United States
Department of
Agriculture

Natural
Resources
Conservation
Service

In cooperation with
the Texas Agricultural
Experiment Station

# Soil Survey of Loving and Winkler Counties, Texas

Interim publication—October 1999

# How to Use This Soil Survey

### General Soil Map

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

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

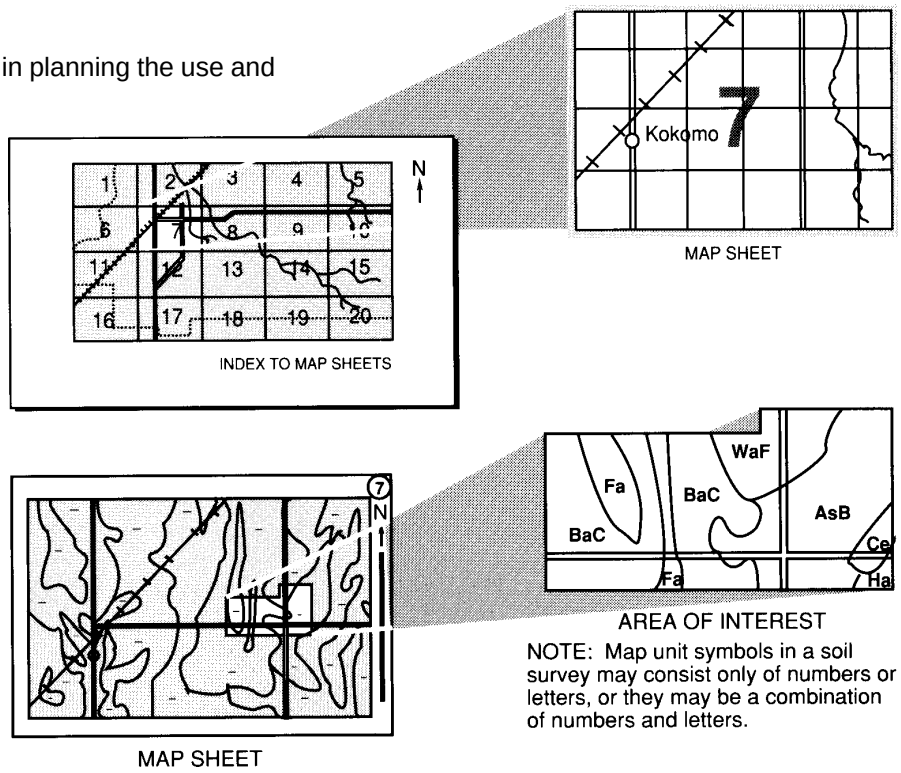
### Detailed Soil Maps

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

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

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

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




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

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

Major fieldwork for this soil survey was completed in 1991. Soil names and descriptions were approved in 1991. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1991. This survey was made cooperatively by the Natural Resources Conservation Service and the Texas Agricultural Experiment Station. The survey is part of the technical assistance furnished to the Upper Pecos Soil and Water Conservation District.

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

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**Cover: An area of Tencee-Mentone complex, gently undulating, that is typical of the rangeland in Loving and Winkler Counties. Windmills are the only method of providing water for livestock in most areas.**

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

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

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

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

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

John P. Burt
State Conservationist
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# Soil Survey of
# Loving and Winkler Counties, Texas

By Jerry L. Rives, Natural Resources Conservation Service

Fieldwork by Jerry L. Rives, Sharon J. Elias, Wesley L. Miller, and Stanley R. Albee

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

Loving and Winkler Counties are located in the western part of Texas (fig. 1). They are mainly in the Southern Desertic Basins, Plains, and Mountains Major Land Resource Area (Trans-Pecos Land Resource Area). A small area in the northeast corner of Winkler County is in the Southern High Plains Major Land Resource Area (High Plains Land Resource Area).

The survey area is generally rectangular. It is about 63 miles from east to west and about 24 miles from north to south. It covers about 1,517 square miles, or 970,906 acres, and includes 4,096 acres of water, mainly in Red Bluff Reservoir and the Pecos River. The land surface is nearly level to undulating. Elevation ranges from about 2,640 feet along the Pecos River in the southwestern part of Loving County to about 3,400 feet in the northeastern part of Winkler County along the High Plains caprock escarpment.

The survey area is about 96 percent range. The remaining 4 percent includes areas of water, urban development, highways, and oil fields.

