single grain; loose, nonsticky, nonplastic; few fine roots; common fine interstitial pores; 55 percent gravel; strongly effervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.
C3—52 to 60 inches; light yellowish brown (10YR 6/4) very gravelly loamy sand, yellowish brown (10YR 5/4) moist; single grain; loose, nonsticky, nonplastic; few fine roots; common fine interstitial pores; 45 percent gravel; strongly effervescent; moderately alkaline (pH 8.0).

Range in Characteristics

Rock fragments: 35 to 65 percent gravel in the control section
Reaction: mildly to moderately alkaline
Calcium carbonate equivalent: less than 10 percent

A horizon
Hue—10YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 through 6, dry or moist

C horizon
Hue—10YR, 7.5YR
Value—5 or 6 dry, 5 or 4 moist
Chroma—3 through 5, dry or moist
Texture—loamy sand, coarse sand

Baboquivari Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: fan terraces

Parent material: mixed fan alluvium
Slope range: 1 to 8 percent
Elevation: 2,800 to 4,200 feet
Classification: Fine-loamy, mixed, thermic Ustollic Haplargids

Typical Pedon

Baboquivari gravelly coarse sandy loam in an area of Baboquivari-Combate complex, 1 to 8 percent slopes, located at a latitude of 31 degrees, 56 minutes, 30 seconds N. and a longitude of 111 degrees, 32 minutes, 55 seconds W.; about 600 feet W. and 1,200 feet N. of the SE corner of sec. 17, T. 17 S., R. 8 E.

A1—0 to 2 inches; yellowish brown (10YR 5/4) gravelly coarse sandy loam, dark yellowish brown (10YR 3/4) moist; moderate medium platy structure; slightly hard, very friable, nonsticky, nonplastic; common very fine and fine and few medium roots; common fine and medium interstitial and tubular pores; 30 percent gravel; noneffervescent; slightly acid (pH 6.3); clear smooth boundary.

A2—2 to 9 inches; brown (10YR 5/3) gravelly coarse sandy loam, dark brown (10YR 3/3) moist; weak fine and medium granular structure; soft, very friable, nonsticky, nonplastic; common fine and few medium roots; common fine and medium interstitial and tubular pores; 30 percent gravel; noneffervescent; slightly acid (pH 6.3); clear wavy boundary.

AB—9 to 14 inches; brown to dark brown (7.5YR 4/4) gravelly coarse sandy loam, dark brown (7.5YR 3/4) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky, nonplastic; common very fine and few medium roots; common fine and medium interstitial and tubular pores; 30 percent gravel; noneffervescent; slightly acid (pH 6.3); clear wavy boundary.

Bt1—14 to 40 inches; yellowish red (5YR 5/6) gravelly sandy clay loam, yellowish red (5YR 4/6) moist; moderate coarse prismatic parting to weak coarse subangular blocky structure; very hard, very friable, sticky, plastic; common fine and few medium roots; common fine and medium interstitial and tubular pores; common distinct clay films on the ped faces and on sand grains; 30 percent gravel; noneffervescent; neutral (pH 7.0); gradual smooth boundary.

Bt2—40 to 51 inches; yellowish red (5YR 5/6) gravelly coarse sandy loam, yellowish red (5YR 4/6) moist; moderate coarse prismatic structure parting to weak coarse subangular blocky; hard, very friable, sticky, plastic; common fine and medium interstitial and tubular pores; common distinct clay films on the ped faces and on sand grains; 30 percent gravel; noneffervescent; neutral (pH 7.0); clear wavy boundary.

C—51 to 60 inches; reddish yellow (7.5YR 6/6) gravelly loamy sand, strong brown (7.5YR 5/6) moist; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, very friable, slightly sticky, slightly plastic; common fine and medium interstitial and tubular pores; few distinct clay films on ped faces; 30 percent gravel; noneffervescent; neutral (pH 7.0).

Range in Characteristics

Rock fragments: 15 to 35 percent gravel
Reaction: slightly acid to mildly alkaline

A and AB horizons
Hue—10YR, 7.5YR
Value—4 or 5 dry, 2 or 3 moist
Chroma—1 through 4, dry or moist
Organic matter—1 to 3 percent

Bt horizon
Hue—5YR, 7.5YR
Value—4 through 6, dry or moist
Chroma—3 through 6, dry or moist
Texture—coarse sandy loam, sandy clay loam

C horizon
Hue—5YR, 7.5YR
Value—4 through 6, dry or moist
Chroma—3 through 6, dry or moist
Texture—loamy sand, coarse sandy loam

Bosa Series

Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderate
Landform: hills and mountains
Parent material: residuum, colluvium, and slope alluvium from andesite
Slope range: 15 to 35 percent
Elevation: 2,000 to 4,500 feet
Classification: Loamy-skeletal, mixed, thermic Lithic Haplargids

Typical Pedon

Bosa gravelly fine sandy loam in an area of Lajitas-Bosa-Rock outcrop complex, 15 to 50 percent slopes, located at a latitude of 31 degrees, 57 minutes, 15 seconds N. and a longitude of 112 degrees, 58 minutes, 00 seconds W.; about 4 miles W. of Sells in the mountains referred to as Birdnest.

A—0 to 1 inch; brown (7.5YR 5/4) gravelly fine sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, sticky, nonplastic; common very fine and fine roots; common very fine and fine interstitial pores; 20 percent gravel; noneffervescent; mildly alkaline (pH 7.6); abrupt smooth boundary.

Bt—1 to 6 inches; reddish brown (5YR 5/4) very gravelly loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure; soft, friable, sticky, plastic; common fine and medium roots; common very fine and fine interstitial and tubular pores; many distinct clay films on ped faces and on rock fragments; 5 percent cobbles and 50 percent gravel; noneffervescent; mildly alkaline (pH 7.6); clear wavy boundary.

Crt—6 to 8 inches; weathered andesite; common distinct reddish brown (5YR 5/4) clay films on rock fragments; abrupt wavy boundary.

R—8 inches; andesite.

Range in Characteristics

Rock fragments: 30 to 75 percent gravel, cobbles and/or stones

Depth to unweathered bedrock: 6 to 20 inches

Reaction: mildly to moderately alkaline

Calcium carbonate: some pedons have calcium carbonate coatings in fractures and disseminated calcium carbonate in the lower part of Bt horizon

Organic matter: less than 1 percent

A horizon
Value—4 through 6 dry
Chroma—3 or 4, dry or moist

Bt horizon
Hue—5YR, 7.5YR
Value—4 through 6 dry, 3 through 5 moist
Chroma—4 through 6 dry, 3 or 4 moist
Texture—loam, clay loam, sandy clay loam

Cr horizon
Some pedons do not have highly fractured andesite above the lithic contact. Clay films and calcium carbonate coatings are common in the fractures.

Bucklebar Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terraces
Parent material: mixed fan alluvium
Slope range: 1 to 3 percent
Elevation: 2,000 to 3,200 feet
Classification: Fine-loamy, mixed, thermic Typic Haplargids

Typical Pedon

Bucklebar sandy loam in an area of Bucklebar-Hayhook-Tubac complex, 0 to 3 percent slopes, located at a latitude of 31 degrees, 56 minutes, 15 seconds N. and a longitude of 111 degrees, 55 minutes, 50 seconds W. of Sells Livestock complex *(fig.17).*

A—0 to 3 inches; strong brown (7.5YR 4/6) sandy loam, dark brown (7.5YR 3/4) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; few fine roots; few fine vesicular, interstitial and tubular pores; noneffervescent; mildly alkaline (pH 7.4); abrupt smooth boundary.

Bt1—3 to 9 inches; strong brown (7.5YR 4/6) sandy loam, dark brown (7.5YR 3/4) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky, nonplastic; few fine roots; common fine tubular pores; few distinct clay films on ped faces, in pores, and between sand grains; noneffervescent; mildly alkaline (pH 7.6); abrupt smooth boundary.

Bt2—9 to 22 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky, plastic; few fine roots; common fine tubular pores; many distinct clay films on ped faces, in pores, and between sand grains; noneffervescent; mildly alkaline (pH 7.6); abrupt smooth boundary.

Btk1—22 to 37 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, plastic; few fine and medium roots; common very fine tubular pores; few faint clay films on ped faces, in pores, and between sand grains, and few distinct calcium carbonate coats on ped faces; violently effervescent; mildly alkaline (pH 7.8); clear smooth boundary.

Btk2—37 to 52 inches; strong brown (7.5YR 4/6) loam, dark brown (7.5YR 3/4) moist; weak medium subangular blocky structure; soft, very friable, nonsticky, nonplastic; few fine roots; few fine tubular pores; very few faint clay films in root channels and pores, and few distinct calcium carbonate coats on ped faces; common fine calcium carbonate filaments; strongly effervescent; mildly alkaline (pH 7.8); clear smooth boundary.

Btk3—52 to 60 inches; strong brown (7.5YR 4/6)

loam; dark brown (7.5YR 3/4) moist; weak fine subangular blocky structure; soft, very friable, sticky, nonplastic; few fine roots; few fine tubular pores; few faint clay films between sand grains, and calcium carbonate coats in root channels and pores; common fine calcium carbonate filaments; strongly effervescent; mildly alkaline (pH 7.8).

Range in Characteristics

Rock fragments: less than 15 percent
Reaction: neutral to moderately alkaline
Clay content: averages more than 20 percent

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist

Bt horizon
Hue—5YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Texture—sandy clay loam, loam

Btk horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Calcium carbonate equivalent—less 15 percent

Caracara Series

Depth class: moderately deep (to a hardpan)
Drainage class: well drained
Permeability: slow
Landform: relict fan terrace and hills
Parent material: fan alluvium from conglomerate
Slope range: 3 to 25 percent
Elevation: 2,000 to 3,500 feet
Classification: Clayey-skeletal, mixed, thermic Petrocalcic Paleargids

Typical Pedon

Caracara extremely gravelly sandy loam in an area of Delthorny-Caracara complex, 3 to 25 percent slopes, located at a latitude of 32 degrees, 12 minutes, and 30 seconds N. and a longitude of 112 degrees, 11 minutes, and 30 seconds W.; about 3 miles W. and N. of Quilotosa trading post *(fig. 18)*.

A—0 to 1 inch; brown to dark brown (7.5YR 4/4) extremely gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common very fine and fine interstitial and tubular pores; 65 percent gravel; slightly effervescent; mildly alkaline (pH 7.4); abrupt smooth boundary.

Bt—1 to 9 inches; reddish brown (5YR 4/4) cobbly sandy clay loam, reddish brown (5YR 4/4) moist; strong medium subangular blocky structure; slightly hard, friable, sticky, plastic; common very fine and fine roots; common very fine and fine tubular pores; many distinct reddish brown (5YR 4/4) clay films on rock fragments; 20 percent cobbles and 10 percent gravel; slightly effervescent; mildly alkaline (pH 7.8); clear wavy boundary.

Btk—9 to 19 inches; reddish brown (5YR 4/4) extremely gravelly clay, yellowish red (5YR 4/6) moist; strong fine subangular blocky structure; slightly hard, friable, very sticky, very plastic; common very fine and fine roots; common very fine and fine tubular pores; many distinct clay films and calcium carbonate coats on rock fragments; 5 percent cobbles and 65 percent gravel; strongly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

Bk—19 to 32 inches; mixed light brown (7.5YR 6/4) and white (7.5YR 8/0) very gravelly sandy clay loam, yellowish red (5YR 5/6) moist; moderate fine subangular blocky structure; slightly hard, friable, very sticky, very plastic; common fine roots; common very fine and fine interstitial and tubular pores; many distinct calcium carbonate coats on rock fragments; common fine and medium hard irregular calcium carbonate masses; 50 percent gravel; violently effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

Bkm—32 to 40 inches; indurated petrocalcic horizon; violently effervescent.

R—40 inches; conglomerate.

Range in Characteristics

Rock fragments: 40 to 75 percent gravel and/or cobbles
Depth to petrocalcic horizon: 20 to 40 inches
Depth to unweathered bedrock: 25 to 60 inches

A horizon
Hue—5YR, 7.5YR, 10YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—4 through 6 dry, 2 through 4 moist
Organic matter—less than 0.5 percent
Calcium carbonate equivalent—0 to 5 percent
Reaction—neutral to mildly alkaline

Bt horizon
Hue—2.5YR, 5YR

Value—4 or 5 dry, 3 or 4 moist
Chroma—4 through 6, dry or moist
Texture—sandy clay, clay, sandy clay loam
Calcium carbonate equivalent—5 to 15 percent
Reaction—mildly to moderately alkaline

Bk horizon
Hue—5YR or 7.5YR
Value—4 through 6 dry, 3 through 5 moist
Chroma—4 through 6 dry, 5 or 6 moist
Calcium carbonate equivalent—15 to 40 percent
Reaction—mildly to moderately alkaline

Bkm horizon
Cementation—indurated or strongly cemented with calcium carbonate
Laminar capping—thin to moderately thick

Caralampi Series

Depth class: very deep
Drainage class: well
Permeability: moderately slow
Landform: relict fan terraces
Parent material: mixed fan alluvium
Slope range: 15 to 50 percent
Elevation: 2,800 to 3,800
Classification: Loamy-skeletal, mixed, thermic Ustollic Haplargids

Typical Pedon

Caralampi very gravelly sandy loam in an area of Caralampi-Selevin-Kimrose complex, 5 to 50 percent slopes, located at a latitude of 32 degrees, 50 minutes, 20 seconds N. and a longitude of 111 degrees, 38 minutes, 58 seconds W.

A—0 to 2 inches; brown to dark brown (7.5YR 4/4) very gravelly sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky, nonplastic; common fine and medium roots; common very fine and fine interstitial pores; 45 percent gravel; noneffervescent; neutral (pH 7.2); abrupt wavy boundary.

Bt1—2 to 10 inches; dark reddish brown (5YR 3/3) extremely gravelly sandy clay loam, dark reddish brown (5YR 3/4) moist; strong medium subangular blocky structure; slightly hard, firm, very sticky, very plastic; common fine and medium roots; common fine interstitial and tubular pores; many distinct clay films on sand grains and gravel, and common clay films on ped faces; 5 percent cobbles and 75 percent gravel; noneffervescent; mildly alkaline (pH 7.2); abrupt wavy boundary.

Bt2—10 to 26 inches; reddish brown (5YR 4/4) extremely gravelly sandy clay loam, yellowish red (5YR 4/6) moist; strong fine and medium subangular blocky structure; hard, very firm, very sticky, very plastic; common very fine and fine roots in cracks; common fine interstitial and tubular pores; many distinct clay films on sand grains and gravel, and common clay films on ped faces; 65 percent gravel; noneffervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.

Bk—26 to 60 inches; reddish brown (5YR 5/4) extremely gravelly sandy clay loam, yellowish red (5YR 5/6) moist; massive; very hard, very firm, sticky, plastic; few very fine roots; many distinct clay films on sand grains and gravel, common faint clay films between sand grains, and distinct calcium carbonate coats on sand and gravel; 60 percent gravel; strongly effervescent; moderately alkaline (pH 8.4).

Range in Characteristics

Rock fragments: 35 to 75 percent gravel and/or cobbles
Reaction: neutral to moderately alkaline

A horizon
Hue—7.5YR, 10YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—2 through 4, dry or moist
Organic matter—1 to 3 percent

Bt horizon
Hue—2.5YR, 5YR
Value—3 or 4 dry or moist
Chroma—2 through 4, dry or moist

Bk horizon
Hue—5YR, 7.5YR
Value—4 or 5, dry or moist
Chroma—4 through 6, dry or moist
Calcium carbonate equivalent—6 to 10 percent

Casa Grande Series

Depth class: very deep
Drainage class: well drained
Permeability: slow
Landform: basin floor
Parent material: mixed fan alluvium and stream alluvium
Slope range: 0 to 2 percent
Elevation: 1,400 to 2,000 feet

Classification: Fine-loamy, mixed, hyperthermic Typic Natrargids

Typical Pedon

Casa Grande fine sandy loam in an area of Casa Grande-Rositas-Valencia complex, 0 to 5 percent slope, located at a latitude of 31 degrees, 54 minutes, 30 seconds N. and a longitude of 112 degrees, 11 minutes, 00 seconds W.

AC—0 to 4 inches; light brown (7.5YR 6/4) fine sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; loose, nonsticky, nonplastic; common very fine and fine roots; common very fine and fine interstitial pores; noneffervescent; mildly alkaline (pH 7.6); abrupt smooth boundary.

Btn—4 to 10 inches; yellowish red (5YR 5/6) sandy loam, reddish brown (5YR 4/4) moist; weak fine columnar parting to weak fine subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; common very fine and fine roots; common fine interstitial pores; noneffervescent; strongly alkaline (pH 8.6); abrupt smooth boundary.

Btknz—10 to 24 inches; yellowish red (5YR 4/6) sandy clay loam, reddish brown (5YR 4/4) moist; moderate fine columnar parting to moderate medium subangular blocky structure; slightly hard, firm, sticky, plastic; common very fine and fine roots; common fine tubular and very fine and fine interstitial pores; few distinct clay films on ped faces and in pores; common fine calcium carbonate filaments and common fine plate-like halite crystals; strongly effervescent; strongly alkaline (pH 8.8); abrupt smooth boundary.

2Btknz1—24 to 36 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; hard, firm, sticky, plastic; common fine roots; common fine tubular pores; few distinct clay films on ped faces and in pores; common medium rounded salt masses; common fine calcium carbonate filaments; violently effervescent; strongly alkaline (pH 8.8); abrupt smooth boundary.

2Btknz2—36 to 45 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; hard, firm, slightly sticky, slightly plastic; common fine tubular, and very fine and fine interstitial pores; few distinct clay films on ped faces and in pores; common medium rounded salt masses, and few fine calcium carbonate filaments; strongly effervescent; strongly alkaline (pH 8.8); abrupt smooth boundary.

2Btknz3—45 to 60 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, very firm, sticky, plastic; common fine tubular, and very fine and fine interstitial pores; common distinct clay films on ped faces; common medium calcium carbonate filaments; common medium soft irregular calcium carbonate masses; strongly effervescent; strongly alkaline (pH 8.6).

Range in Characteristics

Depth to natric horizon: 4 to 18 inches
Depth to calcic horizon: 20 to 40 inches
Reaction: mildly to very strongly alkaline
Salinity: very slight to moderate
Sodicity: moderate to strong
SAR: 13 to 100
EC: 4 to 16 mmho/cm but dominantly 8 to 16

A horizon
- Hue—7.5YR, 10YR
- Value—5 through 7 dry, 3 or 4 moist
- Chroma—3 or 5, dry or moist
- Texture—fine sandy loam, loam

Btn and Btknz horizons
- Hue—5YR, 7.5YR
- Value—4 through 6 dry, 3 through 5 moist
- Chroma—4 through 7, dry or moist
- Texture—loam, sandy clay loam, clay loam, (18 to 35 percent clay)

2Btknz horizon
- Hue—5YR through 10YR
- Value—5 through 8 dry, 4 through 6 moist
- Chroma—3 through 8, dry or moist
- Texture—sandy loam, sandy clay loam, loam, clay loam
- Calcium carbonate equivalent—15 to 25 percent

Salt crystals are apparent in most pedons.

Cellar Series

Depth class: very shallow and shallow
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Landform: hills and mountains
Parent material: slope alluvium from igneous and metamorphic rocks
Slope range: 15 to 60 percent

Elevation: 2,200 to 5,000 feet
Classification: Loamy-skeletal, mixed, nonacid, thermic Lithic Torriorthents

Typical Pedon

Cellar very gravelly sandy loam in an area of Anklam-Cellar-Rock outcrop complex, 15 to 55 percent slopes, located at a latitude of 32 degrees, 13 minutes, 30 seconds N. and a longitude of 112 degrees, 14 minutes, 00 seconds W.

A—0 to 1 inch; yellowish brown (10YR 5/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; common fine roots; common fine tubular pores; 45 percent gravel; noneffervescent; neutral (pH 7.2); abrupt smooth boundary.
C—1 to 12 inches; yellowish brown (10YR 5/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky, nonplastic; common fine roots; common fine tubular pores; 55 percent gravel; noneffervescent; mildly alkaline (pH 7.4); abrupt smooth boundary.
R—12 inches; granite.

Range in Characteristics

Rock fragments: 35 to 60 percent gravel; some pedons contain mostly cobbles and/or stones
Depth to unweathered bedrock: 4 to 20 inches
Reaction: neutral to mildly alkaline
Organic matter: less than 1 percent

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 3 through 5 moist
Chroma—3 through 5 dry, 3 or 4 moist

C horizon
Hue—7.5YR, 10YR
Value—4 through 6 dry, 3 through 5 moist
Chroma—3 through 5 dry, 3 or 4 moist

Chiricahua Series

Depth class: shallow
Drainage class: well drained
Permeability: slow
Landform: hills
Parent material: residuum and slope alluvium from granite
Slope range: 15 to 45 percent
Elevation: 3,200 to 4,200 feet
Classification: Clayey, mixed, thermic, shallow Ustollic Haplargids

Typical Pedon

Chiricahua very cobbly loam in an area of Chiricahua-Lampshire complex, 15 to 45 percent slopes, located at a latitude of 31 degrees, 55 minutes, 22 seconds N. and a longitude of 111 degrees, 40 minutes, 15 seconds W.

A—0 to 3 inches; reddish brown (5YR 4/3) very cobbly loam, dark reddish brown (5YR 3/3) moist; moderate fine granular structure; soft, very friable, slightly sticky, slightly plastic; common very fine and fine roots; many fine interstitial and tubular pores; few distinct clay films between sand grains; 50 percent cobbles; noneffervescent; neutral (pH 6.8); abrupt smooth boundary.
Bt1—3 to 6 inches; dark reddish brown (5YR 3/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; soft, very friable, sticky, plastic; common very fine and fine roots; common fine tubular pores; many distinct clay films on ped faces and in pores, and common organic coats on sand grains and gravel; 5 percent gravel; noneffervescent; neutral (pH 6.8); abrupt smooth boundary.
Bt2—6 to 12 inches; reddish brown (5YR 4/3) clay, 50 percent dark reddish brown (2.5YR 3/4), and 50 percent dark red (2.5YR 3/6) moist; moderate medium angular blocky structure; slightly hard, firm, sticky, plastic; common very fine roots; few fine tubular pores; many distinct clay films on ped faces and in pores, and common organic coats on ped faces; 5 percent gravel; noneffervescent; neutral (pH 6.8); abrupt smooth boundary.
Bt3—12 to 16 inches; dark reddish brown (5YR 3/3) gravelly clay, reddish brown (5YR 5/4), and dark reddish brown (5YR 3/4) moist; moderate medium angular blocky structure; slightly hard, firm, sticky, very plastic; few very fine and fine roots; few fine tubular pores; many distinct clay films on ped faces, in pores, and on rock fragments, and few prominent organic coats on ped faces; 16 percent gravel; noneffervescent; neutral (pH 7.0); abrupt wavy boundary.
Bt4—16 to 19 inches; red (2.5YR 4/6) gravelly clay, dark red (2.5YR 3/6) moist; strong medium subangular blocky structure; hard, firm, sticky, very plastic; few very fine and fine roots; few fine tubular pores; many distinct clay films on ped faces, in pores, and on rock fragments, and few distinct organic coats on ped faces; 30 percent gravel; noneffervescent; neutral (pH 7.0); abrupt wavy boundary.

Crt—19 to 25 inches; weathered granite; many distinct dark red (2.5YR 3/6) clay films on rock fragments and very few iron-manganese stains on rocks.
R—25 inches; granite.

Range in Characteristics

Rock fragments: 5 to 35 percent in the control section
Depth to weathered bedrock: 10 to 20 inches
Depth to unweathered bedrock: 20 to 30 inches
Reaction: slightly acid to mildly alkaline
Organic matter: 1 to 2 percent

A horizon
Hue—5YR, 7.5YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—2 through 6, dry or moist

Bt horizon
Hue—2.5YR, 5YR, 7.5YR
Value—3 or 5, dry or moist
Chroma—2 through 8, dry or moist
Texture—clay, sandy clay, clay loam

Chuichu Series

Depth class: shallow
Drainage class: well drained
Permeability: moderately slow
Landform: hills
Parent material: residuum and slope alluvium from schist
Slope range: 15 to 45 percent
Elevation: 1,400 to 2,600 feet
Classification: Loamy-skeletal, mixed, hyperthermic, shallow Typic Haplargids

Typical Pedon

Chuichu very channery sandy loam in an area of Chuichu-Rock outcrop complex, 15 to 45 percent slopes, located at a latitude of 32 degrees, 39 minutes, 28 seconds N. and a longitude of 111 degrees, 55 minutes, 20 seconds W.; E. end of Tat Momolikot Dam, N. side of hill, just N. of road, (E. of catfish ponds).

A—0 to 2 inches; brown (7.5YR 5/4) very channery sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; few fine roots; 45 percent channers; noneffervescent; neutral (pH 6.8); abrupt smooth boundary.
Bt1—2 to 6 inches; yellowish red (5YR 5/6) very channery loam, reddish brown (5YR 4/4) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; few distinct yellowish red (5YR 5/6) clay films on ped faces and on rock fragments; 45 percent channers; noneffervescent; neutral (pH 7.0); clear wavy boundary.
Bt2—6 to 19 inches; yellowish red (5YR 5/6) very channery loam, reddish brown (5YR 4/4) moist; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; common distinct reddish brown (5YR 4/4) clay films on ped faces and on rock fragments; 10 percent flagstones and 40 percent channers; noneffervescent; neutral (pH 7.0); clear wavy boundary.
Crtk—19 to 25 inches; weathered schist; common distinct clay films in fractures; few distinct calcium carbonate coats in fractures; slightly effervescent.
R—25 inches; schist.

Range in Characteristics

Rock fragments: 35 to 90 percent channers or flagstones
Depth to weathered bedrock: 15 to 20 inches
Depth to unweathered bedrock: 20 to 45 inches
Reaction: neutral to mildly alkaline
Calcium carbonate: present in lower horizons and on the bedrock
Organic matter: less than 1 percent

A horizon
Hue—5YR, 7.5YR
Chroma—4 through 6, dry or moist

Bt horizon
Hue—5YR, 7.5YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—4 through 6 dry, 4 through 8 moist
Texture—sandy clay loam, loam, clay loam

Chutum Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terraces and stream terraces
Parent material: mixed stream alluvium and fan alluvium
Slope range: 1 to 3 percent

Elevation: 2,200 to 3,000 feet
Classification: Fine-loamy, mixed, thermic Typic Calciorthids

Typical Pedon

Chutum loam, 1 to 3 percent slopes, located at a latitude of 32 degrees, 27 minutes, 00 seconds N. and a longitude of 112 degrees, 16 minutes, 00 seconds W.

A—0 to 2 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; moderate medium platy structure; soft, very friable, nonsticky, nonplastic; common fine roots; common very fine and fine vesicular pores; 2 percent gravel; strongly effervescent; moderately alkaline (pH 7.9); abrupt wavy boundary.

Bk1—2 to 11 inches; brown (7.5YR 5/4) clay loam, brown to dark brown (7.5YR 4/4) moist; weak medium platy parting to weak medium subangular blocky structure; hard, friable, slightly sticky, plastic; common fine and few medium roots; few very fine and fine vesicular pores; common fine and medium calcium carbonate filaments; violently effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

Bk2—11 to 26 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; hard, friable, sticky, plastic; few fine roots; common fine and medium calcium carbonate filaments; common fine and medium soft rounded calcium carbonate masses; violently effervescent; moderately alkaline (pH 8.0); gradual wavy boundary.

Bk3—26 to 54 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; very hard, friable, sticky, plastic; few fine roots; common fine vesicular pores; common fine and medium calcium carbonate filaments; common fine and medium soft rounded calcium carbonate masses; violently effervescent; moderately alkaline (pH 8.0); gradual wavy boundary.

Bk4—54 to 60 inches; brown (7.5YR 5/4) and pinkish white (7.5YR 8/2) clay loam, light brown (7.5YR 6/4) and reddish yellow (7.5YR 8/6) moist; massive; very hard, friable, sticky, plastic; common very fine interstitial and tubular pores; common fine and medium calcium carbonate filaments; common fine and medium soft rounded calcium carbonate masses; violently effervescent; moderately alkaline (pH 8.2).

Range in Characteristics

Depth to calcic horizon: 2 to 20 inches
Reaction: mildly to strongly alkaline
Salinity: none to very slight
Sodicity: none to slight

A horizon
Hue—10YR, 7.5YR
Value—5 through 7 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Organic matter—less than 1 percent

B horizon
Hue—5YR, 7.5YR
Value—5 through 7 dry, 4 or 5 moist
Texture—clay loam, sandy loam, sandy clay loam, loam
Calcium carbonate equivalent—greater than 15 percent; some pedons are weakly cemented

Combate Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Landform: alluvial fans
Parent material: mixed fan alluvium
Slope range: 1 to 8 percent
Elevation: 2,800 to 4,200 feet
Classification: Coarse-loamy, mixed, nonacid, thermic Ustic Torrifluvents

Typical Pedon

Combate gravelly loamy coarse sand in an area of Baboquivari-Combate complex, 1 to 8 percent slopes, located at a latitude of 31 degrees, 57 minutes, 40 seconds N. and a longitude of 111 degrees, 33 minutes, 34 seconds W.; about 1,700 feet E. and 1,800 feet S. of the NW corner of sec. 8, T. 17 S., R. 8 E.

A1—0 to 1 inch; brown (10YR 5/3) gravelly loamy coarse sand, dark brown (10YR 3/3) moist; weak very fine and fine granular structure; slightly hard, very friable, nonsticky, nonplastic; many very fine and fine and few medium roots; 30 percent gravel; noneffervescent; neutral (pH 6.6); clear smooth boundary.

A2—1 to 15 inches; dark grayish brown (10YR 4/2) gravelly loamy coarse sand, very dark brown (10YR 2/2) moist; weak very fine and fine granular structure; soft, very friable, nonsticky, nonplastic; many very fine and fine and few medium roots; 25 percent gravel; noneffervescent; neutral (pH 6.8); gradual wavy boundary.

C1—15 to 29 inches; brown to dark brown (10YR 4/3) gravelly coarse sandy loam, very dark brown

(10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky, nonplastic; many very fine and fine and few medium roots; 30 percent gravel; noneffervescent; slightly acid (pH 6.5); gradual wavy boundary.

C2—29 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sandy loam, dark yellowish brown (10YR 3/4) moist; massive; soft, very friable, nonsticky, nonplastic; many very fine and fine and few medium roots; 35 percent gravel; noneffervescent; neutral (pH 6.9).

Range in Characteristics

Rock fragments: less than 35 percent, up to 50 percent in any one subhorizon
Reaction: slightly acid to mildly alkaline
Organic matter: 1 to 3 percent

A horizon
Hue—10YR, 7.5YR
Value—3 through 5 dry, 2 through 4 moist
Chroma—2 through 4, dry or moist

C horizon
Hue—10YR, 7.5YR
Value—3 through 5 dry, 2 through 4 moist
Chroma—2 through 4, dry or moist
Texture—sandy loam, coarse sandy loam, loamy sand (less than 18 percent clay)

Some pedons have a buried paleosol in the lower substratum.

Dateland Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: fan terrace
Parent material: mixed fan alluvium
Slope range: 1 to 2 percent
Elevation: 1,400 to 2,200 feet
Classification: Coarse-loamy, mixed, hyperthermic Typic Camborthids

Typical Pedon

Dateland fine sandy loam, in an area of Dateland-Denure association, 1 to 3 percent slopes, located at a latitude of 32 degrees, 26 minutes, 36 seconds N. and a longitude of 112 degrees, 01 minutes, 24 seconds W.; about 1,350 feet E. and 1,150 feet S. of the NW corner of sec. 25, T. 11 S., R. 3 E.

A—0 to 2 inches; yellowish brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; soft, friable, nonsticky, nonplastic; few fine roots; common fine interstitial, and few fine tubular pores; noneffervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bk1—2 to 7 inches; light yellowish brown (10YR 6/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; soft, friable, slightly sticky, nonplastic; few fine roots; common fine interstitial, and few fine tubular pores; common distinct calcium carbonate coats on lower surfaces of ped faces; slightly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Bk2—7 to 15 inches; light yellowish brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common fine roots; few fine tubular pores; common distinct calcium carbonate coats in root channels and pores; strongly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Bk3—15 to 30 inches; light brown (7.5YR 6/4) loam, brown to dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common fine roots; few fine tubular pores; common distinct calcium carbonate coats in root channels and pores; violently effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Bk4—30 to 52 inches; light brown (7.5YR 6/4) silt loam, brown to dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; few fine tubular pores; common distinct calcium carbonate coats in root channels and pores; violently effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

2Btkb—52 to 60 inches; brown (7.5YR 5/4) loam, strong brown (7.5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable, sticky, plastic; few fine roots; few fine tubular pores; common distinct calcium carbonate coats in root channels and pores, common faint clay films between sand grains, on ped faces, and in pores; violently effervescent; moderately alkaline (pH 8.2).

Range in Characteristics

Rock fragments: less than 35 percent
Reaction: mildly to moderately alkaline
Calcium carbonate equivalent: less than 5 percent

Salinity: none to very slight

A horizon
Hue—7.5YR, 10YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—3 or 4, dry or moist
Organic matter—less than 1 percent

Bk horizon
Hue—7.5YR, 10YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—4 or 6, dry or moist
Texture—loam, silt loam, fine sandy loam

Delnorte Series

Depth class: shallow (to a hardpan)
Drainage class: well drained
Permeability: moderately rapid
Landform: fan terrace
Parent material: mixed fan alluvium
Slope range: 1 to 10 percent
Elevation: 2,000 to 3,000 feet
Classification: Loamy-skeletal, mixed, thermic, shallow Typic Paleorthids

Typical Pedon

Delnorte very gravelly loam, in an area of Delnorte-Stagecoach complex, 1 to 20 percent slopes, located at a latitude of 32 degrees, 38 minutes, 18 seconds N. and a longitude of 112 degrees, 09 minutes, 20 seconds W.; about 1,100 feet W. and 800 feet N. of the SE corner of sec. 16, T. 9 S., R. 2 E.

A—0 to 1 inch; light brown (7.5YR 6/4) very gravelly loam, brown to dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable, nonsticky, nonplastic; few very fine roots; few very fine vesicular pores; 45 percent gravel; strongly effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk—1 to 11 inches; light brown (7.5YR 6/4) very gravelly loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; few very fine roots; few very fine tubular pores; common fine soft rounded calcium carbonate masses; 35 percent gravel; violently effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.

2Bkm—11 inches; extremely hard, indurated petrocalcic horizon; violently effervescent. Under the petrocalcic horizon is unconsolidated alluvium.

Range in Characteristics

Rock fragments: 35 to 75 percent gravel
Depth to petrocalcic horizon: 10 to 20 inches
Depth to unweathered bedrock: greater than 60 inches
Reaction: mildly to moderately alkaline
Calcium carbonate equivalent: greater than 15 percent

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 3 through 5 moist
Chroma—3 or 4, dry or moist

Bk horizon
Hue—7.5YR, 10YR
Value—5 through 7 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Texture—sandy loam, loam

Bkm horizon
Cementation—indurated or strongly cemented with calcium carbonate
Laminar capping—thin to moderately thick
Some pedons have hardpans that are composed of individual layers.

Delthorny Series

Depth class: very shallow and shallow (to a hardpan)
Drainage class: well drained
Permeability: moderately rapid
Landform: relict fan terrace and hills
Parent material: colluvium and slope alluvium from basalt and conglomerate
Slope range: 3 to 45 percent
Elevation: 2,000 to 4,000 feet
Classification: Loamy-skeletal, mixed, thermic, shallow Typic Paleorthids

Typical Pedon

Delthorny very gravelly sandy loam in an area of Delthorny-Caracara complex, 3 to 25 percent slopes, located at a latitude of 32 degrees, 12 minutes, 30 seconds N. and a longitude of 112 degrees, 11 minutes, 30 seconds W.; 3 miles W. and N. of the Quilotosa Trading Post.

A—0 to 2 inches; brown (7.5YR 5/4) very gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, slightly sticky, slightly plastic; common fine roots; common fine tubular pores; common

distinct calcium carbonate coats on rock fragments; 55 percent gravel; strongly effervescent; mildly alkaline (pH 7.8); abrupt smooth boundary.

Bk—2 to 9 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; massive; soft, very friable, slightly sticky, slightly plastic; common very fine roots; common fine tubular pores; many distinct calcium carbonate coats on rock fragments; 55 percent gravel; violently effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

2Bkm—9 to 16 inches; white (10YR 8/2); extremely hard, indurated petrocalcic horizon; violently effervescent.

3R—16 inches; conglomerate.

Range in Characteristics

Rock fragments: 35 to 70 percent
Depth to petrocalcic horizon: 6 to 20 inches
Depth to unweathered bedrock: 10 to 35 inches
Reaction: mildly to moderately alkaline

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—2 through 4, dry or moist
Texture—fine sandy loam, sandy loam
Calcium carbonate equivalent—0 to 10 percent
Organic matter—less than 0.5 percent

Bk horizon
Hue—7.5YR, 10YR
Value—5 through 8 dry, 4 through 7 moist
Chroma—2 through 4, dry or moist
Texture—fine sandy loam, sandy loam, loam
Calcium carbonate equivalent—5 to 20 percent

Bkm horizon:
Cementation—indurated or strongly cemented with calcium carbonate
Laminar capping—moderately thick to thick

Denure Series

Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Landform: fan terrace
Parent material: mixed fan alluvium
Slope range: 1 to 3 percent
Elevation: 1,400 to 2,200 feet
Classification: Coarse-loamy, mixed, hyperthermic Typic Camborthids

Typical Pedon

Denure gravelly sandy loam, in an area of Dateland-Denure association, 1 to 3 percent slopes, located at a latitude of 32 degrees, 22 minutes, 45 seconds N. and a longitude of 111 degrees, 37 minutes, 58 seconds W.; about 3/4 miles N. of Kakohi Hill on Powerline Road.

A—0 to 2 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; weak thick platy structure; soft, very friable, nonsticky, nonplastic; few fine roots; 20 percent gravel; noneffervescent; neutral (pH 7.2); abrupt smooth boundary.

Bw1—2 to 11 inches; light yellowish brown (10YR 6/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; few fine roots; strongly effervescent; mildly alkaline (pH 7.6); clear wavy boundary.

Bw2—11 to 23 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, yellowish brown (10YR 5/4) moist; weak medium subangular blocky structure; soft, very friable, sticky, nonplastic; few fine roots; 20 percent gravel; strongly effervescent; mildly alkaline (pH 7.6); gradual wavy boundary.

Bw3—23 to 35 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; few medium roots; strongly effervescent; mildly alkaline (pH 7.6); gradual wavy boundary.

Bw4—35 to 60 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; strongly effervescent; mildly alkaline (pH 7.6).

Range in Characteristics

Rock fragments: 5 to 35 percent
Reaction: neutral to moderately alkaline
Calcium carbonate equivalent: less than 5 percent
Salinity: none to very slight
Sodicity: none to slight

A horizon
Hue—7.5YR, 10YR
Value—5 through 7 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Organic matter—less than 1 percent
Texture—sandy loam, fine sandy loam

Bw horizon
Hue—7.5YR, 10YR
Value—4 through 6 dry, 4 or 5 moist
Chroma—3 through 6, dry or moist
Texture—sandy loam, fine sandy loam

Dixaleta Series

Depth class: very shallow
Drainage class: well drained
Permeability: moderately rapid
Landform: hills and mountains
Parent material: slope alluvium and colluvium from schist
Slope range: 15 to 70 percent
Elevation: 2,000 to 3,800 feet
Classification: Loamy-skeletal, mixed (calcareous), thermic, shallow Typic Torriorthents

Typical Pedon

Dixaleta very channery sandy loam in an area of Dixaleta-Rock outcrop complex, 15 to 70 percent slopes, located at a latitude of 32 degrees, 20 minutes, 26 seconds N. and a longitude of 112 degrees, 04 minutes, 10 seconds W.

A—0 to 1 inch; light brown (7.5YR 6/4) very channery sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; common very fine roots; few fine tubular pores; 10 percent flagstones and 45 percent channers; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Bw—1 to 8 inches; light brown (7.5YR 6/4) very channery sandy loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, nonsticky, nonplastic; common fine roots; common fine tubular pores; 5 percent flagstones and 45 percent channers; slightly effervescent; mildly alkaline (pH 7.8); clear wavy boundary.

Crk—8 to 21 inches; partially weathered schist; few fine roots matted in fractures; many distinct calcium carbonate coats on rock fragments; strongly effervescent.

R—21 inches; schist.

Range in Characteristics

Rock fragments: 40 to 80 percent channers and 0 to 20 percent flagstones
Depth to weathered bedrock: 5 to 10 inches
Depth to unweathered bedrock: 20 to 30 inches
Reaction: mildly to moderately alkaline

A horizon
Hue—7.5YR, 10YR
Value—4 through 6 dry
Chroma—4 or 6 dry
Organic matter—less than 1 percent

B horizon
Hue—7.5YR, 10YR
Value—4 through 6 dry
Chroma—4 or 6 dry
Calcium carbonate equivalent—3 to 10 percent

Far Series

Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderately rapid
Landform: mountains
Parent material: slope alluvium and colluvium from granite and gneiss
Slope range: 35 to 85 percent slopes
Elevation: 5,300 to 7,500 feet
Classification: Loamy-skeletal, mixed, mesic Lithic Haplustolls

Typical Pedon

Far very gravelly sandy loam in an area of Far-Spudrock-Rock outcrop complex, 35 to 85 percent slopes, located at a latitude of 31 degrees, 47 minutes, 55 seconds N. and a longitude of 111 degrees, 35 minutes, 20 seconds W.

Oi—2 to 0 inches; undecomposed organic matter; oak and pine litter; abrupt wavy boundary.

A—0 to 8 inches; brown to dark brown (10YR 4/3) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky, nonplastic; common fine and medium roots; common very fine and fine interstitial and tubular pores; 45 percent gravel; noneffervescent; slightly acid (pH 6.4); abrupt wavy boundary.

C—8 to 16 inches; brown to dark brown (10YR 4/3) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky, nonplastic; common fine and medium and many coarse roots; common very fine and fine tubular pores; 50 percent gravel;

noneffervescent; slightly acid (pH 6.4); abrupt wavy boundary.
R—16 inches; granite.

Range in Characteristics

Rock fragments: 35 to 70 percent gravel, cobbles and/or stones
Reaction: slightly acid to neutral
Depth to unweathered bedrock: 5 to 20 inches

A horizon
Hue—7.5YR, 10YR
Value—3 through 5 dry, 2 or 3 moist
Chroma—2 or 3, dry or moist
Organic matter—2 to 4 percent

C horizon
Hue—10YR, 7.5YR
Value—3 through 5 dry, 2 or 3 moist
Chroma—2 or 3, dry or moist

Gachado Series

Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderate
Landform: hills
Parent material: slope alluvium and residuum from rhyolite and andesite
Slope range: 15 to 45 percent
Elevation: 1,400 to 2,600 feet
Classification: Loamy-skeletal, mixed, hyperthermic Lithic Haplargids

Typical Pedon

Gachado extremely gravelly sandy loam in an area of Gachado-Lomitas-Rock outcrop complex, 15 to 45 percent slopes, located at a latitude of 32 degrees, 41 minutes, 16 seconds N. and a longitude of 112 degrees, 02 minutes, 15 seconds W.; about 1,500 feet W. and 2,400 feet N. of the SE corner of sec. 34, T. 8 S., R. 3 E.

A—0 to 2 inches; brown (7.5YR 5/4) extremely gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, sticky, nonplastic; few very fine and fine roots; common very fine and fine interstitial and tubular pores; 80 percent gravel; noneffervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.
Bt—2 to 8 inches; strong brown (7.5YR 4/6) very gravelly loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, friable, sticky, slightly plastic; common very fine and fine roots; few fine tubular pores; common distinct clay films on rock fragments; 50 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.
Btk—8 to 18 inches; brown (7.5YR 5/4) extremely gravelly loam, brown to dark brown (7.5YR 4/4) moist; massive; soft, friable, sticky, slightly plastic; few fine roots; few fine interstitial and tubular pores; common distinct clay films on rock fragments; many distinct calcium carbonate coats on the rock fragments; 80 percent gravel; violently effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.
R—18 inches; rhyolite with 0.5-inch laminar cap of calcium carbonate.

Range in Characteristics

Rock fragments: average more than 35 percent in the control section
Depth to unweathered bedrock: 7 to 20 inches
Reaction: mildly to moderately alkaline
Calcium carbonate: occurs as filaments, coats on rock fragments, or as a thin, weakly cemented layer immediately above the bedrock

A horizon
Value—5 through 7 dry, 3 through 5 moist
Chroma—4 through 6, dry or moist

B horizon
Hue—7.5YR, 5YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—4 through 6 dry
Texture—clay loam, sandy clay loam, loam

Gadsden Series

Depth class: very deep
Drainage class: well drained
Permeability: slow
Landform: flood plains
Parent material: mixed alluvium
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,100 feet
Classification: Fine, montmorillonitic (calcareous), hyperthermic, Vertic Torrifluvents

Typical Pedon

Gadsden silty clay loam, 0 to 1 percent slopes, located at a latitude of 32 degrees, 37 minutes, 10

seconds N., and a longitude of 112 degrees, 11 minutes, 5 seconds W.; about 1,500 feet W. and 1,100 N. of SE corner of sec. 30, T. 9 S., R. 2 E.; 1.25 miles NW of Pipeline Road and Vekol Mine Road.

C1—0 to 4 inches; light brown (7.5YR 6/4) silty clay loam, dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, friable, sticky, plastic; few very fine roots; few very fine tubular pores; strongly effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

C2—4 to 20 inches; dark brown (7.5YR 4/4) silty clay, dark brown (7.5YR 3/4) moist; massive; hard, very firm, sticky, plastic; few very fine roots; few very fine tubular pores; strongly effervescent; moderately alkaline (pH 8.0); gradual smooth boundary.

Ck1—20 to 38 inches; dark brown (7.5YR 4/4) silty clay, dark brown (7.5YR 4/4) moist; massive; hard, very firm, sticky, plastic; few very fine roots; few very fine tubular pores; few fine calcium carbonate filaments; strongly effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

Ck2—38 to 60 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; massive; hard, firm, sticky, plastic; few very fine roots; few medium tubular pores; common fine soft rounded calcium carbonate masses; violently effervescent; moderately alkaline (pH 8.4).

Range in Characteristics

Soil cracks: when dry, cracks 0.5 inch or more wide to a depth of 20 inches.
Calcium carbonate equivalent: less than 10 percent
Organic matter: less than 1 percent
Salinity: none to very slight

C horizon
Hue—7.5YR, 10YR
Value—4 or 6 dry, 3 through 5 moist
Texture—silty clay, clay loam, silty clay loam

Garzona Series

Depth class: shallow
Drainage class: somewhat excessively drained
Permeability: moderate
Landform: hills and mountains
Parent material: slope alluvium and colluvium from basalt
Slope range: 20 to 60 percent
Elevation: 2,800 to 4,000 feet
Classification: Loamy-skeletal, mixed, thermic Lithic Camborthids

Typical Pedon

Garzona extremely stony fine sandy loam in an area of Delthorny-Garzona-Rock outcrop complex, 15 to 60 percent slopes, located at a latitude of 32 degrees, 09 minutes, 50 seconds N. and a longitude of 112 degrees, 16 minutes, 50 seconds W.; basalt hills 1 mile S. of 86 on old Pisimino Road.

A—0 to 2 inches; light brown (7.5YR 6/4) extremely stony fine sandy loam, brown (7.5YR 5/4) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common very fine and fine vesicular pores; 45 percent stones, 35 percent cobbles, and 25 percent gravel; noneffervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.

Bt—2 to 8 inches; brown (7.5YR 5/4) very gravelly loam, brown to dark brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky, slightly plastic; common very fine and fine and few medium roots; common fine tubular pores; few faint clay films on rock fragments; 50 percent gravel; noneffervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.

Btk—8 to 12 inches; brown (7.5YR 5/4) very gravelly clay loam, brown to dark brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky, slightly plastic; common very fine and fine roots; common very fine and fine tubular pores; few faint clay films on rock fragments; many distinct calcium carbonate coats on rock fragments; common fine calcium carbonate filaments; 55 percent gravel; strongly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

R—12 inches; basalt.

Range in Characteristics

Rock fragments: 35 to 85 percent gravel, cobbles and/or stones
Depth to unweathered bedrock: 10 to 20 inches
Reaction: mildly to moderately alkaline
Calcium carbonate: coats on rock fragments and filaments in the lower part

A horizon
Hue—7.5YR, 10YR
Value—4 through 6, dry or moist
Chroma—3 or 4, dry or moist

B horizon
Hue—7.5YR, 10YR
Texture—loam, clay loam

Gilman Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: flood plains and alluvial fans
Parent material: mixed stream alluvium
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,000 feet
Classification: Coarse-loamy, mixed (calcareous), hyperthermic Typic Torrifluvents

Typical Pedon

Gilman very fine sandy loam, 0 to 1 percent slopes, located at a latitude of 32 degrees, 43 minutes, 08 seconds N. and a longitude of 111 degrees, 45 minutes, 10 seconds W.; about 20 feet E. and 1,300 feet N. of the SW corner of sec. 17, T. 8 S., R. 6 E.

C1—0 to 1 inch; pale brown (10YR 6/3) very fine sandy loam, brown (10YR 5/3) moist; granular structure; slightly hard, very friable, slightly sticky, slightly plastic; few fine tubular pores; slightly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

C2—1 to 9 inches; yellowish brown (10YR 5/4) silt loam, brown to dark brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; few fine roots; few fine tubular pores; slightly effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.

C3—9 to 16 inches; brown (10YR 5/3) very fine sandy loam, brown to dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky, nonplastic; few fine roots; few fine interstitial pores; slightly effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.

C4—16 to 29 inches; yellowish brown (10YR 5/4) silt loam, brown to dark brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; few fine roots; few fine tubular pores; slightly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

C5—29 to 35 inches; yellowish brown (10YR 5/4) very fine sandy loam, brown to dark brown (10YR 4/3) moist; massive; slightly hard, very friable, nonsticky, nonplastic; few fine roots; few fine tubular pores; slightly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

C6—35 to 60 inches; yellowish brown (10YR 5/4) silt loam, brown to dark brown (10YR 4/3) moist; massive; soft, loose, slightly sticky, slightly plastic; few fine roots; common fine interstitial pores; moderately alkaline (pH 8.2).

Range in Characteristics

Organic matter: less than 1 percent and decreases irregularly with depth
Salinity: none to slight

C horizon
Hue—7.5YR, 10YR
Value—4 through 7 dry, 3 through 6 moist
Chroma—2 through 4, dry or moist
Texture—very fine sandy loam, silt loam. Some pedons have clay loam texture below a depth of 40 inches.

These soils have thin strata of finer or coarser textured material in the profile.

Ginland Series

Depth class: very deep
Drainage class: well drained
Permeability: slow
Landform: flood plains
Parent material: mixed stream alluvium
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,000 feet
Classification: Clayey over loamy, montmorillonitic (calcareous), hyperthermic Vertic Torrifluvents

Typical Pedon

Ginland silty clay, 0 to 1 percent slopes, located at a latitude of 32 degrees, 47 minutes, 05 seconds N. and a longitude of 111 degrees, 49 minutes, 30 seconds W.; about 2,600 feet N. and 280 feet E. of SW corner of sec. 27, T. 7 S., R. 5 E.

C1—0 to 3 inches; pale brown (10YR 6/3) silty clay, brown to dark brown (10YR 4/3) moist; massive; slightly hard, friable, sticky, plastic; few very fine roots; few very fine tubular pores; very fine stratifications with disseminated calcium carbonate; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

C2—3 to 7 inches; grayish brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable, sticky, plastic; few medium roots; common medium tubular pores; disseminated calcium carbonate; mixing of surface material due to cracks; slightly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

C3—7 to 31 inches; yellowish brown (10YR 5/4) silty clay, brown to dark brown (10YR 4/3) moist; massive; very hard, friable, sticky, plastic; few medium roots; few fine tubular pores; disseminated calcium carbonate; strongly

effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

2Btkb1—31 to 35 inches; brown (7.5YR 5/4) sandy clay loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; hard, friable, sticky, plastic; few medium roots; common fine tubular pores; few faint clay films on ped faces; few fine calcium carbonate filaments; strongly effervescent; mildly alkaline (pH 7.8); clear smooth boundary.

2Btkb2—35 to 40 inches; light brown (7.5YR 6/4) sandy clay loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; hard, friable, sticky, plastic; few medium roots; common fine tubular pores; few faint clay films on ped faces and in pores; few distinct calcium carbonate coats in root channels and in pores; few fine soft calcium carbonate masses; strongly effervescent; mildly alkaline (pH 7.8); clear wavy boundary.

2Btkb3—40 to 55 inches; light brown (7.5YR 6/4) sandy clay loam, strong brown (7.5YR 4/6) moist; weak fine subangular blocky structure; hard, friable, sticky, plastic; few fine roots; common fine tubular pores; few faint clay films on ped faces and in pores; few distinct calcium carbonate coats in root channels and in pores; common fine soft calcium carbonate masses; strongly effervescent; mildly alkaline (pH 7.8); clear smooth boundary.

2Btkb4—55 to 60 inches; brown (7.5YR 5/4) sandy clay loam, brown to dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; hard, very firm, sticky, plastic; few fine roots; common fine tubular pores; few faint clay films on ped faces and in pores; few distinct calcium carbonate coats in root channels and in pores; common medium soft calcium carbonate masses; strongly effervescent; mildly alkaline (pH 7.8).