**Figure 1.—Location of Loving and Winkler Counties in Texas.**

## General Nature of the Survey Area

Mary Belle Jones, Pat Wight, and Sharon J. Elias helped prepare this section.

This section describes the settlement and population, agriculture, natural resources, and climate of the survey area.

### Settlement and Population

The earliest known inhabitants of the survey area were bison hunting Indians, primarily the Jumanos, Mescalero Apaches, and Comanches. The bison were easily trapped due to the violent nature of the Pecos River.

The first European explorers in the area were Spaniards. They followed the Pecos River to a low-water crossing in the northwest corner of Loving County. This crossing was later named "Pope's Crossing" in honor of Captain John Pope, who was sent

in 1854 by the U.S. Army to establish a camp that would provide a permanent water supply for the Trans-Pecos area. Pope's Crossing is now covered by Red Bluff Reservoir. The Old Spanish Trail also followed the Pecos River and crossed at Pope's Crossing. The Overland Mail Route followed the Old Spanish Trail through Loving County from 1858 to 1860. The last of the historic crossings through Loving County was the Goodnight-Loving cattle drive, which also followed the Old Spanish Trail and the Overland Mail Route.

Loving County was established in 1887 from part of Tom Green County. The Loving Canal and Irrigation Company created a flurry of settlement by workers who dug canals. This settlement allowed the county to be organized in 1893. The company, however, was involved in a land scandal that robbed the county treasury, forced businesses to close, and caused people to desert. Because the population of the county dropped to only 33, the State legislature was forced to dissolve the county in 1897. This was the only time the legislature has ever performed such an action. Oil was discovered in the area during the mid-1920's, and the "oil boom" began. Loving County was reorganized in 1931 with Mentone as the county seat. It was the last county to be organized in Texas. The 1990 census listed the population of Mentone at 20 and Loving County at 107. Loving County is the least populated county in Texas.

Winkler County was established from part of Tom Green County in 1887 and was organized in 1910. Kermit became the county seat. Winkler County was named in honor of Confederate Army Colonel and Judge Clinton McKamy Winkler. The majority of the settlers to Winkler County were ranchers who were encouraged to move into the area in the late-1800's by The Homestead Act. Most of the inhabitants left the county between 1916 and 1922 because of a severe drought. The county had 6 registered voters in 1926. After the completion of an oil well in 1926, the population grew to an average of 10,000 and has remained at about this size. Winkler County gained National recognition in June, 1980, when a sink hole formed that was 360 feet in diameter and 100 feet deep. The formation occurred over a 24 hour period and caused alarm that a large oil-tank farm adjacent to the area might be consumed. The 1990 census listed the population of Kermit at 6,875 and Winkler County at 8,576. The only other town in Winkler County is Wink, which has a population of 1,189.

## Agriculture

The main agricultural enterprises in the survey area are cow-calf livestock operations. In addition, steer livestock operations utilize seasonally produced forage. Most of the cow-calf operations produce stocker calves for fall markets.

About 300 acres of irrigated cropland has been farmed in the survey area. Most of this acreage is along the Pecos River in Loving County. The diminishing quantity and quality of water available for irrigation has reduced the acreage in annual production to less than 100 acres.

## Natural Resources

Soil, water, oil, natural gas, caliche, and wildlife are the most important natural resources in the survey area. Soil is basic to the production of forage for livestock and to the production of food and fiber crops for market and for home consumption.

Irrigation water from the Pecos River and from wells is used on small farms in the survey area.

Oil and natural gas are produced from numerous wells throughout the survey area. They are a major source of income to landowners and provide a solid tax base to operate public facilities. The companies that explore and develop these resources provide an important source of employment.

Caliche is plentiful in the survey area and is mined commercially. It is used locally for roads and oil-field construction.

Wildlife in the survey area provide recreational opportunities and income for some landowners. The major wildlife species include desert mule deer, scaled quail, mourning dove, and coyote.

## Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Wink, Texas, in the period 1961 to 1990. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 45 degrees F and the average daily minimum temperature is 29 degrees. The lowest temperature on record, which occurred on January 11, 1962, is -14 degrees. In summer, the average temperature is 82 degrees and the average daily maximum temperature is 95 degrees. The highest recorded temperature, which occurred on June 27, 1994, is 117 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive

plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 12.4 inches. Of this, 10.4 inches, or 84 percent, usually falls in April through September. The growing season for most crops falls within this period. The heaviest 1-day rainfall during the period of record was 5.6 inches on October 11, 1940. Thunderstorms occur on about 37 days each year, and most occur in May.