Range in Characteristics

Reaction: mildly to moderately alkaline
Soil cracks: when dry, cracks 0.5 or more inches wide and extending to a depth of 20 or more inches
Depth to contrasting texture: 20 to 39 inches
Calcium carbonate equivalent: less than 15 percent

C horizon
Hue—7.5YR, 10YR
Value—4 through 6 dry, 2 through 4 moist
Chroma—2 or 3, dry or moist

2B horizon
Hue—5YR, 7.5YR
Value—4 through 6 dry, 3 through 5 moist
Chroma—2 through 6, dry or moist
Texture—sandy clay loam, clay loam, loam

Glenbar Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: flood plains
Parent material: mixed stream alluvium
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,200 feet
Classification: Fine-silty, mixed (calcareous), hyperthermic Typic Torrifluvents

Typical Pedon

Glenbar loam, 0 to 1 percent slopes, located at a latitude of 32 degrees, 26 minutes, 54 seconds N. and a longitude of 111 degrees, 59 minutes, 46 seconds W.; about 700 feet W. and 450 feet N. of the SE corner of sec. 19, T. 11 S., R. 4 E.

C1—0 to 1 inch; light brown (7.5YR 6/4) loam, brown to dark brown (7.5YR 4/4) moist; moderate medium single grain; soft, friable, sticky, plastic; common very fine roots; common very fine interstitial and tubular pores; mildly alkaline (pH 7.8); abrupt smooth boundary.

C2—1 to 6 inches; light brown (7.5YR 6/4) loam, brown to dark brown (7.5YR 4/4) moist; massive; soft, friable, sticky, plastic; common very fine roots; common very fine interstitial and tubular pores; slightly effervescent; mildly alkaline (pH 7.8); clear smooth boundary.

C3—6 to 14 inches; brown (7.5YR 5/4) clay loam, brown to dark brown (7.5YR 4/4) moist; massive; soft, friable, sticky, plastic; common very fine roots; common very fine interstitial and tubular pores; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

C4—14 to 25 inches; brown (7.5YR 5/4) silty clay loam, brown to dark brown (7.5YR 4/4) moist; massive; soft, friable, sticky, plastic; common very fine roots; common very fine interstitial and tubular pores; slightly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Ck1—25 to 45 inches; brown (7.5YR 5/4) silty clay loam, brown to dark brown (7.5YR 4/4) moist; weak coarse subangular blocky structure; slightly hard, friable, very sticky, plastic; common very

fine roots; common very fine interstitial and tubular pores; few distinct calcium carbonate coats in root channels and in pores; few faint organic coats in root channels and in pores; strongly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

Ck2—45 to 53 inches; pinkish gray (7.5YR 6/2) silty clay loam, brown (7.5YR 5/2) moist; weak coarse subangular blocky structure; slightly hard, friable, sticky, plastic; few very fine roots; common very fine interstitial and tubular pores; few distinct calcium carbonate coats in root channels and in pores, strongly effervescent; strongly alkaline (pH 8.6); clear smooth boundary.

C—53 to 60 inches; light brownish gray (10YR 6/2) clay loam, brown (10YR 5/3) moist; weak coarse granular parting to weak coarse subangular blocky structure; hard, friable, sticky, plastic; few very fine roots; common very fine interstitial and tubular pores; strongly effervescent; strongly alkaline (pH 8.8).

Range in Characteristics

Reaction: mildly to strongly alkaline
Organic matter: less than 1 percent and decreases irregularly with depth
Salinity: none to very slight

C horizon
Hue—7.5YR, 10YR
Value—5 through 7 dry, 4 or 5 moist
Chroma—2 through 4, dry or moist
Texture—stratified loam, silty clay loam, silt loam, clay loam (18 to 35 percent clay). Many areas have thin strata of coarser or finer materials.

Glendale Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate and moderately slow
Landform: flood plains, stream terraces and alluvial fans
Parent material: mixed stream alluvium and fan alluvium
Slope range: 0 to 3 percent
Elevation: 2,000 to 3,000 feet
Classification: Fine-silty, mixed (calcareous), thermic Typic Torrifluvents

Typical Pedon

Glendale clay loam, 0 to 2 percent slopes, flooded, located at a latitude of 32 degrees, 12 minutes, 13 seconds N. and a longitude of 111 degrees, 13 minutes, 08 seconds W.; about 40 feet W. and 30 feet S. of the NE corner of sec. 21, T. 14 S., R. 11 E.

A—0 to 11 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; soft, friable, slightly sticky, slightly plastic; common very fine and fine roots; common very fine and fine vesicular and tubular pores; slightly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

C1—11 to 32 inches; light yellowish brown (10YR 6/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, friable, slightly sticky, slightly plastic; common very fine and fine and few medium and coarse roots; common very fine and fine tubular pores; strongly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

C2—32 to 46 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 3/4) moist; massive; very hard, friable, sticky, plastic; common very fine and fine roots; strongly effervescent; mildly alkaline (pH 7.6); abrupt wavy boundary.

Ck—46 to 60 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 3/4) moist; massive; very hard, friable, sticky, plastic; common very fine and fine tubular pores; few faint calcium carbonate coats in root channels and in pores; strongly effervescent; mildly alkaline (pH 7.6).

Range in Characteristics

Rock fragments: 0 to 35 percent gravel in any one horizon
Reaction: mildly to moderately alkaline
Organic matter: less than 1 percent, decreasing irregularly with depth
Salinity: none to very slight

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—2 through 4, dry or moist

C horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—2 through 4, dry or moist
Texture—clay loam, silty clay loam, silt loam, loam; thin stratifications of contrasting textures are common.

Grabe Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: alluvial fans
Parent material: mixed fan alluvium and stream alluvium
Slope range: 1 to 3 percent
Elevation: 2,200 to 3,000 feet
Classification: Coarse-loamy, mixed (calcareous), thermic Typic Torrifluvents

Typical Pedon

Grabe fine sandy loam in an area of Grabe-Vado complex, 1 to 5 percent slopes, located at a latitude of 31 degrees, 41 minutes, 50 seconds N. and a longitude of 111 degrees, 44 minutes, 15 seconds W.

A—0 to 2 inches; yellowish brown (10YR 5/4) fine sandy loam, brown to dark brown (10YR 4/3) moist; moderate thin platy structure; soft, friable, nonsticky, nonplastic; few fine roots; common very fine vesicular and few fine tubular pores; noneffervescent; (pH 7.2); abrupt smooth boundary.

C1—2 to 10 inches; yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky, plastic; common very fine and fine roots; few fine tubular pores; noneffervescent; neutral (pH 7.2); clear smooth boundary.

C2—10 to 22 inches; yellowish brown (10YR 5/4) loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky, plastic; common very fine and fine roots; few fine tubular pores; noneffervescent; mildly alkaline (pH 7.6); clear smooth boundary.

C3—22 to 36 inches; yellowish brown (10YR 5/4) loam, brown to dark brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, friable, very sticky, very plastic; common very fine and fine roots; few fine tubular pores; strongly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

C4—36 to 60 inches; yellowish brown (10YR 5/4) loam, brown to dark brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, friable, very sticky, very plastic; few very fine and fine roots; few fine tubular pores; strongly effervescent; moderately alkaline (pH 8.2).

Range in Characteristics

Rock fragments: less than 15 percent
Reaction: neutral to moderately alkaline
Organic matter: less than 1 percent and decreases irregularly with depth

A horizon
Hue—7.5YR, 10YR
Value—4 through 6, dry or moist
Chroma—4 through 6, dry or moist

C horizon
Hue—7.5YR, 10YR
Value—3 through 6, dry or moist
Chroma—4 through 6, dry or moist

This soil is noncalcareous to a depth of 20 inches or more and is a taxadjunct to the series.

Granolite Series

Depth class: shallow
Drainage class: well drained
Permeability: slow
Landform: hills and mountains
Parent material: slope alluvium and residuum from rhyolite
Slope range: 5 to 65 percent
Elevation: 2,000 to 3,600 feet
Classification: Clayey-skeletal, mixed, thermic, shallow Typic Haplargids

Typical Pedon

Granolite extremely gravelly sandy loam in an area of Pantano-Granolite complex, 5 to 25 percent slopes, located at a latitude of 32 degrees, 11 minutes, 38 seconds N. and a longitude of 111 degrees, 21 minutes, 10 seconds W.; about 2,600 feet W. and 1,400 feet N. of SE corner of sec. 20, T. 14 S., R. 10 E.

A—0 to 2 inches; reddish brown (5YR 4/4) extremely gravelly sandy loam, dark reddish brown (5YR 3/4) moist; weak thin platy structure; loose, friable, nonsticky, nonplastic; few very fine roots; many very fine and fine vesicular and tubular pores; 2 percent stones, 15 percent cobbles, and 50 percent gravel; noneffervescent; mildly alkaline (pH 7.2); abrupt smooth boundary.

Bt1—2 to 7 inches; dark reddish brown (2.5YR 3/4) extremely gravelly sandy clay, dark reddish

brown (2.5YR 3/4) moist; moderate fine subangular blocky structure; hard, friable, very sticky, very plastic; common fine and medium roots; few very fine, fine and common tubular pores; few patchy clay bridges in root channels and in pores; 10 percent cobbles and 50 percent gravel; noneffervescent; mildly alkaline (pH 7.4); clear wavy boundary.

Bt2—7 to 16 inches; dark yellowish brown (10YR 4/4) extremely gravelly sandy clay, dark yellowish brown (10YR 3/4) moist; moderate fine subangular blocky structure; very hard, firm, very sticky, very plastic; few to common fine and medium roots; common very fine and fine tubular pores; few patchy clay bridging in root channels and in pores, and common pressure faces on vertical and horizontal faces of peds; 10 percent cobbles and 60 percent gravel; noneffervescent; mildly alkaline (pH 7.4); abrupt wavy boundary.

2Crtk—16 to 19 inches; light gray (5YR 7/1) weathered rhyolite, light gray to gray (5YR 6/1) moist; few fine to coarse roots in fractures; common distinct red (2.5YR 4/6) clay films, and distinct calcium carbonate coats in fractures; clear wavy boundary.

2Crk—19 to 24 inches; light gray (5YR 7/1) weathered rhyolite; light gray to gray (5YR 6/1) moist; few fine to coarse roots in fractures; common distinct calcium carbonate coats in fractures.

2R—24 inches; rhyolite.

Range in Characteristics

Rock fragments: 35 to 85 percent gravel and cobbles
Depth to weathered bedrock: 10 to 20 inches
Depth to unweathered bedrock: 20 to 30 inches
Reaction: neutral to mildly alkaline
Calcium carbonate: some pedons may not have coatings on bedrock and fractures

A horizon
Hue—5YR, 7.5YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—3 or 4, dry or moist
Texture—fine sandy loam, sandy loam

Bt horizon
Hue—5YR through 10YR
Value—3 through 5, dry or moist
Chroma—3 through 6, dry or moist
Texture—sandy clay, clay, clay loam

Gunsight Series

Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Landform: fan terraces and stream terraces
Parent material: mixed fan alluvium and stream alluvium
Slope range: 1 to 15 percent
Elevation: 1,400 to 2,200 feet
Classification: Loamy-skeletal, mixed, hyperthermic Typic Calciorthids

Typical Pedon

Gunsight extremely gravelly sandy loam, in an area of Hickiwan-Gunsight-Momoli complex, 3 to 15 percent slopes, located at a latitude of 32 degrees, 37 minutes, 20 seconds N. and a longitude of 111 degrees, 47 minutes, 15 seconds W.; about 1,700 feet W. and 750 feet S. of the NE corner of sec. 25, T. 9 S., R. 5 E.

A—0 to 3 inches; pink (7.5YR 7/4) extremely gravelly sandy loam, brown (7.5YR 5/4) moist; weak fine platy structure; slightly hard, friable, slightly sticky, nonplastic; common fine roots; common very fine continuous tubular pores; 20 percent cobbles and 45 percent gravel; strongly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bk1—3 to 23 inches; pinkish gray (7.5YR 7/2) extremely gravelly sandy loam, pinkish gray (7.5YR 6/2) moist; massive; hard, firm, slightly sticky, nonplastic; common fine roots; common very fine tubular pores; some thin layers of weakly cemented calcium carbonate; many distinct calcium carbonate coats on sand grains and gravel and common very coarse soft rounded calcium carbonate masses; 15 percent cobbles and 50 percent gravel; violently effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.

Bk2—23 to 60 inches; pinkish gray (7.5YR 6/2) extremely gravelly sandy loam, brown (7.5YR 5/2) moist; massive; hard, firm, slightly sticky, nonplastic; common fine roots; common very fine tubular pores; some thin layers of weakly cemented calcium carbonate; many distinct calcium carbonate coats on rock fragments and common very coarse soft rounded calcium carbonate masses; 15 percent cobbles and 50 percent gravel; violently effervescent; moderately alkaline (pH 8.4).

Range in Characteristics

Rock fragments: 35 to 80 percent
Reaction: moderately alkaline
Depth to calcic horizon: 2 to 10 inches

Salinity: very slight to moderate

A horizon
Hue—7.5YR, 10YR
Value—6 or 7 dry, 4 or 5 moist
Chroma—2 through 4, dry or moist
Texture—sandy loam, fine sandy loam

Bk horizon
Hue—7.5YR, 10YR
Value—4 through 8, dry or moist
Chroma—2 through 4, dry or moist
Texture—sandy loam, fine sandy loam
Calcium carbonate equivalent—greater than 10 percent

Guvo Series

Depth class: very shallow and shallow (to a hardpan)
Drainage class: well drained
Permeability: moderate
Landform: hills
Parent material: slope alluvium from basalt
Slope range: 10 to 25 percent
Elevation: 1,400 to 2,500 feet
Classification: Loamy-skeletal, mixed, hyperthermic, shallow Typic Paleorthids

Typical Pedon

Guvo very cobbly fine sandy loam in an area of Hyder-Rock outcrop-Guvo complex, 10 to 45 percent slopes, located at a latitude of 32 degrees, 45 minutes, 6 seconds N. and a longitude of 111 degrees, 57 minutes, 44 seconds W.; about 1,450 feet W. and 525 feet N. of the SE corner of sec. 27, T. 10 S., R. 3 E.

A—0 to 1 inch; brown (7.5YR 5/4) very cobbly fine sandy loam, reddish yellow (7.5YR 6/6) moist; weak coarse platy structure; soft, friable, slightly sticky, nonplastic; common very fine roots; common fine tubular pores; very few distinct calcium carbonate coats on rock fragments; 20 percent cobbles and 37 percent gravel; slightly effervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.
Bk1—1 to 8 inches; brown (7.5YR 5/4) very cobbly loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, sticky, plastic; common very fine roots; common fine tubular pores; few distinct calcium carbonate coats on rock fragments; 40 percent cobbles and 15 percent gravel; slightly effervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.
Bk2—8 to 18 inches; brown (7.5YR 5/4) very cobbly loam, brown to dark brown (7.5YR 4/4) moist; massive; soft, very friable, sticky, plastic; common fine roots; common fine tubular pores; many distinct calcium carbonate coats on rock fragments; 50 percent cobbles; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.
2Bkm—18 to 24 inches; indurated petrocalcic horizon.
R—24 inches; basalt.

Range in Characteristics

Rock fragments: 35 to 60 percent gravel and/or cobbles and hardpan fragments
Depth to petrocalcic horizon: 5 to 20 inches
Depth to unweathered bedrock: 6 to 30 inches
Reaction: mildly to moderately alkaline
Surface rocks: 45 to 80 percent surface covered with gravel and cobbles

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 through 6 moist
Chroma—3 or 4 dry, 4 through 6 moist
Texture—sandy loam, fine sandy loam, loam
Calcium carbonate equivalent—0 to 13 percent

Bk or Bw horizon
Hue—7.5YR, 10YR
Value—5 through 8 dry, 5 through 7 moist
Chroma—2 through 4, dry or moist
Texture—sandy loam, loam, fine sandy loam
Calcium carbonate equivalent—13 to 40 percent

Bkm horizon
Cementation—indurated or strongly cemented by calcium carbonate

Hantz Series

Depth class: very deep
Drainage class: well drained
Permeability: slow
Landform: flood plains and alluvial fans
Parent material: mixed stream alluvium
Slope range: 0 to 1 percent
Elevation: 2,000 to 3,000 feet
Classification: Fine, mixed (calcareous), thermic Vertic Torrifluvents

Typical Pedon

Hantz clay loam, 0 to 1 percent slopes, located at a latitude of 32 degrees, 28 minutes, 00 seconds N. and a longitude of 112 degrees, 16 minutes, 00 seconds W. Cimarron Peak NE in NE 1/4.

A—0 to 3 inches; light brown (7.5YR 6/4) clay loam, brown to dark brown (7.5YR 4/4) moist; moderate thick platy structure; soft, friable, sticky, nonplastic; common fine roots; few fine vesicular pores; strongly effervescent; mildly alkaline (pH 7.6); abrupt wavy boundary.

C—3 to 10 inches; brown to dark brown (7.5YR 4/4) clay, dark brown (7.5YR 3/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common fine roots; few fine tubular pores; common fine 0.4-inch-wide vertical cracks; few distinct pressure faces on vertical faces of peds; strongly effervescent; mildly alkaline (pH 7.8); clear wavy boundary.

Ck1—10 to 24 inches; brown to dark brown (7.5YR 4/4) clay, dark brown (7.5YR 3/4) moist; moderate medium wedge structure; extremely hard, firm, very sticky, plastic; few fine roots; few fine tubular pores; common medium and fine 0.4-inch to 2-inch wide vertical cracks; common distinct pressure faces on vertical and horizontal faces of peds; few fine soft rounded calcium carbonate masses; violently effervescent; moderately alkaline (pH 8.0); gradual wavy boundary.

Ck2—24 to 50 inches; brown to dark brown (7.5YR 4/4) clay, dark brown (7.5YR 3/4) moist; weak fine and medium subangular blocky structure; extremely hard, firm, very sticky, plastic; few fine roots; few fine tubular pores; few distinct pressure faces on vertical faces of peds; few fine soft rounded calcium carbonate masses; violently effervescent; moderately alkaline (pH 8.2); gradual wavy boundary.

Ck3—50 to 60 inches; brown (7.5YR 5/4) clay, brown to dark brown (7.5YR 4/4) moist; massive; extremely hard, firm, very sticky, plastic; few fine vesicular pores; common medium soft rounded calcium carbonate masses; violently effervescent; moderately alkaline (pH 8.4).

Range in Characteristics

Rock fragments: 0 to 20 percent gravel, average less than 15 percent gravel in the control section

Soil cracks: when dry, cracks 0.4 inch or more wide extend to depths of 20 inches. Pressure faces are common.

Reaction: mildly to moderately alkaline

Organic matter: less than 1 percent throughout

Salinity: none to slight

Sodicity: none to slight

A horizon
Hue—7.5YR, 10YR
Value—4 through 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist

C horizon
Hue—7.5YR, 10YR
Value—4 through 6 dry, 3 or 4 moist
Chroma—2 through 4, dry or moist

Hayhook Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: mixed fan alluvium
Slope range: 1 to 5 percent
Elevation: 2,000 to 3,200 feet
Classification: Coarse-loamy, mixed, thermic Typic Camborthids

Typical Pedon

Hayhook loamy sand in an area of Bucklebar-Hayhook-Tubac complex, 0 to 3 percent slopes, located at a latitude of 31 degrees, 53 minutes, 30 seconds N. and a longitude of 112 degrees, 01 minutes, 00 seconds W.; about 1.0 mile N. of curve to Cowlic on the W. side of the road.

A1—0 to 1 inch; yellowish brown (10YR 5/6) loamy sand, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; few fine roots; few fine interstitial and tubular pores; noneffervescent; neutral (pH 7.0); abrupt smooth boundary.

A2—1 to 6 inches; yellowish brown (10YR 5/6) sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky, nonplastic; few fine roots; few fine interstitial and tubular pores; noneffervescent; neutral (pH 7.2); clear wavy boundary.

Bw1—6 to 19 inches; strong brown (7.5YR 5/6) sandy loam, strong brown (7.5YR 4/6) moist; weak coarse subangular blocky structure; slightly hard, very friable, nonsticky, nonplastic; few fine roots; few fine interstitial and tubular pores; noneffervescent; neutral (pH 7.2); gradual wavy boundary.

Bw2—19 to 36 inches; yellowish brown (10YR 5/6) sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky, nonplastic; few fine roots; few fine interstitial and tubular pores; noneffervescent; mildly alkaline (pH 7.4); gradual wavy boundary.

Bk—36 to 60 inches; yellowish brown (10YR 5/6)

sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; soft, very friable, nonsticky, nonplastic; few fine roots; few fine interstitial and tubular pores; few fine calcium carbonate filaments; slightly effervescent; mildly alkaline (pH 7.4).

Range in Characteristics

Rock fragments: 0 to 35 percent gravel
Reaction: neutral to moderately alkaline
Calcium carbonate: noneffervescent to 20 inches or more

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Texture—loamy sand, sandy loam
Organic matter—less than 1 percent

B horizons
Hue—7.5YR, 10YR
Value—4 through 6, dry or moist
Chroma—4 through 6 dry, 3 through 6 moist
Some areas have a buried soil at depths greater than 40 inches.

Hickiwan Series

Depth class: very shallow and shallow (to a hardpan)
Drainage class: well drained
Permeability: moderately rapid
Landform: fan terraces and relict fan terraces
Parent material: mixed fan alluvium
Slope range: 3 to 15 percent
Elevation: 1,400 to 2,200 feet
Classification: Loamy-skeletal, mixed, hyperthermic, shallow Typic Paleorthids

Range in Characteristics

Hickiwan very gravelly sandy loam in an area of Hickiwan-Gunsight-Momoli complex, 3 to 15 percent slopes, located at a latitude of 32 degrees, 37 minutes, 25 seconds N. and a longitude of 111 degrees, 47 minutes, 25 seconds W.; about 1,060 feet W. and 450 feet S. of the NE corner of sec. 25, T. 9 S., R. 5 E.

A—0 to 2 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; slightly hard, very friable, nonsticky, slightly plastic; common fine roots; common very fine vesicular pores; 42 percent gravel; strongly effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.
Bk—2 to 14 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; massive; slightly hard, very friable, nonsticky, slightly plastic; common fine roots; common fine tubular pores; 45 percent gravel; many distinct calcium carbonate coats on rock fragments; violently effervescent; moderately alkaline (pH 8.4); abrupt wavy boundary.
2Bkm—14 to 60 inches; extremely hard, indurated petrocalcic horizon; violently effervescent.

Range in Characteristics

Rock fragments: 35 to 60 percent gravel and/or cobbles and hardpan fragments
Depth to petrocalcic horizon: 5 to 20 inches
Reaction: mildly to moderately alkaline
Calcium carbonate equivalent: greater than 3 percent below 4 inches

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 through 5, dry or moist
Texture—sandy loam, fine sandy loam, loam

Bk horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 through 5, dry or moist
Texture—sandy loam, loam, fine sandy loam

Bkm horizon
Cementation—strongly to indurated, cemented with calcium carbonate

Hyder Series

Depth class: very shallow and shallow
Drainage class: somewhat excessively drained
Permeability: moderate
Landform: hills
Parent material: slope alluvium and colluvium from basalt
Slope range: 15 to 45 percent
Elevation: 1,400 to 2,500 feet
Classification: Loamy-skeletal, mixed (calcareous), hyperthermic Lithic Torriorthents

Typical Pedon

Hyder extremely cobbly fine sandy loam in an area of Hyder-Rock outcrop-Guvo complex, 10 to 45 percent slopes, located at a latitude of 32 degrees, 44 minutes, 07 seconds N. and a longitude of

111 degrees, 56 minutes, 05 seconds W.; about 750 feet S. and 125 feet E. of the NW corner of sec. 9, T. 8 S., R. 4 E.

A—0 to 1 inch; brown (7.5YR 5/4) extremely cobbly fine sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; few very fine roots; few very fine interstitial and tubular pores; 15 percent stones and 50 percent cobbles; slightly effervescent; mildly alkaline (pH 7.8); abrupt smooth boundary.

Bk—1 to 7 inches; brown (7.5YR 5/4) extremely cobbly loam, brown to dark brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky, slightly plastic; common very fine roots; few very fine tubular pores; many distinct calcium carbonate coats on rock fragments; 15 percent stones and 60 percent cobbles; strongly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

2R—7 inches; basalt.

Range in Characteristics

Rock fragments: 35 to 60 percent gravel and/or cobbles
Depth to unweathered bedrock: 5 to 20 inches
Reaction: mildly to moderately alkaline
Organic matter: less than 1 percent
Calcium carbonate equivalent: 3 to 10 percent

A and Bk horizons
Hue—7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Texture—fine sandy loam, loam

Kamato Series

Depth class: very deep
Drainage class: well drained
Permeability: slow
Landform: basin floors
Parent material: mixed stream alluvium
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,000 feet
Classification: Fine, mixed, hyperthermic Typic Natrargids

Typical Pedon

Kamato loam in an area of Casa Grande-Kamato complex, 0 to 1 percent slopes, located at a latitude of 32 degrees, 03 minutes, 00 seconds N. and a longitude of 112 degrees, 15 minutes, 00 seconds W.; Pisinimo SE in the SW corner.

A1—0 to 2 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 5/3) moist; weak fine platy structure; soft, very friable, slightly sticky, plastic; few fine roots; few medium and fine vesicular pores; slightly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

A2—2 to 8 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; soft, very friable, sticky, nonplastic; few fine roots; many fine vesicular pores; strongly effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary.

Btknz1—8 to 13 inches; light reddish brown (5YR 6/4) sandy clay, reddish brown (5YR 4/4) moist; weak coarse prismatic parting to moderate medium subangular blocky structure; extremely hard, firm, slightly sticky, plastic; few fine roots; few medium vesicular pores; common distinct clay films on ped faces and in pores; few fine calcium carbonate filaments; strongly effervescent; strongly alkaline (pH 8.8); clear wavy boundary.

Btknz2—13 to 26 inches; light reddish brown (5YR 6/4) clay, reddish brown (5YR 5/4) moist; weak coarse prismatic parting to moderate medium subangular blocky structure; extremely hard, firm, slightly sticky, plastic; few fine roots; few medium vesicular pores; common distinct clay films on ped faces and in pores; common fine soft irregular calcium carbonate masses; violently effervescent; strongly alkaline (pH 8.8); gradual wavy boundary.

Btknz3—26 to 44 inches; light reddish brown (5YR 6/4) clay loam, reddish brown (5YR 5/4) moist; weak coarse prismatic parting to moderate medium subangular blocky structure; extremely hard, firm, slightly sticky, plastic; few fine roots; many fine vesicular pores; few distinct clay films on ped faces and in pores; few fine soft irregular calcium carbonate masses; violently effervescent; strongly alkaline (pH 8.8); gradual wavy boundary.

Bkn—44 to 60 inches; light reddish brown (5YR 6/4) clay loam, reddish brown (5YR 5/4) moist; moderate coarse subangular blocky structure; extremely hard, very firm, slightly sticky, plastic; many fine vesicular pores; violently effervescent; strongly alkaline (pH 8.8).

Range in Characteristics

Depth to natric horizon: 10 to 40 inches

A horizon
Hue—5YR, 10YR
Value—5 or 6 dry, 4 through 6 moist

Chroma—2 or 4, dry or moist
Organic matter—less than 1 percent
Salinity—very slight to strong
Ec—0.5 to 5.0 dS/m
Sodicity:—slight to moderate
SAR—4 to 10
Reaction—mildly to moderately alkaline

B horizons
Hue—5YR or 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 or 6, dry or moist
Texture—clay, sandy clay, clay loam
Salinity—very slight to strong
Ec—3.0 to 50.0 dS/m
Sodicity—moderate to strong
SAR—10 to 70
Calcium carbonate equivalent—greater than 10 percent
Reaction—moderately to strongly alkaline

Keysto Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Landform: alluvial fans and stream terraces
Parent material: mixed fan alluvium and stream alluvium
Slope range: 0 to 5 percent
Elevation: 3,000 to 5,000 feet
Classification: Loamy-skeletal, mixed, nonacid, thermic Ustic Torrifluvents

Typical Pedon

Keysto very gravelly sandy loam in an area of Keysto-Riverwash complex, 0 to 5 percent slopes, located at a latitude of 31 degrees, 47 minutes, 33 seconds N. and a longitude of 111 degrees, 39 minutes, 30 seconds W.; Chiuli Shail, Sycamore Canyon road.

A—0 to 3 inches; dark brown (7.5YR 3/2) very gravelly sandy loam, dark brown (7.5YR 3/2) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; common very fine, fine and medium roots; common fine interstitial pores; 5 percent cobbles and 45 percent gravel; noneffervescent; neutral (pH 6.6); abrupt smooth boundary.

C—3 to 24 inches; dark brown (10YR 3/3) extremely cobbly sandy loam, very dark brown (10YR 2/2) moist; massive; soft, very friable, nonsticky, nonplastic; common very fine, fine, medium and coarse roots; common fine interstitial pores; 55 percent cobbles and 24 percent gravel; noneffervescent; neutral (pH 6.8); clear wavy boundary.

Ck—24 to 60 inches; brown to dark brown (10YR 4/3) extremely cobbly loamy sand, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky, nonplastic; common very fine and fine roots and few medium roots; common fine interstitial pores; many distinct calcium carbonate coats on rock fragments; 55 percent cobbles and 30 percent gravel; noneffervescent; mildly alkaline (pH 7.4).

Range in Characteristics

Rock fragments: 35 to 75 percent gravel, cobbles, and stones
Reaction: neutral to mildly alkaline

A horizon
Hue—10YR, 7.5YR
Value—3 or 4 dry, 2 or 3 moist
Chroma—2 or 3, dry or moist
Organic matter—1 to 3 percent

C horizon
Hue—10YR, 7.5YR
Value—3 or 4 dry, 2 or 3 moist
Chroma—2 through 4, dry or moist

Range in Characteristics

Rock fragments: 35 to 75 percent gravel, cobbles, and stones
Reaction: neutral to mildly alkaline

A horizon
Hue—10YR, 7.5YR
Value—3 or 4 dry, 2 or 3 moist
Chroma—2 or 3, dry or moist
Organic matter—1 to 3 percent

C horizon
Hue—10YR, 7.5YR
Value—3 or 4 dry, 2 or 3 moist
Chroma—2 through 4, dry or moist
Texture—sandy loam, loamy sand
Calcium carbonates—coatings on the rock fragments

Kimrose Series

Depth class: shallow (to a hardpan)
Drainage class: well drained
Permeability: moderately slow
Landform: relict fan terraces
Parent material: mixed fan alluvium
Slope range: 5 to 15 percent
Elevation: 2,800 to 3,800 feet

Classification: Loamy-skeletal, mixed, thermic, shallow Ustollic Paleorthids

Typical Pedon

Kimrose very gravelly sandy loam in an area of Caralampi-Selevin-Kimrose complex, 5 to 50 percent slopes, located at a latitude of 31 degrees, 56 minutes, 20 seconds N. and a longitude of 111 degrees, 41 minutes, 35 seconds W. *(fig. 19).*

A—0 to 2 inches; strong brown (7.5YR 5/6) very gravelly sandy loam, dark brown (10YR 3/3) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common very fine and fine interstitial and tubular pores; 35 percent gravel; strongly effervescent; mildly alkaline (pH 7.6); abrupt smooth boundary.

Bk1—2 to 12 inches; strong brown (7.5YR 5/6) very gravelly sandy clay loam, brown to dark brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common very fine and fine interstitial and tubular pores; common distinct calcium carbonate coats on rock fragments; few medium soft irregular calcium carbonate masses; common calcium carbonate filaments; 40 percent gravel; violently effervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.

Bk2—12 to 20 inches; white (7.5YR 8/0) moderately cemented extremely gravelly sandy loam; white (7.5YR 8/0) moist; massive; hard, firm, nonsticky, nonplastic, few very fine and fine roots; many distinct calcium carbonate coats on rock fragments; 10 percent cobbles and 60 percent gravel; violently effervescent; moderately alkaline (pH 8.4); abrupt wavy boundary.

Bkm—20 to 60 inches; white (7.5YR 8/0); indurated petrocalcic horizon with a thin laminar cap; few very fine roots in fractures; violently effervescent.

Range in Characteristics

Rock fragments: 35 to 60 percent gravel, some pedons contain cobbles
Reaction: neutral to moderately alkaline
Depth to petrocalcic horizon: 10 to 20 inches
Calcium carbonate equivalent: greater than 15 percent

A horizon
Hue—7.5YR, 10YR
Value—3 through 5 dry, 3 or 4 moist
Chroma—3 through 6 dry, 2 through 4 moist
Organic matter—0.5 to 1.0 percent

Bk horizon
Hue—7.5YR, 10YR
Value—3 through 8, dry or moist
Chroma—N through 6, dry or moist
Texture—sandy loam, sandy clay loam, loam

Bkm horizon
Cementation—strongly to indurated cemented with calcium carbonate

Kohatk Series

Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderate
Landform: hills
Parent material: slope alluvium, residuum, and colluvium from limestone
Slope range: 10 to 45 percent
Elevation: 2,000 to 3,500 feet
Classification: Loamy-skeletal, carbonatic, thermic Lithic Calciorthids

Typical Pedon

Kohatk very cobbly fine sandy loam in an area of Kohatk-Rock outcrop complex, 10 to 45 percent slopes, located at a latitude of 32 degrees, 37 minutes, 21 seconds N. and a longitude of 112 degrees, 08 minutes, 25 seconds W.; about 1,500 feet W. and 1,000 feet S. of the NE corner of sec. 34, T. 9 S., R. 2 E.

A—0 to 1 inch; light brown (7.5YR 6/4) very cobbly fine sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, friable, slightly sticky, slightly plastic; few fine roots; common fine interstitial and tubular pores; 35 percent cobbles and 20 percent gravel; slightly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk1—1 to 7 inches; light brown (7.5YR 6/4) very cobbly loam, brown to dark brown (7.5YR 4/4) moist; weak fine and medium subangular blocky structure; soft, friable, slightly sticky, slightly plastic; few fine roots; common fine interstitial and tubular pores; many calcium carbonate filaments; 40 percent cobbles; violently effervescent; moderately alkaline (pH 8.4); clear wavy boundary.

Bk2—7 to 10 inches; light brown (7.5YR 6/4) very cobbly loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; soft, friable, slightly sticky, slightly plastic; few fine roots; many

distinct calcium carbonate coats on rock fragments; many soft rounded calcium carbonate masses; 45 percent cobbles; violently effervescent; moderately alkaline (pH 8.4); abrupt wavy boundary.
R—10 inches; limestone; 0.5 inch thick strongly cemented calcium carbonate cap on the bedrock.

Range in Characteristics

Rock fragments: 35 to 60 percent cobbles and gravel on the surface and in the control section
Depth to unweathered bedrock: 6 to 20 inches
Reaction: mildly to moderately alkaline
Calcium carbonate equivalent: 15 to 60 percent; averages more than 40 percent
Clay content: less than 18 percent

A and B horizons
Hue—7.5YR, 10YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—2 through 4, dry or moist
Texture—fine sandy loam, loam

Lajitas Series

Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderately rapid
Landform: hills and mountains
Parent material: slope alluvium from andesite
Slope range: 20 to 50 percent
Elevation: 2,000 to 4,500 feet
Classification: Loamy-skeletal, mixed, nonacid, thermic Lithic Torriorthents

Typical Pedon

Lajitas very gravelly fine sandy loam in an area of Lajitas-Bosa-Rock outcrop 15 to 50 percent slopes, located at a latitude of 31 degrees, 57 minutes, 15 seconds N. and a longitude of 112 degrees, 58 minutes, 00 seconds W.

A—0 to 1 inch; brown (7.5YR 5/4) very gravelly fine sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, sticky, nonplastic; common very fine and fine roots; common very fine and fine interstitial pores; 10 percent cobbles and 45 percent gravel; noneffervescent; mildly alkaline (pH 7.4); abrupt smooth boundary.
C—1 to 6 inches; brown (7.5YR 5/4) very gravelly fine sandy loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, nonsticky, nonplastic; common fine and medium roots; common very fine and fine interstitial and tubular pores; 10 percent cobbles and 45 percent gravel; noneffervescent; mildly alkaline (pH 7.6); abrupt wavy boundary.
R—6 inches; andesite.

Range in Characteristics

Rock fragments: 35 to 75 percent gravel, cobbles and/or stones
Depth to unweathered bedrock: 4 to 20 inches
Reaction: mildly to moderately alkaline
Calcium carbonate: some pedons have coats in the fractures in the bedrock

A and C horizons
Hue—7.5YR, 10YR
Value—5 or 6 dry, 5 or 4 moist
Chroma—2 through 4, dry or moist
Texture—fine sandy loam, loam

Lampshire Series

Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderately rapid
Landform: hills and mountains
Parent material: slope alluvium and colluvium from igneous and metamorphic rock
Slope range: 15 to 65 percent
Elevation: 3,200 to 5,300 feet
Classification: Loamy-skeletal, mixed, nonacid, thermic Ustic Torriorthents

Typical Pedon

Lampshire very gravelly sandy loam in an area of Romero-Lampshire-Rock outcrop complex, 15 to 65 percent slopes, located at a latitude of 32 degrees, 57 minutes, 45 seconds N. and a longitude of 111 degrees, 37 minutes, 30 seconds W.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) very gravelly sandy loam, very dark gray (10YR 3/1) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; common very fine, fine and medium roots; common fine interstitial pores; 45 percent gravel; noneffervescent; neutral (pH 6.6); abrupt smooth boundary.
C—2 to 8 inches; very dark gray (10YR 3/1) very gravelly sandy loam, black (10YR 2/1) moist; massive; slightly hard, friable, nonsticky, nonplastic; common very fine, fine, and medium roots; common fine interstitial and tubular pores; 40 percent gravel; noneffervescent; slightly acid (pH 6.4); abrupt wavy boundary.
R—8 inches; granite.

Range in Characteristics

Rock fragments: 35 to 70 percent gravel and cobbles
Reaction: slightly acid to neutral
Depth to unweathered bedrock: 4 to 20 inches
Clay content: less than 20 percent

A and C horizons
Hue—7.5YR, 10YR
Value—4 or 5 dry, 2 or 3 moist
Chroma—1 through 4, dry or moist
Organic matter—1 to 2 percent

Lomitas Series

Depth class: shallow
Drainage class: somewhat excessively drained
Permeability: moderate
Landform: hills
Parent material: slope alluvium and colluvium from rhyolite and andesite
Slope range: 15 to 45 percent
Elevation: 1,400 to 2,600 feet
Classification: Loamy-skeletal, mixed, hyperthermic Lithic Camborthids

Typical Pedon

Lomitas extremely gravelly loam in an area of Gachado-Lomitas-Rock outcrop complex, 15 to 45 percent slopes, located at a latitude of 32 degrees, 42 seconds, 40 minutes, N. and a longitude of 111 degrees, 57 seconds, 10 minutes W.; about 3 miles SW of Vaiva Vo village.

A—0 to 2 inches; brown (7.5YR 5/4) extremely gravelly loam, brown to dark brown (7.5YR 4/4) moist; weak medium platy structure; soft, very friable, nonsticky, nonplastic; few fine roots; few fine tubular pores; 10 percent cobbles and 60 percent gravel; noneffervescent; mildly alkaline (pH 7.8); abrupt smooth boundary.

Bk—2 to 12 inches; brown (7.5YR 5/4) extremely gravelly loam, brown to dark brown (7.5YR 4/4) moist; massive; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common fine tubular pores; common distinct calcium carbonate coats in rock fragments; 10 percent cobbles and 70 percent gravel; strongly effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.

R—12 inches; rhyolite; many distinct calcium carbonate coats in the fractures.

Range in Characteristics

Rock fragments: greater than 35 percent gravel and/or cobbles
Depth to unweathered bedrock: 10 to 20 inches
Reaction: mildly to moderately alkaline
Calcium carbonates: occur as coats on the rock fragments and in fractures

A horizon
Hue—10YR, 7.5YR
Value—5 or 6 dry, 3 through 5 moist
Chroma—3 or 4 dry, 4 through 6 moist

B horizon
Hue—7.5YR, 5YR
Value—4 through 6 dry, 4 or 5 moist
Chroma—4 through 6 dry, 3 or 4 moist
Texture—loam, fine sandy loam, sandy loam

Mohall Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: fan terraces, stream terraces and basin floors
Parent material: mixed fan alluvium and stream alluvium
Slope range: 0 to 3 percent
Elevation: 1,400 to 2,400 feet
Classification: Fine-loamy, mixed, hyperthermic Typic Haplargids

Typical Pedon

Mohall sandy loam, in an area of Tucson-Mohall-Valencia complex, 1 to 3 percent slopes, located at a latitude of 32 degrees, 16 minutes, 03 seconds N. and a longitude of 111 degrees, 41 minutes, 09 seconds W.; where pavement ends at Queens Well, then go 3.5 miles W. on dirt road towards the charro by the basalt hills.

A—0 to 1 inch; yellowish red (5YR 5/6) sandy loam, yellowish red (5YR 4/6) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; few fine roots; common fine interstitial and tubular pores; noneffervescent; mildly alkaline (pH 7.4); clear smooth boundary.

Bt1—1 to 3 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak fine prismatic parting to moderate medium subangular blocky structure; slightly hard, friable, sticky, plastic; few fine roots; common fine

interstitial and tubular pores; common distinct clay films on ped faces and in pores; noneffervescent; mildly alkaline (pH 7.4); abrupt smooth boundary.

Bt2—3 to 14 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium prismatic parting to moderate medium subangular blocky structure; slightly hard, friable, sticky, plastic; few fine roots; common fine interstitial and tubular pores; common distinct clay films on ped faces and in pores; noneffervescent; mildly alkaline (pH 7.8); clear wavy boundary.

Bt3—14 to 24 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak coarse prismatic parting to moderate coarse subangular blocky structure; slightly hard, friable, sticky, plastic; few fine roots; common fine tubular pores; few distinct clay films on ped faces and in pores; 10 percent gravel; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

Btk1—24 to 34 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate coarse subangular blocky structure; slightly hard, friable, sticky, plastic; few fine roots; few fine tubular pores; few distinct clay films on ped faces and in pores; common fine soft rounded calcium carbonate masses; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

Btk2—34 to 41 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate coarse subangular blocky structure; slightly hard, friable, sticky, plastic; few very fine roots; few fine tubular pores; common distinct clay films on ped faces and in pores; common medium soft rounded calcium carbonate masses; violently effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

Btk3—41 to 60 inches; yellowish red (5YR 4/6) clay loam, dark reddish brown (5YR 3/4) moist; moderate coarse prismatic parting to moderate medium subangular blocky structure; slightly hard, friable, sticky, plastic; few very fine roots; few fine tubular pores; common distinct clay films on ped faces and in pores; common coarse soft rounded calcium carbonate masses; strongly effervescent; moderately alkaline (pH 8.2).

Range in Characteristics

Rock fragments: less than 15 percent gravel
Depth to calcic horizon: 20 to 40 inches
Salinity: none to very slight
Reaction: mildly to moderately alkaline

A horizon
- Hue—7.5YR, 10YR
- Value—5 through 7 dry, 3 through 5 moist
- Chroma—2 through 6, dry or moist
- Organic matter—less than 0.5 percent
- Texture—sandy loam, fine sandy loam, loam

The A horizon is often commonly capped with a thin C horizon. This horizon is often coarser in texture than the A horizon. It is thought to be recent water- or wind-deposited material.

B horizons
- Hue—10YR, 7.5YR, 5YR
- Value—5 through 7 dry, 3 through 5 moist
- Chroma—3 through 6, dry or moist
- Texture—fine sandy loam, loam, sandy clay loam, clay loam; but includes strata of sandy loam and silt loam
- Calcium carbonate equivalent—greater than 15 percent

Momoli Series

Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Landform: stream terraces and fan terraces
Parent material: mixed fan alluvium and stream alluvium
Slope range: 1 to 10 percent
Elevation: 1,400 to 2,200 feet
Classification: Loamy-skeletal, mixed, hyperthermicTypic Camborthids

Typical Pedon

Momoli extremely gravelly sandy loam in an area of Denure-Momoli complex, 1 to 5 percent slopes, located at a latitude of 32 degrees, 40 minutes, 18 seconds N. and a longitude of 112 degrees, 21 minutes, 18 seconds W.; about 1,700 feet N. and 2,000 feet W. of the SE corner of sec. 3, T. 9 S., R. 3 E.

A—0 to 2 inches; brown (7.5YR 5/4) extremely gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, nonsticky, nonplastic; few very fine roots; common fine interstitial and tubular pores; 60 percent gravel; strongly effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

Bw—2 to 21 inches; light brown (7.5YR 6/4) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky,

nonplastic; common fine roots; common fine interstitial and tubular pores; 25 percent gravel; violently effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Bk1—21 to 33 inches; light brown (7.5YR 6/4) extremely gravelly coarse sandy loam, brown to dark brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky, nonplastic; few very fine roots; common fine interstitial and tubular pores; common distinct calcium carbonate coats on rock fragments; 5 percent cobbles and 65 percent gravel; violently effervescent; moderately alkaline (pH 8.2); clear smooth boundary.

Bk2—33 to 54 inches; pink (7.5YR 7/4) very gravelly coarse sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; few very fine roots; common fine interstitial and tubular pores; common distinct calcium carbonate coats on rock fragments and sand grains; common coarse soft rounded calcium carbonate masses; 50 percent gravel; violently effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Bk3—54 to 60 inches; light brown (7.5YR 6/4) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; few very fine roots; common fine interstitial and tubular pores; 25 percent gravel; strongly effervescent; moderately alkaline (pH 8.2);

Range in Characteristics

Rock fragments: 60 to 80 percent of surface is covered with varnished gravel, and the profile contains more than 35 percent rock fragments
Reaction: mildly to moderately alkaline
Calcium carbonate equivalent: less than 5 percent above 40 inches
Salinity: none to very slight

A horizon
- Hue—7.5YR, 10YR
- Value—4 through 6 dry, 3 through 5 moist
- Chroma—4 through 6, dry or moist
- Texture—fine sandy loam, sandy loam, coarse sandy loam

B horizons
- Hue—7.5YR, 10YR
- Value—5 through 7 dry, 4 or 5 moist
- Chroma—4 through 6, dry or moist
- Texture—fine sandy loam, sandy loam, coarse sandy loam

Nahda Series

Depth class: moderately deep (to a hardpan)
Drainage class: well drained
Permeability: slow
Landform: fan terraces
Parent material: mixed fan alluvium
Slope range: 1 to 15 percent
Elevation: 1,800 to 3,000 feet
Classification: Clayey-skeletal, mixed, thermic Petrocalcic Paleargids

Typical Pedon

Nahda extremely gravelly sandy loam in an area of Nahda-Stagecoach complex, 1 to 15 percent slopes, located at a latitude of 32 degrees, 10 minutes, 41 seconds N. and a longitude of 111 degrees, 18 minutes, 20 seconds W.; about 350 feet E. and 1,000 feet N. of the SW corner of sec. 26, T. 14 S., R. 10 E.

E—0 to 2 inches; light brown (7.5YR 6/4) extremely gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak medium and coarse platy structure; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common very fine and fine vesicular pores; 10 percent cobbles and 50 percent gravel; noneffervescent; neutral (pH 6.3); abrupt smooth boundary.

Bt—2 to 12 inches; yellowish red (5YR 5/6) extremely gravelly sandy clay, yellowish red (5YR 4/6) moist; moderate very fine and fine subangular blocky structure; slightly hard, friable, sticky, plastic; common very fine and fine roots; common very fine and fine interstitial and tubular pores; many distinct red (2.5YR 4/6) clay films on ped faces, in pores, and on rock fragments; 10 percent cobbles and 60 percent gravel; noneffervescent; neutral (pH 6.8); clear wavy boundary.

Btk1—12 to 23 inches; red (2.5YR 5/8) extremely gravelly sandy clay, red (2.5YR 4/8) moist; moderate very fine and fine subangular blocky structure; slightly hard, friable, sticky, plastic; common fine and medium roots matted around stones; few very fine and fine interstitial and tubular; common faint red (2.5YR 4/6) clay films on ped faces and in pores; few fine calcium carbonate filaments; fine soft calcium carbonate masses; 10 percent cobbles and 60 percent gravel; strongly effervescent; mildly alkaline (pH 7.8); gradual wavy boundary.

Btk2—23 to 36 inches; red (2.5YR 5/8) extremely

gravelly sandy clay, red (2.5YR 4/8) moist; moderate very fine and fine subangular blocky structure; slightly hard, friable, sticky, plastic; common fine and medium roots matted around stones; common very fine and fine interstitial and tubular pores; common faint red (2.5YR 4/6) clay films on ped faces and in pores; common distinct iron-manganese stains; few fine calcium carbonate filaments; fine soft calcium carbonate masses; 10 percent cobbles and 70 percent gravel; strongly effervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.

2Bkm—36 to 60 inches; extremely hard, indurated petrocalcic horizon; few very fine and fine roots in fractures; violently effervescent.

Range in Characteristics

Rock fragments: 35 to 85 percent gravel and/or cobbles
Depth to petrocalcic horizon: 20 to 40 inches
Organic matter: less than 0.5 percent
Reaction: neutral to moderately alkaline
Salinity: none to very slight

E horizon
Value—5 through 7 dry, 3 through 5 moist
Chroma—3 through 6, dry or moist

Bt horizon
Hue—2.5YR, 5YR
Value—4 or 5 dry
Chroma—4 through 8, dry or moist
Texture—sandy clay, clay, sandy clay loam
Calcium carbonate equivalent—0 to 15 percent

Btk horizons
Hue—2.5YR, 5YR
Value—4 through 6 dry, 4 or 5 moist
Chroma—6 or 8, dry or moist
Texture—sandy clay, sand clay loam
Calcium carbonate equivalent—greater than 15 percent

Bkm horizon
Cementation—indurated or strongly cemented by calcium carbonate

Oracle Series

Depth class: shallow
Drainage class: well drained
Permeability: moderately slow
Landform: hills
Parent material: slope alluvium and residuum from granite
Slope range: 5 to 15 percent
Elevation: 3,000 to 4,200 feet
Classification: Loamy, mixed, thermic, shallow Ustollic Haplargids

Typical Pedon

Oracle gravelly sandy loam in an area of Oracle-Romero-Rock outcrop complex, 5 to 35 percent slopes, located at a latitude of 31 degrees, 57 minutes, 54 seconds N. and a longitude of 111 degrees, 33 minutes, 55 seconds W.; about 500 feet W. and 600 feet S. of the NE corner of sec. 7, T. 17 S., R. 8 E.

A1—0 to 1 inch; yellowish brown (10YR 5/4) gravelly sandy loam, dark yellowish brown (10YR 3/4) moist; weak medium and coarse platy structure; slightly hard, very friable, nonsticky, slightly plastic; many very fine and fine and few medium roots; many very fine and fine interstitial and tubular pores; 30 percent gravel; noneffervescent; neutral (pH 6.6); clear smooth boundary.

A2—1 to 5 inches; brown (7.5YR 5/4) gravelly sandy loam, dark brown (7.5YR 3/4) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky, nonplastic; many very fine and fine and few medium roots; many very fine and fine interstitial and tubular pores; 30 percent gravel; noneffervescent; neutral (pH 6.8); clear wavy boundary.

Bt—5 to 13 inches; reddish brown (5YR 4/4) gravelly sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate fine subangular blocky structure; slightly hard, very friable, sticky, plastic; many very fine and fine and few medium roots; many very fine and fine interstitial and tubular pores; many faint dark reddish brown (5YR 3/4) clay films on ped faces and in pores; 30 percent gravel; noneffervescent; neutral (pH 6.8); abrupt wavy boundary.

Crt—13 to 20 inches; pinkish white (7.5YR 8/2), and very dark gray (7.5YR 3/0) weathered granite; few very fine and fine roots in fractures; common distinct dark reddish brown (5YR 3/4) clay films in fractures.

Cr—20 to 60 inches; weathered granite.

Range in Characteristics

Rock fragments: 1 to 35 percent fine granitic gravel
Depth to weathered bedrock: 10 to 20 inches
Depth to unweathered bedrock: greater than 60 inches
Reaction: slightly acid to neutral

A horizons
Hue—10YR, 7.5YR
Organic matter—1 to 2 percent in the upper 7 inches

Pahaka Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid in the upper substratum and moderately slow in the lower substratum
Landform: fan terraces
Parent material: mixed fan alluvium
Slope range: 1 to 3 percent
Elevation: 1,400 to 2,400 feet
Classification: Coarse-loamy, mixed, hyperthermic Typic Camborthids

Typical Pedon

Pahaka sandy loam in an area of Mohall-Pahaka complex, 1 to 3 percent slopes, located at a latitude of 32 degrees, 34 minutes, 12 seconds N. and a longitude of 111 degrees, 01 minutes, 29 seconds W.; about 2,400 feet E. and 1,700 feet N. of the SW corner of sec. 11, T. 10 S., R. 3 E.

A—0 to 3 inches; yellowish brown (10YR 5/6) sandy loam, dark yellowish brown (10YR 4/4) moist; weak fine platy structure; soft, friable, nonsticky, nonplastic; common fine roots; common very fine interstitial and tubular pores; noneffervescent; mildly alkaline (pH 7.6); abrupt smooth boundary.

Bw1—3 to 14 inches; brown (7.5YR 5/4) sandy loam, brown to dark brown (7.5YR 4/4) moist; weak coarse subangular blocky structure; soft, friable, slightly sticky, slightly plastic; common very fine roots; common very fine interstitial and tubular pores; few faint clay bridging between sand grains; noneffervescent; mildly alkaline (pH 7.6); clear smooth boundary.