The average seasonal snowfall is about 3.4 inches. The greatest snow depth at any one time during the period of record was 8 inches. On the average, 1 day per year has at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 43 percent. Humidity is higher at night, and the average at dawn is about 74 percent. The sun shines 78 percent of the time possible in summer and 68 percent in winter. The prevailing wind is from the south-southeast. Average windspeed is highest, 12.7 miles per hour, in April.

## 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 range yields under defined levels of management are assembled from plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a

given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

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

In this survey area, map units are broadly defined because land use is less intensive. Boundaries were plotted and verified at wide intervals. The broadly defined units have map symbols consisting of all capital letters in the legend for the detailed soil maps. The detail of mapping was selected to meet the anticipated long-term use of the survey, and the map units were designed to meet the needs for that use.

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

# General Soil Map Units

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

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

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

## Soil Descriptions

### Areas Dominated by Well Drained, Sandy and Loamy Soils on Uplands in the Semiarid Part of the Trans-Pecos

This group of map units makes up about 80 percent of the survey area. The major soils are the Blakeney, Coyanosa, Douro, Elgee, Faskin, Kinco, Los Tanos, Paisano, Penwell, Pyote, Ratliff, Sharvana, and Wickett soils. Also in this group are extensive areas of Dune land. Most of the soils in this group have a sandy or loamy surface layer. Coyanosa and Paisano soils have a surface layer of very gravelly fine sandy loam. Blakeney, Paisano, and Sharvana soils are shallow over strongly cemented caliche. Douro and Wickett soils are moderately deep over strongly cemented caliche. Coyanosa soils are shallow over sandstone bedrock, and Los Tanos soils are moderately deep over sandstone bedrock.

The soils in this group are used as rangeland, except in areas of urban development in the towns of Kermit and Wink. The native range grasses in areas of this group include black grama, sand bluestem, cane bluestem, giant dropseed, sand dropseed, plains bristlegrass, and bush muhly. Woody plants, such as mesquite, sand sagebrush, catclaw acacia, fourwing saltbush, and Havard oak, have encroached on most areas.

Most of the soils in this group are best suited to livestock ranching because of the hazard of wind erosion. Management practices that maintain an adequate vegetative cover reduce this hazard.

#### 1. Wickett-Pyote-Sharvana

*Gently undulating, shallow to very deep, sandy soils on upland plains and ridges*

The landscape is characterized by gentle slopes on ridges and upland plains. Slopes range from 0 to 5 percent. Drainageways are narrow and do not have defined channels. The natural vegetation is mainly short and middle height, drought-tolerant grasses. Overgrazing allows shrubs, such as mesquite, catclaw acacia, and white-thorn acacia, to increase.

This map unit makes up about 36 percent of the survey area. It is about 36 percent Wickett soils, 29 percent Pyote soils, and 22 percent Sharvana soils. The minor soils include Blakeney, Conger, Elgee, Kinco, and Penwell soils.

The nearly level and gently sloping Wickett soils are on the lower side slopes of ridges. They are moderately deep, well drained soils that have a sandy surface layer over a subsoil of fine sandy loam. They are underlain by indurated caliche.

The gently undulating Pyote soils are on sandy ridges. They are very deep, well drained soils that have a thick, sandy surface layer over a subsoil of fine sandy loam. They are underlain by thick beds of sand and calcium carbonate.

The gently undulating Sharvana soils are on ridgetops and upper slopes of ridges. They are very shallow and shallow, well drained soils that have a thin, sandy surface layer over a thin subsoil of fine sandy loam. They are underlain by indurated caliche.

The soils in this unit are suited to livestock ranching, which is the main enterprise for which they

are used. Because of wind erosion, overgrazing is the main concern affecting ranch management. Maintaining adequate vegetative cover on these sandy soils is essential to reducing the hazard of wind erosion. Water for livestock is mainly provided by wells, and pipelines distribute the water to selected areas.

## 2. Blakeney-Sharvana-Kinco

*Nearly level and gently undulating, very shallow to very deep, loamy soils on upland plains and ridges*

The landscape is characterized by gently undulating ridges, side slopes, and valleys between ridges. Slopes range from 0 to 5 percent. The ridges and side slopes drain into the valleys but do not have defined drainage channels. The natural vegetation is mainly short and middle height grasses and drought-tolerant shrubs.