Bw2—14 to 19 inches; yellowish brown (10YR 5/6) sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; soft, friable, slightly sticky, slightly plastic; few fine roots; common very fine interstitial and tubular pores; few faint clay bridging between sand grains; noneffervescent; mildly alkaline (pH 7.6); clear smooth boundary.

Bk—19 to 25 inches; yellowish brown (10YR 5/6) sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; soft, friable, slightly sticky, slightly plastic; few fine roots; common very fine interstitial and tubular pores; few faint clay bridging between sand grains; calcium carbonate coats on lower surfaces of peds; strongly effervescent; mildly alkaline (pH 7.8); clear smooth boundary.

2Btkb1—25 to 30 inches; strong brown (7.5YR 5/6) sandy loam, strong brown (7.5YR 4/6) moist; weak coarse subangular blocky structure; slightly hard, friable, sticky, plastic; few fine roots; few fine tubular pores; few faint clay bridging between sand grains; calcium carbonate coats on lower surfaces of peds; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

2Btkb2—30 to 36 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; moderate coarse subangular blocky parting to moderate fine subangular blocky structure; slightly hard, friable, sticky, plastic; few fine roots; few fine tubular pores; few distinct clay films on ped faces; common coarse soft irregular calcium carbonate masses; slightly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

2Btkb3—36 to 42 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; moderate coarse subangular blocky parting to moderate fine subangular blocky structure; hard, friable, sticky, plastic; few fine roots; common fine tubular pores; few distinct clay films on ped faces; common coarse soft irregular calcium carbonate masses; violently effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

2Btkb4—42 to 60 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; moderate coarse subangular blocky structure; hard, friable, sticky, plastic; few fine roots; common fine tubular pores; few distinct clay films on ped faces; common coarse soft irregular calcium carbonate masses; violently effervescent; moderately alkaline (pH 8.2).

Range in Characteristics

Rock fragments: 5 to 55 percent in any one horizon, average less than 35 percent in the control section
Depth to buried argillic: 20 to 35 inches
Calcium carbonate equivalent: less than 5 percent
Salinity: none to very slight

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 through 6 moist
Chroma—4 through 6, dry or moist
Texture—sandy loam, fine sandy loam

Reaction—neutral to mildly alkaline

B horizons
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Texture—sandy loam, fine sandy loam
Reaction—mildly to moderately alkaline

2B horizons
Hue—5YR or 7.5YR
Value—4 through 7 dry, 3 or 5 moist
Chroma—4 through 6, dry or moist
Texture—loam, clay loam, sandy clay loam
Reaction—mildly to moderately alkaline

Pajarito Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: mixed fan alluvium
Slope range: 1 to 3 percent
Elevation: 2,000 to 3,000 feet
Classification: Coarse-loamy, mixed, thermic Typic Camborthids

Typical Pedon

Pajarito gravelly fine sandy loam in an area of Glendale-Pajarito complex, 1 to 3 percent slopes, located at a latitude of 32 degrees, 30 minutes, 11 seconds N. and a longitude of 112 degrees, 32 minutes, 00 seconds W.; located near the Sikort Chuapo Mountains.

A—0 to 2 inches; light brown (7.5YR 6/4) gravelly fine sandy loam; brown to dark brown (7.5YR 4/4) moist; weak fine platy structure; soft, very friable, slightly sticky, slightly plastic; few very fine and fine roots; few very fine and fine tubular pores; 20 percent gravel; noneffervescent; mildly alkaline (pH 7.8); clear smooth boundary.

Bw1—2 to 10 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; few medium roots; common very fine and fine tubular pores; 5 percent gravel; noneffervescent; moderately alkaline (pH 8.0); clear wavy boundary.

Bw2—10 to 22 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; few medium roots; common very fine and fine tubular pores; 10 percent gravel; slightly effervescent; moderately alkaline (pH 8.0); gradual wavy boundary.

Bk1—22 to 30 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few medium roots; common very fine and fine tubular pores; common distinct calcium carbonate coats on rock fragments; common fine calcium carbonate filaments; 10 percent gravel; strongly effervescent; moderately alkaline (pH 8.2); gradual wavy boundary.

Bk2—30 to 57 inches; light brown (7.5YR 6/4) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; massive; soft, very friable, slightly sticky, nonplastic; few medium and coarse roots; few fine tubular pores; common distinct calcium carbonate coats on rock fragments; few fine calcium carbonate filaments; 20 percent gravel; strongly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Ck—57 to 60 inches; light brown (7.5YR 6/4) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; massive; loose, nonsticky, nonplastic; few fine tubular pores; common distinct calcium carbonate coats on rock fragments; 25 percent gravel; strongly effervescent; moderately alkaline (pH 8.2).

Range in Characteristics

Rock fragments: average less than 15 percent gravel in the control section
Calcium carbonate equivalent: less than 5 percent
Reaction: mildly to moderately alkaline

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 3 or 4 moist
Texture—fine sandy loam, sandy loam

B horizons
Value—5 or 6 dry, 3 or 4 moist
Chroma—4 or 6, dry or moist
Texture—fine sandy loam, sandy loam

Pantak Series

Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderate
Landform: hills and mountains
Parent material: slope alluvium and residuum from igneous rock

Slope range: 25 to 60 percent
Elevation: 3,200 to 5,300 feet
Classification: Loamy-skeletal, mixed, thermic Lithic Ustollic Haplargids

Typical Pedon

Pantak very gravelly sandy loam in an area of Lampshire-Pantak-Rock outcrop complex, 25 to 60 percent slopes, located at a latitude of 31 degrees, 48 minutes, 50 seconds N. and a longitude of 111 degrees, 35 minutes, 00 seconds W.

A—0 to 1 inch; brown to dark brown (10YR 4/3) very gravelly sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonsticky, nonplastic; common fine roots; common fine interstitial pores; 40 percent gravel; noneffervescent; moderately acid (pH 6.0); abrupt wavy boundary.

AB—1 to 4 inches; brown (10YR 5/3) very gravelly sandy loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; soft, very friable, nonsticky, nonplastic; common fine and medium roots; common fine tubular pores; 45 percent gravel; noneffervescent; moderately acid (pH 6.0); abrupt wavy boundary.

Bt—4 to 14 inches; yellowish brown (10YR 5/4) very gravelly sandy clay loam, dark yellowish brown (10YR 3/4) moist; weak fine subangular blocky structure; soft, very friable, sticky, plastic; common fine and medium roots; common fine tubular pores; common distinct clay films on rock fragments; 50 percent gravel; noneffervescent; moderately acid (pH 6.0); abrupt wavy boundary.

R—14 inches; andesite.

Range in Characteristics

Rock fragments: 35 to 65 percent
Depth to unweathered bedrock: 4 to 20 inches
Reaction: moderately acid to neutral
Calcium carbonate: can have in the rock fractures
Organic matter: 1 to 3 percent

A horizon
Hue—7.5YR, 10YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—2 through 4, dry or moist

Bt horizon
Hue—7.5YR, 10YR
Value—4 or 5, dry or moist
Chroma—2 or 4, dry or moist
Texture—clay loam, sandy clay loam (20 to 35 percent clay)

Pantano Series

Depth class: shallow
Drainage class: well drained
Permeability: moderate
Landform: hills
Parent material: slope alluvium from diorite
Slope range: 5 to 25 percent
Elevation: 2,000 to 3,600 feet
Classification: Loamy-skeletal, mixed, thermic, shallow Typic Calciorthids

Typical Pedon

Pantano extremely gravelly fine sandy loam in an area of Pantano-Granolite complex, 5 to 25 percent slopes, located at a latitude of 32 degrees, 11 minutes, 31 seconds N. and a longitude of 111 degrees, 20 minutes, 46 seconds W.; about 1,600 feet W. and 1,450 feet N. of the SE corner of sec. 20, T. 14 S., R. 10 E.

A—0 to 2 inches; pale brown (10YR 6/3) extremely gravelly fine sandy loam, brown to dark brown (10YR 4/3) moist; moderate medium and coarse platy structure; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common very fine and fine vesicular and tubular; few patchy calcium carbonate coats on lower surfaces of peds; 10 percent cobbles and 70 percent gravel; slightly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bk1—2 to 8 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak very fine and fine subangular blocky structure; soft, very friable, sticky, nonplastic; common very fine and fine roots; common very fine and fine vesicular and tubular; common distinct calcium carbonate coats on lower surfaces of peds and gravel; 55 percent gravel; strongly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Bk2—8 to 11 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak very fine and fine subangular blocky structure; soft, very friable, slightly sticky, nonplastic; common very fine and fine roots; common very fine and fine vesicular and tubular pores; many distinct calcium carbonate coats on rock fragments; 55 percent gravel; strongly effervescent; moderately alkaline (pH 8.4); clear wavy boundary.

Bk3—11 to 16 inches; light brown (7.5YR 6/4) extremely gravelly sandy loam, brown to dark

brown (7.5YR 4/4) moist; massive; soft, very friable, nonsticky, nonplastic; common very fine and fine roots matted around stones; common very fine and fine vesicular and tubular pores; many distinct calcium carbonate coats on rock fragments; common coarse and very coarse irregular calcium carbonate nodules; 10 percent cobbles and 60 percent gravel; violently effervescent; moderately alkaline (pH 8.4); abrupt irregular boundary.

2Crk—16 to 22 inches; pinkish gray (5YR 6/2) weathered diorite, reddish gray (5YR 5/2) moist; few very fine and fine roots in fractures; many distinct calcium carbonate coats in rock fractures; violently effervescent.

R—22 inches; diorite.

Range in Characteristics

Rock fragments: 35 to 75 percent gravel and/or cobbles
Depth to weathered bedrock: 10 to 20 inches
Depth to unweathered bedrock: 20 to 30 inches
Depth to calcic horizon: 2 to 14 inches
Reaction: mildly to moderately alkaline

A horizon
Hue—7.5YR, 10YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—3 or 4, dry or moist

Bk horizons
Hue—7.5YR, 10YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—2 through 4, dry or moist
Texture—sandy loam, loam
Calcium carbonate equivalent—averages 15 to 40 percent

Pinamt Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: fan terraces and relict fan terraces
Parent material: mixed fan alluvium
Slope range: 1 to 15 percent
Elevation: 1,400 to 2,200 feet
Classification: Loamy-skeletal, mixed, hyperthermic Typic Haplargids

Typical Pedon

Pinamt extremely gravelly loam in an area of Pinamt-Momoli complex, 1 to 10 percent slopes, located at a latitude of 32 degrees, 45 minutes, 25 seconds N. and a longitude of 112 degrees, 00 minutes, 45 seconds W.; about 2,375 feet N. and 1,150 feet E. of the SW corner of sec. 1, T. 8 S., R. 3 E.

A—0 to 2 inches; light yellowish brown (10YR 6/4) extremely gravelly loam, yellowish brown (10YR 5/4) moist; weak fine platy structure; soft, friable, sticky, plastic; few very fine roots; common fine interstitial and tubular pores; 70 percent gravel; strongly effervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.

Btk1—2 to 11 inches; reddish brown (5YR 5/4) very gravelly clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, sticky, plastic; few very fine roots; few very fine tubular pores; many distinct clay films on ped faces, in pores, and on rock fragments; few fine calcium carbonate filaments; 10 percent cobbles and 45 percent gravel; violently effervescent; moderately alkaline (pH 8.4); clear wavy boundary.

Btk2—11 to 20 inches; reddish brown (5YR 5/4) very gravelly sandy clay loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky, plastic; few very fine roots; few fine tubular pores; few distinct clay films on ped faces and in pores; few fine calcium carbonate filaments, common fine soft irregular calcium carbonate masses and common distinct calcium carbonate coats on rock fragments; 10 percent cobbles and 40 percent gravel; strongly effervescent; moderately alkaline (pH 8.4); clear wavy boundary.

Btk3—20 to 30 inches; light brown (7.5YR 6/4) very gravelly sandy clay loam, brown (7.5YR 5/4) moist; soft, friable, slightly sticky, slightly plastic; few very fine tubular pores; few distinct clay films in pores, on rock fragments and clay bridging between the sand grains; common fine soft irregular calcium carbonate masses; 15 percent cobbles and 40 percent gravel; violently effervescent; moderately alkaline (pH 8.4); clear wavy boundary.

B—30 to 60 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown (7.5YR 5/4) moist; soft, friable, slightly sticky, slightly plastic; few clay bridges on sand grains; 15 percent cobbles and 45 percent gravel; violently effervescent; moderately alkaline (pH 8.4).

Range in Characteristics

Rock fragments: 35 to 80 percent gravel and/or cobbles
Reaction: mildly to strongly alkaline

Depth to calcic horizon: 5 to 40 inches
Salinity: none to very slightly in the upper part and slightly to moderate in the lower part
Clay content: averages more than 18 percent

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Texture—loam, fine sandy loam

B horizons
Hue—5YR, 7.5YR
Value—4 through 6 dry, 3 through 5 moist
Chroma—4 through 6, dry or moist
Texture—clay loam, sandy clay loam, loam, sandy loam, fine sandy loam

Some profiles have an indurated hardpan below 40 inches.

Quilotosa Series

Depth class: very shallow and shallow
Drainage class: somewhat excessively drained
Permeability: moderately rapid
Landform: hills and mountains
Parent material: slope alluvium and residuum from granite
Slope range: 3 to 45 percent
Elevation: 1,500 to 3,200 feet
Classification: Loamy-skeletal, mixed (calcareous), hyperthermic Lithic Torriorthents

Typical Pedon

Quilotosa extremely gravelly coarse sandy loam, 3 to 15 percent slopes, located at a latitude of 32 degrees, 10 minutes, 50 seconds N. and a longitude of 112 degrees, 39 minutes, 35 seconds W.; in the NW 1/4 of the SW 1/4 of sec. 26, T. 14 S., R. 3 W.

A—0 to 3 inches; light brown (7.5YR 6/4) extremely gravelly coarse sandy loam, brown (7.5YR 5/4) moist; weak thin platy parting to weak fine granular structure; soft, very friable, nonsticky, nonplastic; common fine roots; common very fine interstitial pores; 65 percent gravel; strongly effervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.

Bk—3 to 8 inches; light brown (7.5YR 6/4) extremely gravelly coarse sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, nonsticky, nonplastic; common fine roots; common fine interstitial pores; many distinct calcium carbonate coats on rock fragments; 65 percent gravel; violently effervescent; moderately alkaline (pH 8.0); gradual wavy boundary.

Crk—8 to 10 inches; weathered granite; slightly hard, firm; many distinct calcium carbonate coats on rock fragments; violently effervescent; abrupt wavy boundary.

R—10 inches; granite; many distinct calcium carbonate coats in fractures.

Range in Characteristics

Rock fragments: 35 to 85 percent gravel, cobbles, stones and/or boulders
Reaction: mildly to moderately alkaline
Depth to unweathered bedrock: 8 to 20 inches
Calcium carbonate equivalent: less than 5 percent

A and Bk horizons
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist
Texture—sandy loam, coarse sandy loam

Rillito Series

Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: moderate
Landform: fan terraces and stream terraces
Parent material: mixed fan alluvium and stream alluvium
Slope range: 1 to 8 percent
Elevation: 1,400 to 2,000 feet
Classification: Coarse-loamy, mixed, hyperthermic Typic Calciorthids

Typical Pedon

Rillito gravelly fine sandy loam in an area of Gunsight-Rillito complex, 1 to 8 percent slopes, located at a latitude of 32 degrees, 16 minutes, 25 seconds N. and a longitude of 112 degrees, 43 minutes, 00 seconds W.

A—0 to 3 inches; light yellowish brown (10YR 6/4) gravelly fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; common very fine roots; common very fine interstitial pores; 30 percent gravel; strongly effervescent; moderately alkaline (pH 8.0); clear smooth boundary.

Bw—3 to 13 inches; light yellowish brown (10YR 6/4) gravelly fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky,

slightly plastic; common very fine, fine and medium roots; few fine tubular pores; 30 percent gravel; strongly effervescent; mildly alkaline (pH 7.8); clear smooth boundary.

Bk1—13 to 31 inches; very pale brown (10YR 7/3) gravelly loam, yellowish brown (10YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky, slightly plastic; few very fine and medium roots; few very fine tubular pores; common distinct calcium carbonate coats rock fragments; 20 percent gravel; strongly effervescent; mildly alkaline (pH 7.8); clear wavy boundary.

Bk2—31 to 60 inches; very pale brown (10YR 7/3) gravelly loam, yellowish brown (10YR 5/4) moist; weak fine and medium subangular blocky structure; hard, very friable, sticky, plastic; common very fine roots; common very fine and fine tubular pores; few distinct calcium carbonate coats on rock fragments; 30 percent gravel; violently effervescent; mildly alkaline (pH 7.8).

Range in Characteristics

Rock fragments: 15 to 35 percent gravel
Reaction: mildly to moderately alkaline
Depth to calcic horizon: 3 to 25 inches
Salinity: none to slight

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—4 through 6, dry or moist

B horizons
Hue—7.5YR, 10YR
Value—5 through 7 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Texture—fine sandy loam, loam
Calcium carbonate equivalent—5 to 30 percent

Romero Series

Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderately rapid
Landform: hills and mountains
Parent material: slope alluvium and residuum from granite and schist
Slope range: 5 to 65 percent slopes
Elevation: 3,000 to 5,300 feet
Classification: Loamy-skeletal, mixed, nonacid, thermic, shallow Ustic Torriorthents

Typical Pedon

Romero very gravelly sandy loam in an area of Romero-Lampshire-Rock outcrop complex, 15 to 65 percent slopes, located at a latitude of 31 degrees, 58 minutes, 30 seconds N. and a longitude of 111 degrees, 33 minutes, 04 seconds W.; about 2,100 feet S. and 1,500 feet W. of the NE corner of sec. 5, T. 17 S., R. 8 E.

A1—0 to 2 inches; brown to dark brown (10YR 4/3) very gravelly sandy loam, very dark brown (10YR 2/2) moist; weak fine and medium platy structure; soft, very friable, nonsticky, nonplastic; many very fine and fine and few medium and coarse roots; few very fine and fine interstitial and tubular pores; 1 percent stones, 5 percent cobbles, and 40 percent gravel; noneffervescent; slightly acid (pH 6.4); clear smooth boundary.

A2—2 to 7 inches; brown to dark brown (10YR 4/3) very gravelly sandy loam, very dark brown (10YR 2/2) moist; weak very fine and fine subangular blocky structure; soft, very friable, slightly sticky, nonplastic; many very fine and fine and few medium and coarse roots; few very fine and fine interstitial and tubular pores; 5 percent cobbles and 50 percent gravel; noneffervescent; neutral (pH 6.8); abrupt wavy boundary.

Cr—7 to 60 inches; white (10YR 8/2), and very dark brown (10YR 2/2) weathered granite; few very fine and fine roots in fractures.

Range in Characteristics

Rock fragments: 35 to 90 percent gravel, channers, flagstones, and/or cobbles
Reaction: slightly acid to mildly alkaline
Depth to weathered bedrock: 4 to 20 inches
Depth to unweathered bedrock: 20 to 60 inches or more
Organic matter: 1 to 2 percent

A horizons
Hue—7.5YR, 10YR
Value—4 through 6 dry, 2 through 6 moist
Chroma—2 through 6, dry or moist

Rositas Series

Depth class: very deep
Drainage class: somewhat excessively drained
Permeability: rapid
Landform: dunes
Parent material: eolian sands
Slope range: 1 to 5 percent
Elevation: 1,400 to 2,000 feet
Classification: Mixed, hyperthermic Typic Torripsamments

Typical Pedon

Rositas loamy fine sand, 2 to 5 percent slopes, located at a latitude of 32 degrees, 45 minutes, 50 seconds N. and a longitude of 111 degrees, 48 minutes, 59 seconds W.; about 2,200 feet W. and 285 feet N. of the SE corner of sec. 34, T. 7 S., R. 5 E.

C1—0 to 1 inch; light yellowish brown (10YR 6/4) loamy fine sand, dark yellowish brown (10YR 4/4) moist; single grain; loose, nonsticky, nonplastic; few fine roots; few fine interstitial pores; noneffervescent; mildly alkaline (pH 7.4); abrupt smooth boundary.

C2—1 to 12 inches; light yellowish brown (10YR 6/4) fine sand, dark yellowish brown (10YR 4/4) moist; single grain; loose, nonsticky, nonplastic; few fine roots; few fine interstitial pores; noneffervescent; mildly alkaline (pH 7.6); clear smooth boundary.

C3—12 to 60 inches; light yellowish brown (10YR 6/4) fine sand, dark yellowish brown (10YR 4/4) moist; single grain; loose, nonsticky, nonplastic; few fine roots; few fine interstitial pores; slightly effervescent; mildly alkaline (pH 7.8).

Range in Characteristics

Reaction: neutral to strongly alkaline
Salinity: none to very slight

C horizons
Hue—7.5YR, 10YR
Value—5 or 6 dry, 3 through 5 moist
Chroma—3, 4 or 6, dry or moist
Texture—loamy sand, loamy fine sand, fine sand

Sahuarita Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate in the upper substratum and moderately slow in the lower substratum
Landform: fan terraces
Parent material: mixed fan alluvium
Slope range: 1 to 3 percent
Elevation: 2,000 to 3,000 feet
Classification: Coarse-loamy, mixed, thermic Typic Camborthids

Typical Pedon

Sahuarita sandy loam in an area of Pajarito-Sahuarita complex, 1 to 3 percent slopes, located at a latitude of 32 degrees, 11 minutes, 52 seconds N. and a longitude of 111 degrees, 18 minutes, 10 seconds W.; about 300 feet E. and 2,300 feet S. of the NW corner of sec. 23, T. 14 S., R. 10 E.

A1—0 to 4 inches; light brown (7.5YR 6/4) sandy loam, brown to dark brown (7.5YR 4/4) moist; weak medium platy structure; soft, friable, nonsticky, nonplastic; common very fine and fine roots; few fine tubular pores; slightly effervescent; mildly alkaline (pH 7.6); abrupt smooth boundary.

A2—4 to 7 inches; brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 3/4) moist; massive; soft, friable, nonsticky, nonplastic; common very fine and fine roots; common very fine tubular pores; slightly effervescent; mildly alkaline (pH 7.8); abrupt smooth boundary.

Bw1—7 to 18 inches; brown (7.5YR 5/4) sandy loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, nonsticky, slightly plastic; common very fine and fine roots; common very fine and few fine tubular pores; slightly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

Bw2—18 to 30 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky, nonplastic; common very fine and fine roots; common very fine tubular pores; few distinct organic coats in root channels and in pores; strongly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Bwb—30 to 34 inches; brown (7.5YR 5/4) loam, brown to dark brown (7.5YR 4/4) moist; weak fine prismatic parting to moderate medium subangular blocky structure; slightly hard, very friable, nonsticky, nonplastic; common medium roots; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

2Btkb1—34 to 46 inches; reddish brown (5YR 5/4), sandy clay loam, reddish brown (5YR 4/4) moist; weak medium prismatic structure; hard, friable, slightly sticky, plastic; few very fine and fine roots; common very fine tubular pores; few distinct clay films on ped faces and in pores; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

2Btkb2—46 to 60 inches; reddish brown (5YR 5/4), sandy clay loam, reddish brown (5YR 4/4) moist; weak medium prismatic structure; hard, friable,

slightly sticky, plastic; few very fine tubular pores; few faint clay films on ped faces and in pores; 10 percent gravel; strongly effervescent; moderately alkaline (pH 8.0).

Range in Characteristics

Rock fragments: 0 to 35 percent gravel
Depth to buried argillic: 20 to 40 inches
Reaction: mildly to moderately alkaline

A horizons
Value—5 or 6 dry, 3 or 4 moist

Bw and Bwb horizons
Value—5 or 6 dry, 4 or 5 moist
Texture—sandy loam, fine sandy loam
Calcium carbonate equivalent—0 to 5 percent

2B horizons
Value—5 or 6 dry, 4 or 5 moist
Texture—loam, sandy clay loam
Calcium carbonate equivalent—less than 15 percent

Sasco Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate
Landform: stream terraces
Parent material: mixed stream alluvium
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,000 feet
Classification: Coarse-silty, mixed, hyperthermic Typic Camborthids

Typical Pedon

Sasco loam, 0 to 1 percent slopes, located at a latitude of 32 degrees, 45 seconds, 53 minutes N. and a longitude of 111 degrees, 48 seconds, 58 minutes W.; about 2,000 feet W. and 600 feet N. of the SE corner of sec. 34, T. 7 S., R. 5 E.

A—0 to 1 inch; pale brown (10YR 6/3) loam, brown to dark brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky, slightly plastic; few fine roots; few fine tubular pores; slightly effervescent; mildly alkaline (pH 7.8); abrupt smooth boundary.

Bw1—1 to 5 inches; pale brown (10YR 6/3) loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; few fine roots; common fine tubular pores; strongly effervescent; mildly alkaline (pH 7.7); clear smooth boundary.

Bw2—5 to 15 inches; pale brown (10YR 6/3) silt loam, yellowish brown (10YR 5/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; few fine roots; few fine tubular pores; strongly effervescent; mildly alkaline (pH 7.6); clear smooth boundary.

C1—15 to 19 inches; very pale brown (10YR 7/3) silt loam, yellowish brown (10YR 5/6) moist; massive; soft, very friable, slightly sticky, nonplastic; few fine roots; few fine tubular pores; strongly effervescent; mildly alkaline (pH 7.8); abrupt smooth boundary.

C2—19 to 58 inches; pale brown (10YR 6/3) silt loam, brown to dark brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky, slightly plastic; few fine roots; common fine tubular pores; strongly effervescent; moderately alkaline (pH 7.9); abrupt wavy boundary.

C3—58 to 60 inches; light yellowish brown (10YR 6/4) silt loam; dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky, nonplastic; few fine roots; few medium tubular pores; slightly effervescent; mildly alkaline (pH 7.6).

Range in Characteristics

Reaction: mildly to moderately alkaline
Salinity: none to very slight

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—2 through 4, dry or moist

B and C horizons
Hue—7.5YR, 10YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—2 through 4, dry or moist
Texture—silt loam, silt; contains strata less than 5 inches thick of sandy loam or silty clay loam

Selevin Series

Depth class: very deep
Drainage class: well drained
Permeability: slow
Landform: relict fan terraces
Parent material: mixed fan alluvium
Slope range: 5 to 15 percent
Elevation: 2,800 to 3,800 feet
Classification: Clayey-skeletal, mixed, thermic Ustollic Paleargids

Typical Pedon

Selevin extremely gravelly sandy loam in an area of Caralampi-Selevin-Kimrose complex, 5 to 50 percent slopes, located at a latitude of 31 degrees, 49 minutes, 55 seconds N. and a longitude of 111 degrees, 40 minutes, 05 seconds W.

A—0 to 1 inch; reddish brown (5YR 4/4) extremely gravelly sandy loam, dark reddish brown (5YR 3/3) moist; weak thin platy structure; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common fine tubular pores; 65 percent gravel; noneffervescent; neutral (pH 7.2); abrupt smooth boundary.

Bt—1 to 16 inches; dark reddish brown (5YR 3/4) very gravelly sandy clay, dark reddish brown (5YR 3/4) moist; strong medium prismatic parting to strong medium subangular blocky structure; slightly hard, firm, very sticky, very plastic; common medium and coarse roots; common fine tubular pores; many distinct clay films on sand grains and gravel, on ped faces, and in pores; 40 percent gravel; noneffervescent; neutral (pH 7.2); gradual wavy boundary.

Btk—16 to 32 inches; reddish brown (5YR 4/4) extremely gravelly sandy clay loam, dark reddish brown (5YR 3/4) moist; massive; slightly hard, friable, sticky, plastic; common very fine, fine, medium and coarse roots; common fine tubular pores; few distinct clay films on sand grains and gravel; many distinct calcium carbonate coats on rock fragments; 65 percent gravel; strongly effervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.

Bk—32 to 60 inches; pink (7.5YR 8/4) extremely gravelly sandy loam, pink (7.5YR 7/4) moist; massive; hard, friable, sticky, plastic; few very fine and fine roots; common fine interstitial and tubular pores; many distinct calcium carbonate coats on rock fragments; common medium round calcium carbonate nodules; 65 percent gravel; violently effervescent; moderately alkaline (pH 8.2).

Range in Characteristics

Rock fragments: 35 to 75 percent
Depth to calcic horizon: 30 to 40 inches
Reaction: neutral to moderately alkaline

A horizon
Hue—5YR, 7.5YR
Value—3 through 5 dry, 2 through 4 moist
Chroma—2 through 4, dry or moist
Organic matter—1 to 2 percent

Bt horizon
Hue—2.5YR, 5YR
Value—3 through 5, dry or moist
Chroma—3 through 6, dry or moist
Texture—sandy clay loam, sandy clay, clay
Calcium carbonate equivalent—5 to 20 percent

Bk horizon
Hue—5YR, 7.5YR
Value—6 through 8, dry or moist
Chroma—2 through 4, dry or moist
Texture—sandy loam, sandy clay loam
Calcium carbonate equivalent—15 to 40 percent

Soledad Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: mixed fan alluvial
Slope range: 1 to 5 percent
Elevation: 2,000 to 3,200
Classification: Loamy-skeletal, mixed, thermic Typic Haplargids

Typical Pedon

Soledad gravelly loamy sand in an area of Soledad-Topawa complex, 1 to 5 percent slopes, located at a latitude of 32 degrees, 5 minutes, 0 seconds N. and a longitude of 111 degrees, 49 minutes, 20 seconds W. *(fig. 20)*.

A—0 to 3 inches; brown (7.5YR 5/4) gravelly loamy sand, brown to dark brown (7.5YR 4/4) moist; weak coarse platy structure; soft, very friable, nonsticky, nonplastic; few fine roots; common fine interstitial pores; 20 percent gravel; noneffervescent; neutral (pH 7.0); abrupt smooth boundary.

Bt1—3 to 13 inches; yellowish red (5YR 4/6) gravelly sandy loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, nonsticky, nonplastic; common fine and medium and few coarse roots; common fine interstitial and tubular pores; common distinct clay films on rock fragments and clay bridging on sand grains and gravel; 15 percent gravel; noneffervescent; mildly alkaline (pH 7.4); clear smooth boundary.

Bt2—13 to 27 inches; yellowish red (5YR 4/6) very gravelly sandy loam, reddish brown (5YR 4/4) moist; massive; soft, friable, nonsticky, nonplastic; common fine and medium roots; common fine interstitial pores; common distinct

clay films on rock fragments and clay bridging on sand grains and gravel; 55 percent gravel; noneffervescent; mildly alkaline (pH 7.6); clear smooth boundary.

Bk1—27 to 40 inches; reddish yellow (5YR 6/6) very gravelly sandy loam, yellowish red (5YR 4/6) moist; massive; soft, very friable, nonsticky, nonplastic; common fine roots; common fine interstitial and tubular pores; many distinct calcium carbonate coats on rock fragments; common fine and medium calcium carbonate filaments; 55 percent gravel; strongly effervescent; mildly alkaline (pH 7.8); gradual smooth boundary.

Bk2—40 to 60 inches; reddish yellow (5YR 6/6) very gravelly sandy loam, yellowish red (5YR 4/6) moist; massive; soft, very friable, nonsticky, nonplastic; few fine roots; few fine tubular and common interstitial pores; many distinct calcium carbonate coats on rock fragments; common fine and medium calcium carbonate filaments; 55 percent gravel; violently effervescent; moderately alkaline (pH 8.2).

Range in Characteristics

Rock fragments: 10 to 75 percent gravel and cobbles
Reaction: neutral to moderately alkaline
Organic matter: less than 1 percent

A horizon
- Hue—5YR, 7.5YR
- Value—4 through 6 dry, 3 or 4 moist
- Chroma—4 or 6, dry or moist

Bt horizons
- Hue—5YR, 7.5YR
- Value—4 or 5 dry, 3 through 5 moist
- Chroma—4 through 6, dry or moist
- Texture—sandy loam, loam (8 to 19 percent clay)

Bk horizons
- Hue—5YR, 7.5YR
- Value—4 or 5 dry, 3 through 5 moist
- Chroma—3 or 4, dry or moist
- Texture—sandy loam, loam
- Calcium carbonate equivalent—less than 10 percent

Spudrock Series

Depth class: moderately deep
Drainage class: well drained
Permeability: moderately rapid
Landform: mountains
Parent material: slope alluvium, colluvium and residuum from granite and gneiss
Slope range: 35 to 85 percent
Elevation: 5,300 to 7,500 feet
Classification: Loamy-skeletal, mixed, mesic Typic Ustochrepts

Typical Pedon

Spudrock stony fine sandy loam in an area of Far-Spudrock-Rock outcrop, 35 to 85 percent slopes, located at a latitude of 32 degrees, 57 minutes, 40 seconds N. and a longitude of 111 degrees, 35 minutes, 55 seconds W.

Oi—2 to 0 inches; recent litter of pine, oak and grasses; abrupt smooth boundary.

A—0 to 3 inches; very dark grayish brown (10YR 3/2) stony fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky, nonplastic; common very fine, fine, and medium roots; common fine interstitial pores; 10 percent stones and 15 percent gravel; noneffervescent; neutral (pH 6.8); abrupt smooth boundary.

Bw—3 to 15 inches; brown to dark brown (10YR 4/3) extremely gravelly loamy fine sand, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable, nonsticky, nonplastic; common fine and medium roots; common fine interstitial and tubular pores; common distinct organic coats in root channels and in pores; faint organic coats on sand grains and gravel; 65 percent gravel; noneffervescent; neutral (pH 6.8); gradual irregular boundary.

B/C—15 to 36 inches; 60 percent very pale brown (10YR 7/4), and 40 percent yellowish brown (10YR 5/4) very gravelly fine sandy loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, nonsticky, nonplastic; common fine and medium roots; common very fine and fine tubular pores; very few distinct reddish brown (5YR 4/4) clay films on rock fragments; 40 percent gravel; noneffervescent; neutral (pH 6.8); gradual irregular boundary.

Cr—36 to 60 inches; very pale brown (10YR 8/4), black (10YR 2/1), and brownish yellow (10YR 6/6) weathered granite (grus); brown to dark brown (10YR 4/3) moist; common fine and medium roots in fractures.

Range in Characteristics

Rock fragments: 35 to 65 percent gravel, cobbles and stones

Reaction: slightly acid to neutral, some pedons are strongly acid
Depth to weathered bedrock: 30 to 60 inches
Depth to unweathered bedrock: greater than 60 inches
Organic matter: 1 to 3 percent

A horizon
Value—3 through 5 dry, 2 or 3 moist
Chroma—2 or 3, dry or moist

Bw horizon
Value—5 or 6 dry, 4 or 5 moist
Chroma—2 or 4, dry or moist
Texture—fine sandy loam, sandy loam, loamy fine sand (5 to 20 percent clay)

B/C horizon
Value—5 through 7 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Texture—fine sandy loam, sandy loam (5 to 20 percent clay)

Stagecoach Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: mixed fan alluvium
Slope range: 1 to 20 percent
Elevation: 2,000 to 3,000
Classification: Loamy-skeletal, mixed, thermic Typic Calciorthids

Typical Pedon

Stagecoach very gravelly sandy loam in an area of Delnorte-Stagecoach complex, 1 to 20 percent slopes, located at a latitude of 32 degrees, 38 minutes, 08 seconds N. and a longitude of 112 degrees, 09 minutes, 38 seconds W.; about 100 feet S. and 2,500 feet E. of the NW corner of sec. 21, T. 9 S., R. 2 E.

A—0 to 1 inch; light brown (7.5YR 6/4) very gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, slightly sticky, nonplastic; few very fine and fine roots; common very fine vesicular and tubular pores; 45 percent gravel; violently effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

Bw—1 to 10 inches; brown (7.5YR 5/4) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; common very fine and fine roots; common very fine interstitial and tubular pores; 25 percent gravel; violently effervescent; moderately alkaline (pH 8.4); clear smooth boundary.

Bk1—10 to 24 inches; light brown (7.5YR 6/4) gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; common very fine and fine roots; common very fine interstitial and tubular pores; common faint calcium carbonate coats on rock fragments; 25 percent gravel; violently effervescent; moderately alkaline (pH 8.4); gradual wavy boundary.

Bk2—24 to 32 inches; light brown (7.5YR 6/4) very gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; massive; soft, friable, slightly sticky, slightly plastic; few very fine and fine roots; many distinct calcium carbonate coats on rock fragments; few fine soft rounded calcium carbonate masses; 45 percent gravel; violently effervescent; moderately alkaline (pH 8.4); gradual wavy boundary.

Bk3—32 to 60 inches; pinkish white (7.5YR 8/2) very gravelly sandy loam, pink (7.5YR 7/4) moist; massive; hard, very firm, slightly sticky, slightly plastic; many distinct calcium carbonate coats on rock fragments; 60 percent gravel; violently effervescent; moderately alkaline (pH 8.4).

Range in Characteristics

Rock fragments: 35 to 85 percent
Depth to calcic horizon: 10 to 25 inches
Reaction: mildly to moderately alkaline
Organic matter: less than 1 percent

A and B horizons
Hue—7.5YR, 10YR
Value—5 through 8 dry, 4 through 7 moist
Chroma—2 through 6, dry or moist
Texture—sandy loam; in the lower horizons some pedons have loamy sand textures or less than 35 percent coarse fragments
Calcium carbonate equivalent—greater than 5 percent below 10 inches

Tatai Series

Depth class: very deep
Drainage class: well drained

Permeability: moderately slow
Landform: flood plains
Parent material: mixed stream alluvium
Slope range: 0 to 2 percent
Elevation: 1,400 to 2,000 feet
Classification: Fine-loamy, mixed, hyperthermic Typic Camborthids

Typical Pedon

Tatai silt loam, 0 to 2 percent slopes, located at a latitude of 32 degrees, 42 minutes, 55 seconds N. and a longitude of 111 degrees, 47 minutes, 03 seconds W.; about 2,100 feet N. and 1,910 feet W. of the SE corner of sec. 24, T. 8 S., R. 4 E.; Santa Rosa Wash.

A—0 to 2 inches; light brown (7.5YR 6/4) silt loam, brown to dark brown (7.5YR 4/4) moist; moderate thin platy structure; slightly hard, friable, slightly sticky, slightly plastic; common very fine roots; few fine tubular pores; slightly effervescent; moderately alkaline (pH 8.4); abrupt smooth boundary.

Bw—2 to 24 inches; light brown (7.5YR 6/4) silt loam, brown to dark brown (7.5YR 4/4) moist; slightly hard, friable, slightly sticky, slightly plastic; common very fine roots; few fine tubular pores; slightly effervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

2Btkb—24 to 36 inches; reddish brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate fine subangular blocky structure; hard, firm, sticky, plastic; common very fine roots; few fine tubular pores; common distinct clay films on ped faces and in pores; common medium soft rounded calcium carbonate masses; violently effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

3Bnb—36 to 60 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 3/4) moist; weak fine subangular blocky structure; hard, firm, sticky, plastic; common very fine roots; few fine tubular pores; violently effervescent; strongly alkaline (pH 8.8).

Range in Characteristics

Depth to buried argillic: 20 to 38 inches but typically 24 to 30 inches
Reaction: moderately to strongly alkaline

A and B horizons
Hue—7.5YR, 10YR
Value—5 or 6 dry, 3 through 5 moist
Chroma—2 through 4, dry or moist
Texture—silt loam, silty clay loam (18 to 35 percent clay)
Calcium carbonate equivalent—5 to 15 percent
Salinity—slight to moderate
Sodicity—none to slight

2B and 3B horizons
Hue—5YR, 7.5YR
Value—5 or 6 dry, 3 through 5 moist
Chroma—3 through 6, dry or moist
Texture—clay loam, sandy clay loam, loam (20 to 35 percent clay)
Calcium carbonate equivalent—greater than 15 percent
Salinity—moderate to strong
Sodicity—moderate to strong

Topawa Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: fan terraces
Parent material: mixed fan alluvium
Slope range: 1 to 5 percent
Elevation: 2,000 to 3,200
Classification: Loamy-skeletal, mixed, thermic Typic Haplargids

Typical Pedon

Topawa very gravelly sandy loam in an area of Soledad-Topawa complex, 1 to 5 percent slopes, located at a latitude of 32 degrees, 5 minutes, 20 seconds N. and a longitude of 111 degrees, 49 minutes, 00 seconds W.

A—0 to 2 inches; brown (7.5YR 5/4) very gravelly sandy loam, brown to dark brown (7.5YR 4/4) moist; weak medium platy structure; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common fine interstitial pores; 40 percent gravels; noneffervescent; neutral (pH 7.0); abrupt smooth boundary.

Bt1—2 to 8 inches; reddish brown (5YR 4/4) extremely gravelly sandy loam, dark red (2.5YR 3/6) moist; moderate fine subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; common fine and very fine roots; common fine interstitial and tubular pores; many distinct clay films on rock fragments and clay bridging on sand grains and gravel; 70 percent gravel; noneffervescent; neutral (pH 7.2); abrupt smooth boundary.

Bt2—8 to 18 inches; reddish brown (5YR 4/4) very

gravelly sandy clay loam, dark red (2.5YR 3/6) moist; moderate fine subangular blocky structure; very hard, firm, sticky, plastic; common fine and very fine roots; few fine tubular pores; many distinct clay films on rock fragments, on ped faces, and in pores; clay bridging on sand grains and gravel; 40 percent gravel; noneffervescent; neutral (pH 7.2); clear wavy boundary.

Bt3—18 to 37 inches; yellowish red (5YR 4/6) extremely cobbly sandy clay loam, dark reddish brown (2.5YR 3/4) moist; moderate fine subangular blocky structure; very hard, firm, sticky, plastic; few fine roots; few fine tubular pores; many distinct clay films on rock fragments, on ped faces and in pores; 30 percent cobbles and 45 percent gravel; noneffervescent; neutral (pH 7.2); clear wavy boundary.

Bt4—37 to 60 inches; yellowish red (5YR 5/6) gravelly sandy loam, yellowish red (5YR 4/6) moist; massive; hard, firm, slightly sticky, slightly plastic; few fine roots; many fine interstitial pores; few distinct clay films on ped faces; clay bridging on sand grains and gravel; 25 percent gravel; noneffervescent; mildly alkaline (pH 7.6).

Range in Characteristics

Rock fragments: greater than 35 percent gravel and cobbles in the control section
Reaction: neutral to moderately alkaline
Calcium carbonate equivalent: less than 10 percent
Organic matter: less than 1 percent

A horizon
Hue—5YR, 7.5YR
Value—4 or 5 dry, 3 or 4 moist
Chroma—4 through 6 dry, 3 or 4 moist

Bt horizons
Hue—2.5YR, 5YR
Value—3 through 5 dry, 3 or 4 moist
Chroma—3 through 6, dry or moist
Texture—sandy loam, sandy clay loam, clay loam

Trix Series

Depth class: very deep
Drainage class: well drained
Permeability: moderate in the upper substratum to moderately slow in the lower substratum
Landform: alluvial fans
Parent material: mixed fan alluvium
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,200 feet
Classification: Fine-loamy, mixed (calcareous), hyperthermic Typic Torrifluvents

Typical Pedon

Trix very fine sandy loam, in an area of Mohall-Trix complex, 0 to 1 percent slopes, located at a latitude of 32 degrees, 03 minutes, 50 seconds N. and a longitude of 112 degrees, 18 minutes 30 seconds W.

C1—0 to 5 inches; strong brown (7.5YR 5/6) very fine sandy loam, brown to dark brown (7.5YR 4/4) moist; moderate thin platy structure; soft, very friable, nonsticky, slightly plastic; few fine roots; few fine tubular pores; noneffervescent; mildly alkaline (pH 7.8); abrupt smooth boundary.

C2—5 to 11 inches; strong brown (7.5YR 5/6) very fine sandy loam, brown to dark brown (7.5YR 4/4) moist; weak coarse platy structure; soft, very friable, nonsticky, slightly plastic; common fine roots; common fine tubular pores; very few calcium carbonate filaments; slightly effervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.

C3—11 to 22 inches; brown (7.5YR 5/4) loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; hard, very friable, sticky, plastic; common fine roots; common fine tubular pores; few calcium carbonate filaments; slightly effervescent; moderately alkaline (pH 7.8); clear wavy boundary.

2Btkb1—22 to 38 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak coarse prismatic parting to moderate medium subangular blocky structure; hard, friable, sticky, plastic; few fine roots; few fine tubular pores; common distinct clay films on ped faces and in pores; few calcium carbonate filaments; slightly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

2Btkb2—38 to 45 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, friable, very sticky, very plastic; few fine tubular pores; common distinct clay films on ped faces and in pores; few fine calcium carbonate filaments; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

2Btkb3—45 to 60 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate coarse subangular blocky structure; hard, friable, very sticky, very plastic; few distinct clay films on ped faces and in pores; common medium soft rounded calcium carbonate masses; violently effervescent; moderately alkaline (pH 8.0).

Range in Characteristics

Rock fragments: less than 5 percent
Depth to buried argillic: 20 to 30 inches
Reaction: mildly to moderately alkaline
Calcium carbonate equivalent: less than 15 percent in upper substratum and greater than 15 percent in lower substratum

C horizons
Hue—7.5YR, 10YR
Value—5 or 6 dry, 3 through 5 moist
Chroma—3 through 6, dry or moist

2B horizons
Hue—5YR, 7.5YR
Value—5 through 7 dry, 3 through 6 moist
Chroma—3 through 6, dry or moist
Texture—clay loam, sandy clay loam

Tubac Series

Depth class: very deep
Drainage class: well drained
Permeability: slow
Landform: basin floors
Parent material: mixed stream alluvium
Slope range: 0 to 2 percent
Elevation: 2,000 to 3,200 feet
Classification: Fine, mixed, thermic Typic Paleargids

Typical Pedon

Tubac loam in an area of Tubac complex, 0 to 2 percent slopes, located at a latitude of 31 degrees, 48 seconds, 30 minutes N. and a longitude of 111 degrees, 55 seconds, 30 minutes W.; N. of Fresnal Wash.

A—0 to 1 inch; brown (7.5YR 5/4) loam, brown to dark brown (7.5YR 4/4) moist; weak thin platy structure; soft, very friable, slightly sticky, slightly plastic; common very fine and fine roots; common very fine and fine vesicular and tubular pores; noneffervescent; mildly alkaline (pH 7.8); abrupt smooth boundary.

E/B—1 to 3 inches; brown (7.5YR 5/4) clay loam, brown to dark brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; soft, very friable, sticky, plastic; common very fine and fine roots; common very fine and fine interstitial and tubular pores; common distinct clay films on ped faces and in pores; noneffervescent; mildly alkaline (pH 7.6); clear wavy boundary.

Bt—3 to 13 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; strong medium subangular blocky structure; soft, very friable, very sticky, very plastic; common very fine and fine roots; common fine interstitial and tubular pores; many distinct clay films on ped faces and in pores; noneffervescent; mildly alkaline (pH 7.6); abrupt smooth boundary.

Btk1—13 to 28 inches; reddish brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; strong medium subangular blocky structure; hard, friable, very sticky, very plastic; common very fine and fine roots; common very fine and fine tubular pores; many distinct clay films on ped faces and in pores; few fine calcium carbonate filaments; few distinct manganese stains on ped faces; slightly effervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.

Btk2—28 to 48 inches; reddish brown (5YR 4/4) sandy clay loam, reddish brown (5YR 4/3) moist; weak fine subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few very fine and fine roots; common very fine and fine interstitial and tubular pores; common distinct clay films on rock fragments, on ped faces, and in pores; few distinct manganese stains on ped faces; 10 percent gravel; slightly effervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.

Bk—48 to 60 inches; strong brown (7.5YR 5/6) fine sandy loam, brown to dark brown (7.5YR 4/4) moist; weak fine and medium subangular blocky structure; soft, very friable, slightly sticky, slightly plastic; few very fine and fine roots; common very fine and fine interstitial pores; few distinct calcium carbonate coats on rock fragments; common fine soft calcium carbonate masses; strongly effervescent; moderately alkaline (pH 8.2).

Range in Characteristics

Rock fragments: less than 10 percent
Calcium carbonate equivalent: less than 15 percent
Organic matter: less than 1 percent

A horizon
Value—4 or 5 dry
Chroma—2 through 4 moist
Texture—sandy loam, loam
Reaction—neutral to mildly alkaline

Bt horizons
Hue—2.5YR through 7.5YR
Value—3 through 5 dry, 3 or 4 moist
Chroma—4 through 6 dry, 2 through 6 moist

Texture—sandy clay loam, clay, sandy clay, clay loam; some pedons have fine sandy loam
Reaction—mildly to strongly alkaline

Tucson Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: basin floors
Parent material: mixed fan alluvium
Slope range: 1 to 3 percent
Elevation: 1,400 to 2,200 feet
Classification: Fine-loamy, mixed, hyperthermic Typic Haplargids

Typical Pedon

Tucson gravelly fine sandy loam, in an area of Tucson-Mohall-Valencia complex, 1 to 3 percent slopes, located at a latitude of 32 degrees, 05 minutes, 00 seconds N. and a longitude of 112 degrees, 29 minutes, 00 seconds W.; Pisinimo SW in NW 1/4 *(fig. 21).*

A—0 to 1 inch; light brown (7.5YR 6/4) gravelly fine sandy loam, brown (7.5YR 5/4) moist; weak thin platy structure; soft, friable, nonsticky, nonplastic; few fine roots; common fine vesicular pores; 20 percent gravel; noneffervescent; mildly alkaline (pH 7.6); abrupt wavy boundary.

Bt1—1 to 7 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky, nonplastic; few fine roots; few fine vesicular pores; few patchy clay films on ped faces and in pores; 5 percent gravel; noneffervescent; mildly alkaline (pH 7.6); abrupt smooth boundary.

Btk1—7 to 14 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; few fine vesicular pores; few distinct clay films on ped faces and in pores; common fine calcium carbonate filaments; 3 percent gravel; strongly effervescent; mildly alkaline (pH 7.6); clear wavy boundary.

Btk2—14 to 21 inches; light reddish brown (5YR 6/4) sandy clay loam, reddish brown (5YR 5/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; few fine vesicular pores; few distinct clay films on ped faces and in pores; few fine soft calcium carbonate masses; common fine calcium carbonate filaments; 3 percent gravel; strongly effervescent; mildly alkaline (pH 7.8); clear wavy boundary.

Bk1—21 to 37 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; weak coarse subangular blocky structure; hard, friable, slightly sticky, slightly plastic; few fine roots; few fine vesicular pores; many fine soft calcium carbonate masses; 5 percent gravel; violently effervescent; moderately alkaline (pH 8.0); clear wavy boundary.

Bk2—37 to 60 inches; light reddish brown (5YR6/4) loam, reddish brown (5YR 5/4) moist; weak coarse subangular blocky structure; hard, friable, slightly sticky, slightly plastic; few fine roots; few fine tubular pores; common fine calcium carbonate filaments; few fine soft calcium carbonate masses; 3 percent gravel; violently effervescent; strongly alkaline (pH 8.8).

Range in Characteristics

Rock fragments: average less than 15 percent gravel
Depth to calcic horizon: less than 20 inches
Reaction: mildly to very strongly alkaline
Salinity: very slight to moderate
Sodicity: slight to moderate

A horizon
Value—5 through 7 dry, 3 through 6 moist
Chroma—4 through 6, moist or dry
Organic matter—less than 1 percent

Bt and Btk horizons
Hue—5YR, 7.5YR
Value—4 through 6 dry, 3 through 5 moist
Chroma—4 through 6, dry or moist
Texture—sandy clay loam, clay loam, loam
SAR—exceeds 13 percent in some pedons
Calcium carbonate equivalent—3 to 10 percent

Bk horizons
Hue—5YR, 7.5YR
Value—4 through 6 dry, 3 through 5 moist
Chroma—4 through 6, dry or moist
Texture—sandy loam, loam, clay loam
Calcium carbonate equivalent—10 to 30 percent

Surface is covered by 70 to 80 percent varnish-covered gravel

Vado Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately rapid
Landform: fan terraces
Parent material: mixed fan alluvium

Slope range: 1 to 8 percent
Elevation: 2,000 to 3,000 feet
Classification: Loamy-skeletal, mixed, thermic Typic Camborthids

Typical Pedon

Vado gravelly fine sandy loam in an area of Grabe-Vado complex, 1 to 5 percent slopes, located at a latitude of 31 degrees, 41 minutes, 15 seconds N. and a longitude of 111 degrees, 44 minutes, 58 seconds W.

A—0 to 3 inches; yellowish brown (10YR 5/4) gravelly fine sandy loam, brown to dark brown (10YR 4/3) moist; weak coarse platy structure; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common fine interstitial and tubular pores; 15 percent gravel; strongly effervescent; mildly alkaline (pH 7.4); abrupt smooth boundary.

AC—3 to 6 inches; yellowish brown (10YR 5/4) gravelly fine sandy loam, brown to dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common fine interstitial and tubular pores; many distinct calcium carbonate coats on lower surfaces of peds and gravel; 15 percent gravel; strongly effervescent; mildly alkaline (pH 7.4); abrupt smooth boundary.

Bw1—6 to 17 inches; yellowish brown (10YR 5/4) gravelly sandy loam, brown to dark brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky, nonplastic; common very fine, fine and medium roots; common fine tubular and few fine interstitial pores; many distinct calcium carbonate coats on lower surfaces of peds and gravel; 30 percent gravel; strongly effervescent; mildly alkaline (pH 7.4); abrupt wavy boundary.