This map unit makes up about 17 percent of the survey area. It is about 42 percent Blakeney soils, 23 percent Sharvana soils, and 12 percent Kinco soils. The minor soils include Conger, Mentone, and Wickett soils.

The gently undulating Blakeney soils are on ridgetops and side slopes of ridges. They are very shallow and shallow, well drained, loamy soils. They are underlain by indurated caliche.

The nearly level and gently undulating Sharvana soils are on upland plains. They are very shallow and shallow, well drained soils that have a surface layer and subsoil of fine sandy loam. They are underlain by indurated caliche.

The nearly level Kinco soils are on the lower footslopes of ridges and in valleys between ridges. They are very deep, well drained, loamy soils that have a loamy subsoil. They are underlain by calcareous, loamy materials of eolian or alluvial origin.

The soils in this unit are suited to livestock ranching, which is the main enterprise for which they are used. Wind erosion is the main hazard affecting rangeland. Because of the hazard of wind erosion, overgrazing is the major concern affecting range management. Range management practices that maintain an adequate cover of vegetation reduce the hazard of wind erosion. Water for livestock is mainly provided by wells, and pipelines distribute the water to selected areas.

## 3. Penwell-Elgee-Pyote

*Gently undulating, very deep, sandy soils on upland plains*

The landscape is characterized by gently undulating areas (fig. 2). Slopes range from 1 to 5 percent. The soils in this unit are eolian sands that have been stabilized against wind erosion by vegetation. The dunes are aligned from southwest to northeast along the direction of the prevailing wind. The natural vegetation is mainly middle height and tall grasses and drought-tolerant shrubs.

This map unit makes up about 14.6 percent of the survey area. It is about 37 percent Penwell soils, 34 percent Elgee soils, and 15 percent Pyote soils. The minor soils include Kinco and Wickett soils. Also included are areas of active sand dunes.

The Penwell soils are on stabilized sand hummocks near active sand dunes. They are very deep, excessively drained fine sands. They are underlain by eolian sands.

The Elgee soils are gently sloping. They are on the lower side slopes of sand hummocks. They are very deep, well drained, sandy soils that have a subsoil of loamy fine sand. They are underlain by eolian sands.

The Pyote soils are in the interdune or blowout areas. They are very deep, well drained, sandy soils that have a subsoil of fine sandy loam. They are underlain by calcareous eolian sands.

The soils in this unit are suited to livestock ranching, which is the main enterprise for which they are used. Wind erosion is the main hazard affecting rangeland. Overgrazing and acquiring and distributing water for livestock are the major concerns affecting ranch management. Overgrazing reduces the amount of vegetation on a site. Vegetation is needed to protect the soil against wind erosion. The abrasive action of blowing sand particles hinders the establishment of native grasses. Pipelines deliver water from wells to selected areas. Some interdune and blowout areas are ponded temporarily because of a perched seasonal high water table.

## 4. Penwell-Dune Land

*Gently undulating and hummocky, very deep, sandy soils and active sand dunes on upland plains*

The landscape is characterized by hummocky sand dunes and areas of sandy soils that are stabilized against wind erosion by native vegetation (fig. 2). Slopes range from 0 to 5 percent. The entire landscape, particularly the dunes, are aligned southwest to northeast along the direction of the prevailing wind. Some of the interdune and blowout areas are ponded temporarily because of a perched seasonal high water table. The native vegetation is mainly middle height and tall, drought-tolerant grasses and shrubs.