Bw2—17 to 29 inches; yellowish brown (10YR 5/4) very gravelly sandy loam, brown to dark brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky, nonplastic; common very fine, fine and medium roots; common fine interstitial and tubular pores; many distinct calcium carbonate coats on lower surfaces of peds and gravel; 40 percent gravel; violently effervescent; mildly alkaline (pH 7.4); clear wavy boundary.

Bk1—29 to 51 inches; yellowish brown (10YR 5/4) very gravelly sandy loam, brown to dark brown (10YR 4/3) moist; massive; soft, very friable, nonsticky, nonplastic; common very fine and fine roots; common fine interstitial and tubular pores; many distinct calcium carbonate coats on lower surfaces of peds and gravel; 45 percent gravel; violently effervescent; mildly alkaline (pH 7.4); abrupt wavy boundary.

Bk2—51 to 60 inches; yellowish brown (10YR 5/4) loam, brown to dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; soft, very friable, nonsticky, nonplastic; few very fine and fine roots; common fine tubular pores; violently effervescent; mildly alkaline (pH 7.4).

Range in Characteristics

Rock fragments: average 35 to 70 percent
Reaction: mildly to moderately alkaline
Calcium carbonate equivalent: less than 5 percent

A horizon
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 through 5, dry or moist
Texture—fine sandy loam, sandy loam
Organic matter—less than 1 percent

Bw horizons
Hue—10YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 through 5, dry or moist

Bk horizons
Hue—7.5YR, 10YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Texture—sandy loam, loam, some strata of sand

Vaiva Series

Depth class: very shallow and shallow
Drainage class: well drained
Permeability: moderate
Landform: hills and mountains
Parent material: slope alluvium and residuum from granite
Slope range: 15 to 40 percent
Elevation: 1,500 to 3,200 feet
Classification: Loamy-skeletal, mixed, hyperthermic Lithic Haplargids

Typical Pedon

Vaiva very gravelly loam in an area of Quilotosa-Rock outcrop-Vaiva complex, 15 to 45 percent slopes, located at a latitude of 32 degrees, 27 minutes, 10 seconds N. and a longitude of 111 degrees, 52 minutes, 25 seconds W.; about 2,640 feet W. and 100 feet S. of the NE corner of sec. 29, T. 11 S., R. 5 E.

A—0 to 1 inch; yellowish brown (10YR 5/4) very gravelly loam, brown to dark brown (10YR 4/3) moist; weak fine platy structure; soft, very friable, slightly sticky, nonplastic; few fine roots; common very fine tubular pores; 50 percent gravel; noneffervescent; moderately alkaline (pH 8.2); abrupt smooth boundary.

Bt1—1 to 13 inches; reddish brown (5YR 4/4) very gravelly sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate very fine subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; few very fine tubular pores; common distinct clay films on ped faces; 55 percent gravel; noneffervescent; moderately alkaline (pH 8.2); clear smooth boundary.

Bt2—13 to 19 inches; yellowish red (5YR 5/6) extremely gravelly sandy clay loam, reddish brown (5YR 4/4) moist; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; few very fine tubular pores; common distinct clay films on ped faces and on rock fragments; 80 percent gravel; noneffervescent; moderately alkaline (pH 8.2); clear wavy boundary.

R—19 inches; granite.

Range in Characteristics

Rock fragments: 30 to 50 percent of surface is covered with gravel, cobbles and/or stones; the control section ranges from 35 to 80 percent rock fragments

Depth to unweathered bedrock: 4 to 20 inches

Reaction: mildly to moderately alkaline

A horizon

Hue—10YR, 7.5YR
Value—4 through 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Organic matter—less than 1 percent

Bt horizons

Hue—7.5YR, 5YR
Value—4 through 6 dry, 4 or 5 moist
Chroma—3 or 4, dry or moist
Texture—sandy clay loam, clay loam (more than 20 percent clay)

Valencia Series

Depth class: very deep

Drainage class: well drained

Permeability: moderately rapid in the upper part and moderately slow in the lower part

Landform: flood plains and alluvial fans

Parent material: mixed fan alluvium and stream alluvium

Slope range: 0 to 2 percent

Elevation: 1,400 to 2,200 feet

Classification: Coarse-loamy, mixed, hyperthermic Fluventic Camborthids

Typical Pedon

Valencia fine sandy loam in an area of Casa Grande-Rositas-Valencia complex, 0 to 5 percent slopes, located at a latitude of 32 degrees, 27 minutes, 38 seconds N. and a longitude of 112 degrees, 00 minutes, 50 seconds W.; about 1,100 feet W. and 550 feet S. of the NE corner of sec. 24, T. 11 S., R. 4 E.

A1—0 to 1 inch; light yellowish brown (10YR 6/4) fine sandy loam; dark yellowish brown (10YR 4/4) moist; weak fine platy structure; soft, very friable, slightly sticky, plastic; common very fine roots; common very fine vesicular and tubular pores; noneffervescent; mildly alkaline (pH 7.4); abrupt smooth boundary.

A2—1 to 10 inches; light yellowish brown (10YR 6/4) fine sandy loam; dark yellowish brown (10YR 4/4) moist; weak coarse subangular blocky structure; soft, friable, sticky, nonplastic; common very fine roots; common fine tubular pores; noneffervescent; mildly alkaline (pH 7.4); clear wavy boundary.

Bk1—10 to 16 inches; brown (7.5YR 5/4) sandy loam; strong brown (7.5YR 4/6) moist; weak medium subangular blocky structure; soft, friable, slightly sticky, slightly plastic; common fine roots; common fine interstitial and tubular pores; few distinct calcium carbonate coats in root channels and pores; strongly effervescent; moderately alkaline (pH 8.2); clear wavy boundary.

Bk2—16 to 25 inches; strong brown (7.5YR 5/6) sandy loam, brown to dark brown (7.5YR 4/4) moist; weak coarse subangular blocky parting to weak medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; common very fine interstitial and tubular pores; common distinct calcium carbonate coats in root channels and pores; slightly effervescent; mildly alkaline (pH 7.4); abrupt wavy boundary.

2Btknb1—25 to 35 inches; strong brown (7.5YR 5/6) sandy clay loam, strong brown (7.5YR 4/6) moist; weak coarse subangular blocky parting to moderate medium subangular blocky structure; very hard, firm, sticky, plastic; few fine roots; common fine interstitial and tubular pores; common distinct clay films on ped faces; common coarse soft irregular calcium carbonate

masses; strongly effervescent; very strongly alkaline (pH 9.4); abrupt wavy boundary.
2Btknb2—35 to 47 inches; strong brown (7.5YR 4/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine roots; few fine interstitial and tubular pores; many distinct clay bridging between sand grains; common coarse soft irregular calcium carbonate masses; strongly effervescent; very strongly alkaline (pH 9.4); abrupt wavy boundary.
2Btknb3—47 to 60 inches; strong brown (7.5YR 4/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky, plastic; few fine roots; few fine tubular pores; many distinct clay films on ped faces; common very coarse soft irregular calcium carbonate masses; strongly effervescent; very strongly alkaline (pH 9.4).

Range in Characteristics

Depth to buried argillic: 20 to 40 inches
Reaction: mildly to very strongly alkaline
Sodicity: none to strong
Salinity: none to moderate

A and B horizons
Hue—10YR, 7.5YR
Value—5 or 6 dry, 4 or 5 moist
Chroma—2 through 6, dry or moist
Organic matter—less than 0.5 percent
Calcium carbonate equivalent—less than 5 percent
Texture for B horizons: sandy loam, fine sandy loam with some pedons containing thin strata of coarser or slightly finer textures

2Btknb horizons
Hue—5YR, 7.5YR
Value—5 or 6 dry, 3 through 5 moist
Chroma—3 through 6, dry or moist
Texture—clay loam, sandy clay loam

Vecont Series

Depth class: very deep
Drainage class: well drained
Permeability: slow
Landform: basin floors
Parent material: mixed stream alluvium
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,000 feet
Classification: Fine, mixed, hyperthermic Typic Haplargids

Typical Pedon

Vecont clay loam, 0 to 1 percent slopes, located at a latitude of 32 degrees, 29 minutes, 05 seconds N. and a longitude of 111 degrees, 51 minutes, 50 seconds W.; about 2,400 feet N. and 600 feet E. of SW corner of sec. 16, T. 11 S., R. 5 E.

A—0 to 2 inches; yellowish brown (10YR 5/4) clay loam, brown to dark brown (10YR 4/3) moist; weak thin platy structure; slightly hard, friable, sticky, plastic; few fine roots; few fine tubular pores; noneffervescent; moderately alkaline (pH 8.0); abrupt smooth boundary.
Bt1—2 to 4 inches; dark yellowish brown (10YR 4/4) clay loam, brown to dark brown (10YR 4/3) moist; moderate medium prismatic parting to weak fine subangular blocky structure; hard, friable, sticky, plastic; few fine roots; few fine tubular pores; few distinct clay films on ped faces and in pores; noneffervescent; moderately alkaline (pH 8.0); clear wavy boundary.
Bt2—4 to 14 inches; dark yellowish brown (10YR 4/4) clay loam, brown to dark brown (10YR 4/3) moist; moderate medium platy parting to weak fine subangular blocky structure; hard, friable, sticky, plastic; few fine roots; few very fine tubular pores; common distinct clay films on ped faces and in pores; noneffervescent; moderately alkaline (pH 8.0); clear smooth boundary.
Bt3—14 to 18 inches; dark yellowish brown (10YR 4/4) clay loam, brown to dark brown (10YR 4/3) moist; moderate fine prismatic structure; hard, friable, sticky, plastic; few fine roots; few fine tubular pores; common distinct clay films on ped faces and in pores; noneffervescent; moderately alkaline (pH 8.0); abrupt wavy boundary.
Bt4—18 to 24 inches; yellowish brown (10YR 5/4), clay loam, brown to dark brown (10YR 4/3 moist; weak fine subangular blocky structure; hard, friable, sticky, plastic; few fine roots; few very fine tubular pores; common distinct clay films on ped faces and in pores; slightly effervescent; moderately alkaline (pH 8.2); gradual smooth boundary.
Bt5—24 to 35 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; weak fine subangular blocky structure; hard, friable, sticky, plastic; few fine roots; few very fine tubular pores; few distinct clay films on

ped faces and in pores; slightly effervescent; moderately alkaline (pH 8.2); gradual smooth boundary.

Bt6—35 to 43 inches; brown (7.5YR 5/4) clay loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; hard, friable, sticky, plastic; few fine roots; few very fine tubular pores; few distinct clay films on ped faces and in pores; slightly effervescent; moderately alkaline (pH 8.2); gradual smooth boundary.

Bt7—43 to 60 inches; brown (7.5YR 5/4) clay loam, brown to dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; hard, friable, sticky, plastic; few fine roots; few very fine tubular pores; few distinct clay films on ped faces and in pores; slightly effervescent; moderately alkaline (pH 8.2).

Range in Characteristics

Rock fragments: 0 to 10 percent gravel
Organic matter: less than 1 percent
Calcium carbonate equivalent: less than 15 percent
Salinity: none to very slight

A horizon
Value—5 or 6 dry
Chroma—3 or 4 moist

Bt horizons
Value—4 through 6 dry
Chroma—3 through 6 moist
Texture—clay loam, silty clay, clay

Wintersburg Series

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: fan terraces and stream terraces
Parent material: mixed fan alluvium and stream alluvium
Slope range: 0 to 1 percent
Elevation: 1,400 to 2,000 feet
Classification: Fine-loamy, mixed, hyperthermic Typic Calciorthids

Typical Pedon

Wintersburg loam, 0 to 1 percent slopes, located at a latitude of 32 degrees, 03 minutes, 00 seconds N. and a longitude of 112 degrees, 24 minutes, 00 seconds W.

A—0 to 2 inches; light brown (7.5YR 6/4) loam, brown to dark brown (7.5YR 4/4) moist; weak medium platy structure; soft, friable, slightly sticky, slightly plastic; common fine roots; common fine vesicular pores; strongly effervescent; mildly alkaline (pH 7.8); abrupt wavy boundary.

Bw—2 to 13 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; few fine and medium roots; common fine tubular pores; few distinct calcium carbonate coats on ped faces; few fine calcium carbonate filaments; violently effervescent; mildly alkaline (pH 7.8); clear wavy boundary.

Bk1—13 to 21 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; hard, friable, slightly sticky, slightly plastic; few fine and medium roots; few fine tubular pores; few distinct calcium carbonate coats on lower surfaces of peds; few fine soft rounded calcium carbonate masses; violently effervescent; mildly alkaline (pH 7.8); clear wavy boundary.

Bk2—21 to 51 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; hard, friable, slightly sticky, slightly plastic; few fine roots; common fine tubular pores; common distinct calcium carbonate coats on ped faces and in pores; common fine soft rounded calcium carbonate masses; violently effervescent; mildly alkaline (pH 7.8); gradual wavy boundary.

Bk3—51 to 60 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; very hard, friable, slightly sticky, slightly plastic; few fine roots; few fine tubular pores; few distinct calcium carbonate coats on ped faces; few fine soft rounded calcium carbonate masses; violently effervescent; strongly alkaline (pH 8.8).

Range in Characteristics

Depth to calcic horizon: 10 to 30 inches
Reaction: mildly to strongly alkaline
Salinity: none to slight

A horizon
Hue—10YR, 7.5YR
Value—4 through 6 dry, 2 through 4 moist
Chroma—2 through 4, dry or moist
Organic matter— less than 1 percent

Bw horizon
Hue—10YR, 7.5YR
Value—5 through 7 dry, 4 through 6 moist
Chroma—2 through 4, dry or moist

Texture—loam, clay loam, sandy clay loam

Bk horizons
Hue—10YR, 7.5YR
Value—6 through 8 dry, 5 through 7 moist
Chroma—2 through 4, dry or moist
Texture—loam, clay loam, silt loam
Calcium carbonate equivalent—greater than 15 percent

Figure 17.—Profile of Bucklebar sandy loam in an area of Bucklebar-Hayhook-Tubac complex, 0 to 3 percent slopes.

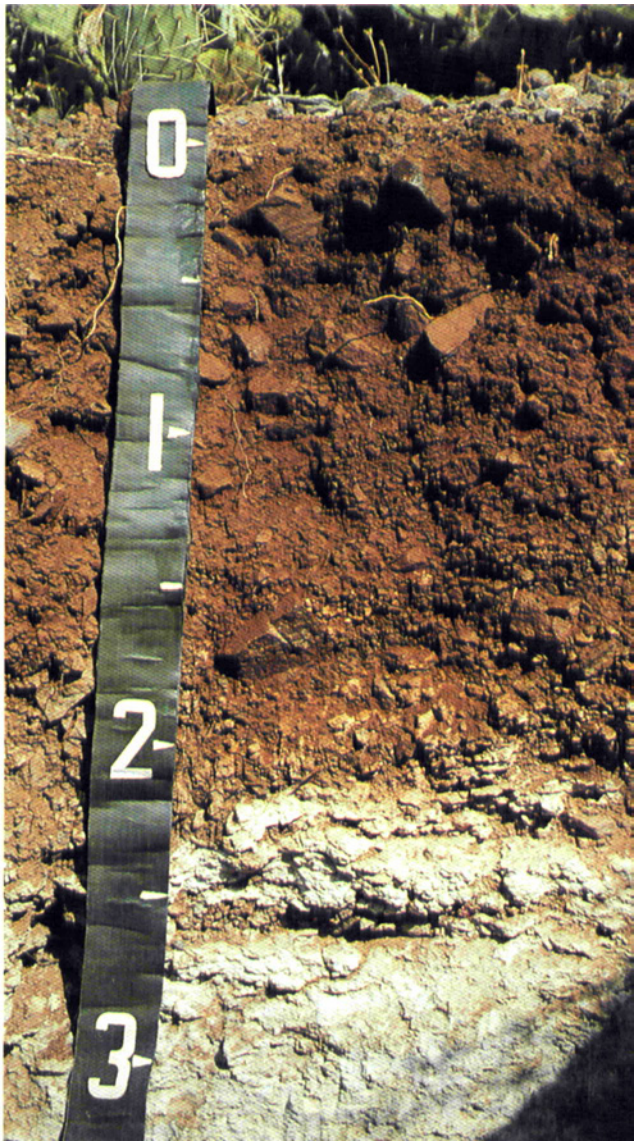

Figure 18.—Profile of Caracara extremely gravelly sandy loam in an area of Delthorny-Caracara complex, 3 to 25 percent slopes.

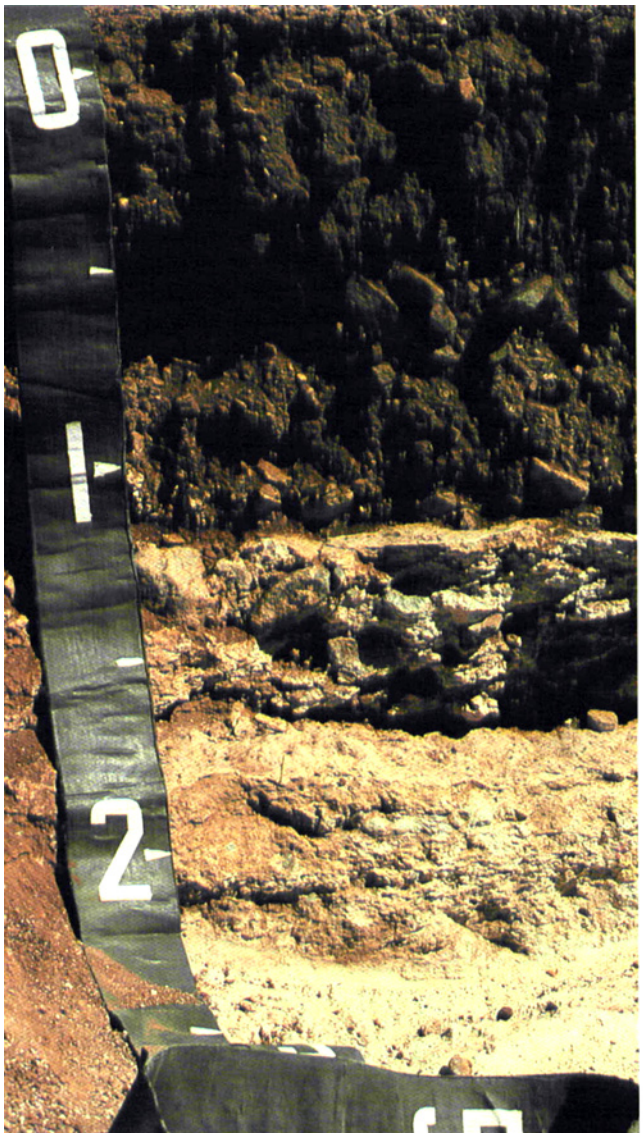

Figure 19.—Profile of Kimrose very gravelly sandy loam in an area of Caralampi-Selevin-Kimrose complex, 5 to 50 percent slopes.

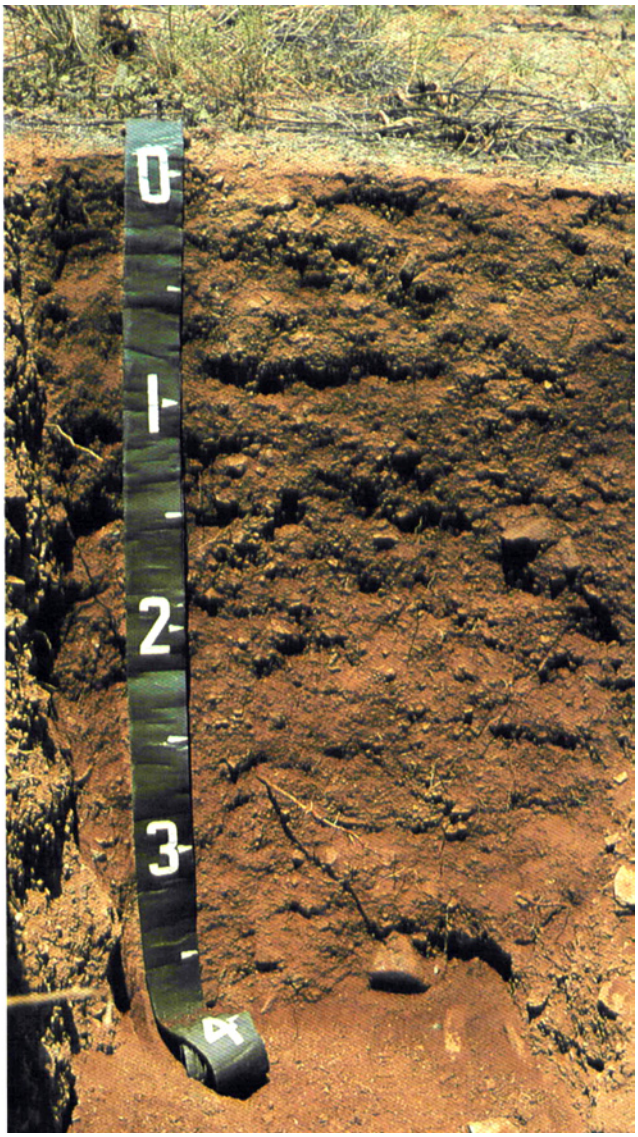

Figure 20.—Profile of Soledad gravelly loamy sand in an area of Soledad-Topawa complex, 1 to 5 percent slopes.

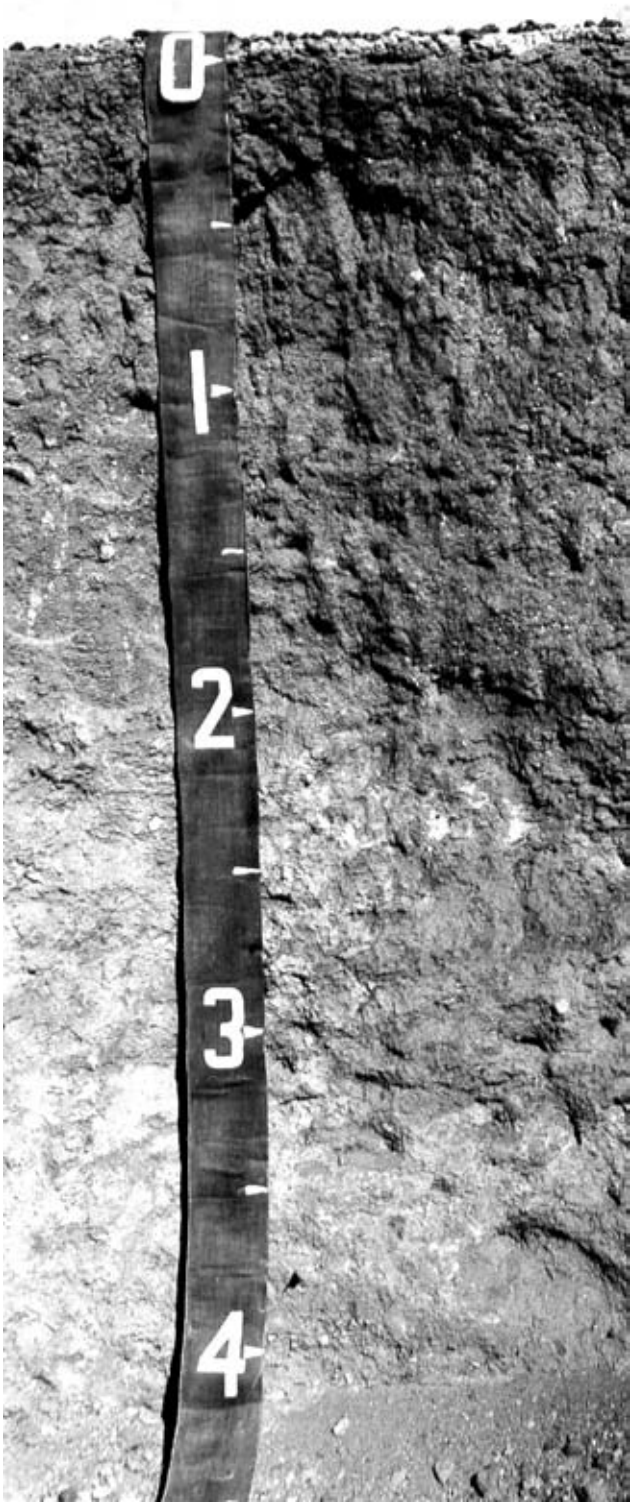

Figure 21.—Profile of Tucson gravelly fine sandy loam showing the leached surface horizon, which is lighter in color.

Formation of the Soils

Soil is a natural, three-dimensional body on the surface of the earth that supports plants. Although the soil mantle on the earth's surface varies widely in many places, all soils have some things in common. They all consist of mineral, organic matter, living organisms, water, and air, which occur in varying amounts in different soils.

Soil results from the action of soil-forming processes on materials deposited or accumulated by geological processes. The characteristics of the soil at any given point are determined by five factors: (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material accumulated and has existed since accumulation, (3) the plant and animal life on and in the soil, (4) the topography, or lay of the land, and (5) the length of time that the forces of soil formation have acted on the parent material (Jenny, 1980). These factors of soil formation are independent, and few generalizations can be made regarding any one factor unless the effects of the others are known (Gile, 1965).

The Tohono O'odham Nation covers 2,855,032 acres in southern Arizona and has a diversity of soil types. It is located in the Basin and Range Province, which is characterized by numerous mountain ranges that rise abruptly from broad, plain-like valleys or basins (Thornbury 1969). These features have resulted mainly from mid-Tertiary block faulting: upfaulted blocks eroded to form mountains and pediments, and downfaulted blocks filled with sediments (Kottlowski 1965). The Nation lies in the Sonoran Desert. Its western boundary is about 10 miles east of Ajo, its northernmost boundary is about 10 miles south of Casa Grande, its eastern boundary falls along the Baboquivari Mountain Range, and its southern boundary is the United States-Mexico border.

Parent Material

Parent material is the unconsolidated material in which the soil forms. It may have weathered in place from rock, or it may have been transported by water, wind, or ice.

The parent material of the soils in the survey area was derived from several sources and types of bedrock. Parent material can be put into six general groups: residuum, colluvium, slope alluvium, fan alluvium, stream alluvium, and eolian sand. Soils can form from a single parent material or a combination of parent materials.

Residuum is unconsolidated, weathered, or partly weathered mineral material that accumulated by the disintegration of bedrock in place. An example of a soil with this type of parent material is the Oracle series.

Colluvium is unconsolidated earth materials deposited on and at the base of moderately steep and steep slopes by mass wasting (direct gravitational action) and local runoff. An example of a soil with this type of parent material is the Lampshire series.

Alluvium is unconsolidated material deposited by running water, including gravel, sand, silt, clay, and various mixtures of these. Slope alluvium is moved from steep slopes to more gentle slopes. An example of a soil with this type of parent material is the Cellar soil. Fan alluvium is moved along alluvial fans and fan terraces. Examples of soils having this type of parent material are the Topawa and Hayhook series. Stream alluvium is deposited by streams. Examples of soils having this type of parent material is the Ginland and Glendale series. Alluvial parent material can come from more than one source.

Eolian parent material pertains to material transported and deposited by the wind. It results in dune formations. The Rositas series is an example of eolian sand parent material.

Climate

Climate, past and present, has a profound and continuing effect on soil formation. Heat and moisture control the kinds and amounts of organisms inhabiting the area (Cook and Warren 1973). These factors affect the accumulation of organic matter, the type and rate of weathering of the soil mineral constituents, and the development of diagnostic soil features. The Tohono O'odham Nation has a very diverse climate, which ranges from the dry, hot

Sonoran desert of the west to the mild, cool Mexican oak-pine woodlands of Kitt and Baboquivari Peaks. The survey area encompasses four temperature and moisture regimes: Aridic Ustic Mesic, Ustic Aridic Thermic, Typic Aridic Thermic, and Typic Aridic Hyperthermic.

Aridic Ustic Mesic conditions are found at elevations of 5,300 to 7,700 feet, Mean annual air temperatures are typically 52 to 57 degrees F., and the mean annual precipitation is 20 to 24 inches. Precipitation occurs as summer thunderstorms, gentle winter rains, and snow. This region has 160 to 195 frost-free days yearly. Soils that commonly form under these conditions have surface horizons that are high in organic matter. These soils are generally low in nutrients because leaching occurs at a high rate.

Ustic Aridic Thermic conditions are found at elevations of 3,000 to 5,300 feet. Mean annual air temperatures are typically 63 to 67 degrees F., and the mean annual precipitation is 12 to 16 inches. Precipitation occurs as summer thundershowers and gentle winter rains. This region has 215 to 250 frost-free days yearly. Soils that commonly form under these conditions are well developed and have surface horizons that are moderately high in organic matter.

Typic Aridic Thermic conditions are found at elevations of 2,000 to 3,000 feet. Mean annual air temperatures are 67 to 70 degrees F., and the mean annual precipitation is 10 to 12 inches. Precipitation occurs as violent summer thundershowers and gentle winter rains. This region has 240 to 260 frost-free days yearly. Very diverse soils form under these conditions. The soils range from young, undeveloped Fluvents to very old, well developed Paleargids.

Typic Aridic Hyperthermic conditions are found at elevations of 1,400 to 2,000 feet. Mean annual air temperatures are 70 to 73 degrees F., and the mean annual precipitation is 7 to 10 inches. Precipitation occurs as violent summer thundershowers and gentle winter rains. This region has 250 to 300 frost free days yearly. Soils that form under these conditions are also very diverse.

Plant and Animal Life

The effects of plants, animals, and humans are important in soil formation. Where the temperature is suitable for their growth, plants begin to grow as soon as they receive suitable amounts of water and nutrients. Plants, including fungi, influence soil formation by returning residues to the soil and aiding in decomposition. Plants influence the temperature of the soil by providing shade during warm periods and by helping to reduce evaporation from the soil surface. Vegetation also affects the transfer of minerals within the soil, the soil pH, and, in conjunction with climate and topography, the movement of material by leaching.

Bacteria, nematodes, and other forms of animal life aid in the weathering of minerals and the decomposition of organic matter. The larger animals, such as rock squirrels, gophers, javelina, skunks, and reptiles, turn and mix the soil during burrowing activities, altering the soil.

Humans can have a strong influence on soil formation. Tillage and overgrazing may accelerate erosion. Changes in drainage conditions or topography induced by land shaping also influence the soil. Modifications in natural fertility by fertilizers, incorporation of organic residues, or cropping practices can also alter the soil-forming process.

As a rule, humans, plants, animals, insects, bacteria, and fungi affect the formation of soils by increasing the content of organic matter, producing gains or losses in plant nutrients, mixing soil layers, and changing structure and porosity.

Topography

Topography and runoff influence the formation of soils by affecting drainage, erosion, soil temperature, and plant cover. The thickness and the kind of soil horizons depend on the amount of water that percolates through the parent material. Normally, more water enters a soil that is nearly level or gently sloping soil than one that is strongly sloping or steep. The topography of the survey area is very diverse, ranging from very steep slopes (50 percent or more) to nearly flat concave basin floors and valleys.

The amount of runoff depends on the slope. Steeper slopes have a higher amount of runoff than do gentle slopes. Coarse-textured soils take in water more rapidly than do fine-textured soils, so less water is lost through runoff on slopes that have coarse-textured soils than on those having fine-textured soils.

Aspect affects soil formation in the moderate to high elevations. Soils are slightly deeper on the north- and east-facing slopes because rainfall is more effective, temperatures are cooler, and plants are more numerous.

Time

Soils of the area range from very old to very young. The kind of horizons and the degree of soil formation depend in part on how long the soil has remained stable.

In this survey area, the youngest soils that show

the least development are on flood plains and stream terraces. The parent material of these soils has been in place only a short period. Examples of these soils are the Glenbar, Glendale, and Gadsden series.

Soils on alluvial fans and fan terraces show greater development. Deposition of parent material still occurs on alluvial fans. Fan terraces are relict alluvial fans that have been dissected and no longer have active deposition of parent material. Argillic horizons have developed, and calcium carbonate is accumulating. The younger soils in this group include the Bucklebar and Soledad series. The older soils in this group are generally higher in clay and of a redder color. These would include the Tubac series.

The survey also has some very old soils found on rolling hills and high fan terraces.

These soils exhibit very well developed argillic horizons and thick calcic horizons. Some soils have petrocalcic horizons, which are cemented calcic horizons. Examples of these soils are the Caracara, Nahda, Caralampi, and Selevin series.

Some soils have well developed horizons that become buried by recent sediment or exposed through erosion. Examples of these soils are the Sahuarita, Trix, and Pahaka series.

Landforms of the Survey Area

The survey area is part of the Basin and Range Province, which is characterized by north-south trending ranges of mountains and broad basins or valleys between the mountains. There are several broad basins and drainage systems in the survey area. The Santa Rosa Wash runs in a northerly direction, eventually merging with the Santa Cruz River. The Vomari Wash originates in Mexico, runs in a northwesterly direction, and joins the San Simon Wash. The San Simon Wash runs in a southern direction, merging with the Vomari Wash, and then flows into Mexico, where it drains into the Gulf of California.

The following are landforms recognized in the survey area and some of the soils associated with them. Landforms are not static; they are continually being created and eroded *(figs. 22, 23, 24).*

Flood Plains

This landform is formed by early Holocene-age to present-day stream alluvium. In this survey area, floodwaters flow at low to very low gradients along the basin floor and tend to be elongated in nature. The

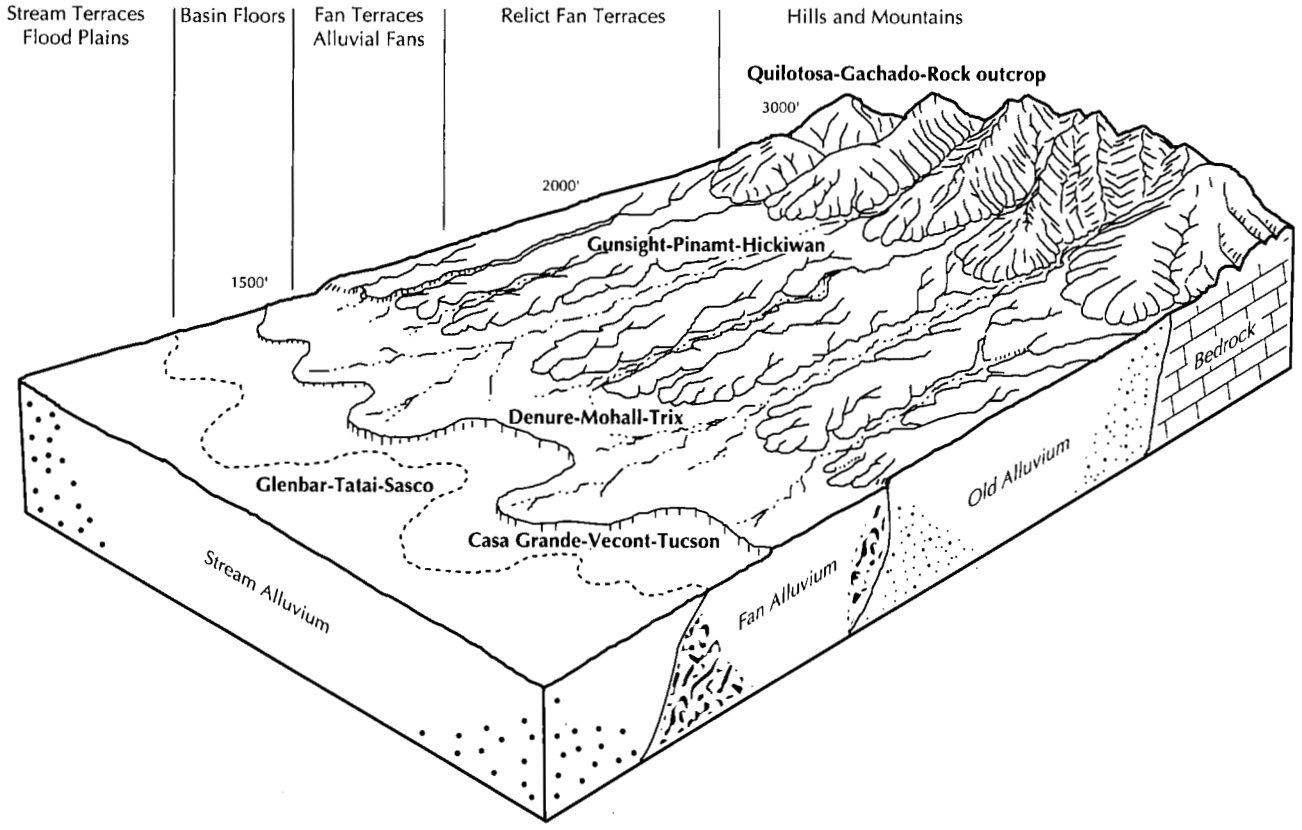

Figure 22.—Generalized relationship of some very warm (hyperthermic) soils in the survey area.

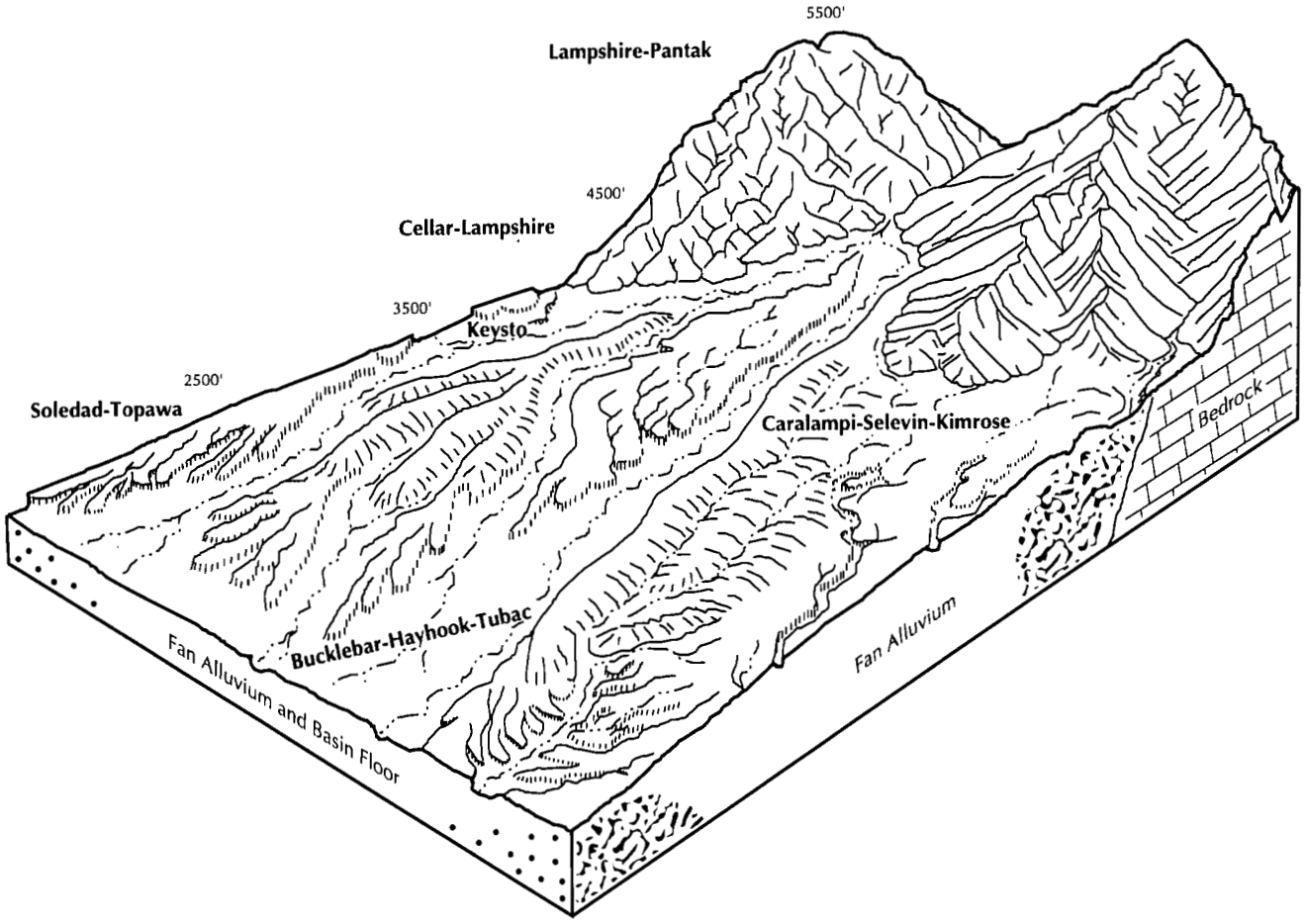

Figure 23.—Generalized relationship of some warm (thermic) soil map units.

low velocity. The soils on the flood plains receive periodic depositions of fresh alluvium, causing an irregular decrease in organic carbon and weak to no soil development. The sediment load of this floodwater also tends to be loamy and fine. The Glendale and Glenbar series developed in this type of stream alluvium are characterized by numerous braided channels. On the outer edge of the flood plain are areas where recent material is backfilling over late Pleistocene material on the basin floor. The Ginland and Tatai series are formed in this manner.

Alluvial Fans

An alluvial fan is formed by Holocene-age and present-day alluvium originating from mountains, hills, and other landscapes upslope. Sediment loads are deposited when slope gradients change from upland positions to a less sloping landform. An inherent feature of fan development is the continuously changing pattern of channels and loci of deposition (Cooke 1973). Over a long period of time, these changes ensure the maintenance of fans formed by distributing material widely over the surface (Cooke 1973). The alluvial areas in this survey generally take two forms. One is the triangular convex shape formed from the higher-positioned fan terraces and mountains. Soil series representing this position are the Combate and Arizo series and to some extent the Grabe series. The second is the narrow ephemeral stream area bounded by other landforms and soils older in age (Pleistocene). The soils in this position have buried paleosols that are generally related to the older landforms and soils bounding this area. These paleosols are at moderate depths in the soil profile. Typical soils representing this position are the Trix and Valencia series.

Stream Terraces

This position is the erosional remnant of the active flood plains that existed during the late Pleistocene to mid-Holocene ages. The slopes are in the same general direction as the current flood plain. The soils in this position are underlain by stratified sand,

mid-Holocene ages. The slopes are in the same general direction as the current flood plain. The soils in this position are underlain by stratified sand, gravel, loamy, or clayey sediments and, in some cases, buried paleosols.

The soils on stream terraces have been stable for a sufficient time period to form cambic horizons. A cambic horizon is characterized by the formation of calcium carbonate coatings in root channels and on gravel surfaces. In some cases, clay bridging between sand grains and clay films has also begun begun to form in root channels. This position is still subject to overbank flooding during major events. These rare flooding occurrences and the thin alluvial deposits from the floodwaters do not inhibit soil development. Typical soils that represent stream terraces are the Sasco series and to some extent the Glendale series.

Basin Floors

This landform was developed during the Pleistocene era, when effective moisture was greater than at the present time. During the Pleistocene era, the present-day basin floor soils were formed on two active landforms—alluvial fans (relict alluvial flats) and lake plains (pluvial lake or playas) in an enclosed basin where there is no water outlet. Sediment from these two alluvial processes filled the enclosed basin, increasing the thickness of the soil mantle. Eventually, enough sediment was deposited to fill the basin and allow water to flow out of it.

Soils on the basin floors have features that show several climate changes during the Pleistocene era. It is common for soils in this position to have several buried horizons representing relict paleosols. These horizons were formed during the wetter climates of several Ice Age epics of the Pleistocene era. Soils on the basin floors generally have sodium (natric horizons) and gypsum accumulations. Typical soils that represent basin floors are the Casa Grande and Kamato series.

Fan Terraces

This landform developed from the Pleistocene to early Holocene eras. On this position, soils exhibit different degrees of pedogenic (soil) development. The degree of development depends upon the amounts of translocated calcium carbonate and/or silicified clays, which are related to the age of the soil.

The fan terraces have been dissected or downcut to the point at which flooding frequency is none.

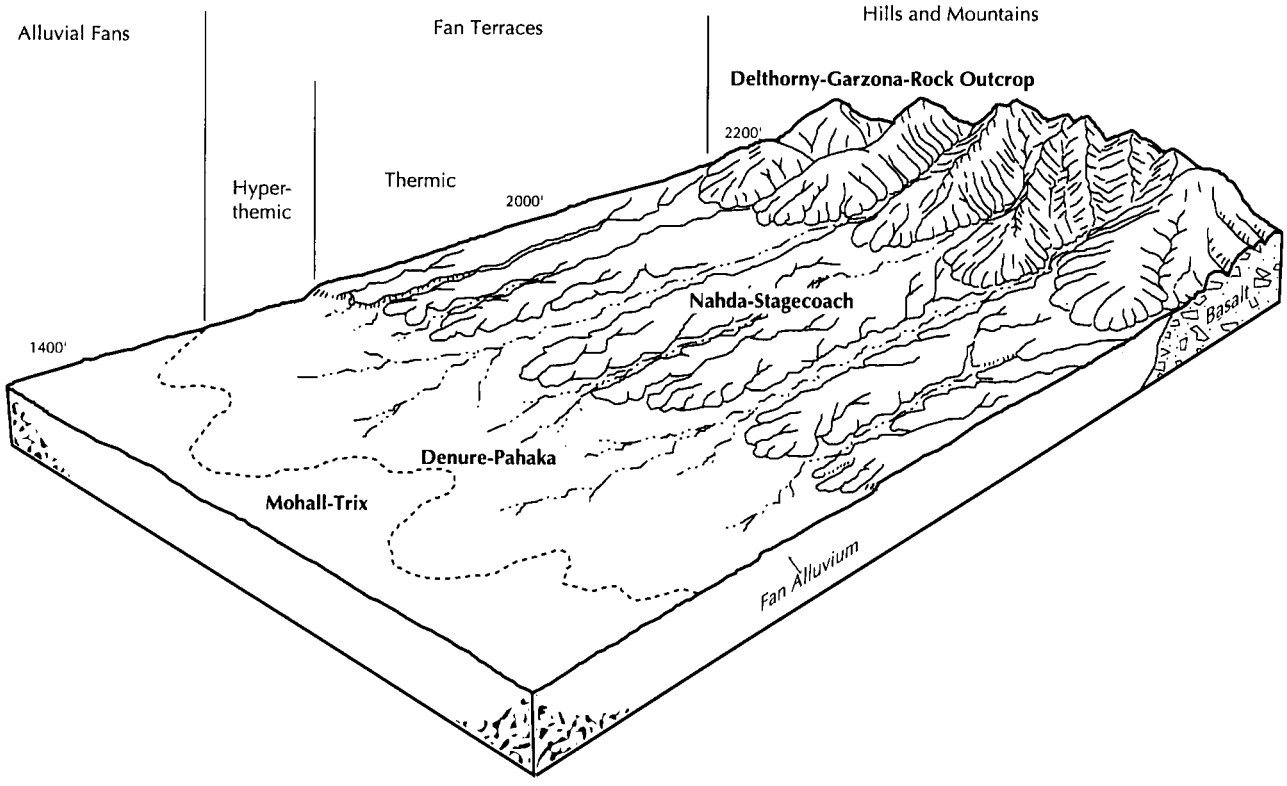

Figure 24.—Pattern of soil map units on the thermic-hyperthermic break.

Peterson refers to this position as an erosional fan remnant. He mentions that this surface is "particularly significant for soil survey because of their different ages, slopes, and probably, soils." (Peterson 1981).

This landform has two important components. One is the summit, where erosional activity is stable to metastable. This area will show the different degrees of soil development and age. Second is the side slope, where erosional activity is cutting back in to the more stable summit. In some areas, the surface mantles on the sideslopes are thin or eroded off. The argillic horizons are thinner, and the calcic horizons are higher in the soil profile as a result of this erosion.

Soils on fan terraces vary greatly in their makeup. The Hayhook, Denure, and the Vado series are some of the soils that can be found on the younger fan terraces. The Bucklebar, Mohall, Gunsight, Soledad, and Topawa series are soils that can be found on the older fan terraces.

Relict Fan Terraces

This landform represents the oldest and most stable landform from the Pliocene to mid-Pleistocene eras. The soils on this landform are characterized by well-developed argillic horizons (silicified clay accumulation) and/or petrocalcic horizons (cemented calcium carbonate). The topography of this landform ranges from moderate to steep slopes. Underlying the soil material in this position is a conglomerate rock. This is a sedimentary rock composed of rock fragments, sand, and finer material cemented by silica, calcium carbonate and iron oxides. The conglomerate is shallow to very deep within the soil profiles. The erosional activity on this landform is very similar to fan terraces. In some areas the soil has eroded down to the petrocalcic horizon or the conglomerate. Soil series that are found on relict fan terraces are the Caracara, Delthorny, Kimrose, and Caralampi series.

Dunes

This landform has developed from Holocene-age and present-day eolian sands. In this survey area, the sand source is derived from old Pleistocene lake plains and ephemeral streams. The dunes in this area are nonactive to semiactive, their activity is being restricted by the establishment of vegetation. The dunes around the south central part of the survey area are on the basin floors capping the Casa Grande series and have salt accumulations in the lower horizon. This is possible due to the capillary movement of the salts from the buried Casa Grande soil. The dunes on the northern end of the survey (near Chuichu) cap an old flood plain and stream terrace. These dunes have different plant communities because salts are not present. The dune development on the northern end of the survey might have changed the course of the Santa Rosa Wash. At one time, the floodwaters probably flowed in a northeasterly direction past Vaiva Vo and merged with the Santa Cruz River north of Chuichu. As the dunes developed, the floodwater direction was diverted to a more northerly direction, merging with the Santa Cruz River around the Maricopa area. The Rositas series can be found on dunes.

Hills and Mountains

The mountain slopes have no particular age connotation and, therefore, are not considered a geomorphic surface (Balster and Parsons 1968). Soil development on this landform is highly dependent on the nature of the bedrock such as its chemical composition, grain size, and hardness. The most influential soil forming factors in determining how soil developed on hills and mountains are time and the slope gradient of the bedrock.

Soils on this landform vary greatly in horizon development, from soils with no development to soils with well developed argillic horizons, calcic horizons, and/or petrocalcic horizons. Soils that have little or no horizon development are usually found on the steeper slopes where erosional activity is greatest. Soils that have well developed horizons are generally on gently sloping to moderately steep slopes where erosion is slight to moderate.

For example, the Bosa series and the Lajitas series formed on andesite bedrock. The Bosa soils form on the lower slopes and somewhat more stable to metastable surfaces. This stability allows residual weathering of the bedrock and permits clay particles to orient and coat sand grains and rock fragments, forming an argillic horizon. The Lajitas soils are usually on the steeper slopes and more active erosional surfaces. The constant erosion of the soil does not allow time for clays to orient to develop an argillic horizon.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

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. An illuvial horizon in which layer-lattice clays have accumulated.

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 3.5
Low	3.5 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.

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.

Basin floor. A broad, structural lowland that is nearly level, commonly elongated and many miles across, between mountain ranges. It is a product of past environments, and the surface is no longer within reach of fresh sediment. The erosional surface is cut along at least one side by the incision of major streams. It has a centripetal drainage pattern and is poorly organized. It is geomorphically stable. Flooding can occur from ponding of localized precipitation.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface. In this survey, bedrock is referred to as weathered or unweathered. Weathered bedrock is soft and/or highly fractured. It can be easily dug with hand implements or small machines. Unweathered bedrock is hard and has none to few fractures. It must be dug with heavy equipment or blasted.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

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.

Calcareous. As used in this soil survey, it refers to a soil that has a calcic horizon.

Cambic horizon. An altered horizon that has textures of loamy very fine sand, or very fine sand, or finer. Evidence of alteration include the elimination of fine stratifications, redistribution of carbonates, and yellower or redder colors than in the underlying horizons.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Canyon. A long, deep, narrow, very steep sided valley with high, precipitous walls in an area of high local relief.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil 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.

Charco. A water hole, pool, or puddle.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax plant community. The 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.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil 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 sequence. 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.

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.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deep percolation. Water movement below the root zone of a plant.

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.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of 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.

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.

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.

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.

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.

Extrusive rock. Igneous rock derived from deep-seated molten matter (magma) emplaced on the earth's surface.

Fan alluvium. Unconsolidated clastic material deposited on alluvial fans and fan terraces by running water, including gravel, sand, silt, clay and various mixtures of these.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, or clay.

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.

Flooding frequency classes.

None—No reasonable possibility of flooding (near 0 percent chance of flooding in any year).

Rare—Flooding unlikely but possible under unusual weather conditions (from near 0 to 5 percent chance or near 0 to 5 times in 100 years).

Occasional—Flooding is expected infrequently under usual weather conditions (5 to 50 percent chance of flooding or 5 to 50 times in 100 years).

Frequent—Flooding is likely to occur often under usual weather conditions (more than a 50 percent chance of flooding or more than 50 times in 100 years).

Common—Occasional and frequent classes can be grouped for certain purposes and called common flooding.

Footslope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragile (in tables). A soil that is easily damaged by use or disturbance.

Fuel moisture content. The percentage of moisture, on a weight basis, in all the different fuels—woody and herbaceous, live or dead—on the landscape.

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.

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. Commonly referred to as a petrocalcic horizon.

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.

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.

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.

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.

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.
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.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

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.

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.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value 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.

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

Paleosols. Soils formed in past environments.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely 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.

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.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. 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.

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

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. The classes, expressed as millimhos per centimeter, are as follows:

Nonsaline	0 to 2 dS/m
Very slight or very slightly saline	2 to 4 dS/m
Slight or slightly saline	4 to 8 dS/m
Moderate or moderately saline	8 to16 dS/m
Strong or strongly saline	more than 16 dS/m

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.

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.

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.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

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.

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.

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.

Slow intake (in tables). The slow movement of water into 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.

Stream terrace. One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel, originally formed near the level of the stream and representing the dissected remnants of an abandoned flood plain, stream bed, or valley floor produced during a former stage of erosion or deposition.

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.

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

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.

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.

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.

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.

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.