This map unit makes up about 9.9 percent of the

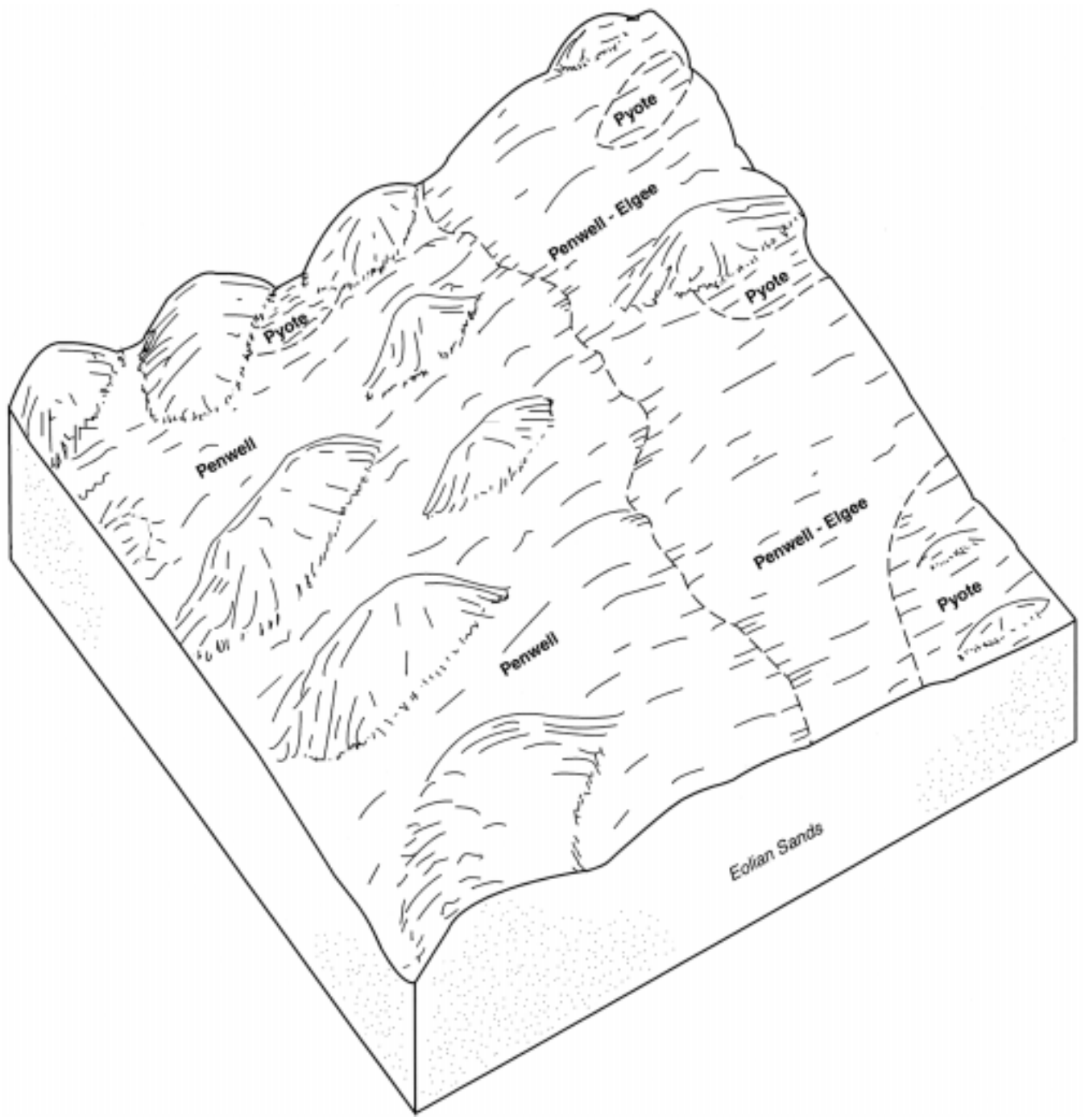


**Figure 2.—Typical pattern of soils and parent materials in the Penwell-Dune land and Penwell-Elgee-Pyote general soil map units.**

survey area. It is about 44 percent Penwell soils and 42 percent Dune land. The minor soils include Elgee and Pyote soils.

The Penwell soils are on the more stable parts of the landscape, typically on the windward side of active sand dunes. These stable areas are less prominent than the active sand dunes because vegetation reduces the amount of wind erosion. The Penwell soils are very deep, excessively drained, and sandy. They are underlain by eolian sands.

The Dune land consists of active sand dunes on a hummocky landscape. The dunes are mounds of sand

that are as much as 40 feet high. The Dune land is devoid of vegetation because of the shifting sands. Seedlings are destroyed by the abrasive action of the sand particles during windstorms. The Dune land consists of very deep, excessively drained sands that are underlain by eolian sands.

The Penwell soils are suited to livestock ranching, which is the main enterprise for which they are used. Overgrazing and acquiring and distributing water for livestock are the main concerns affecting ranch management. Maintaining a vegetative cover that is adequate to reduce the extent of wind erosion is critical. The Dune land is devoid of vegetation and should be left undisturbed to reduce the extent of wind erosion. Numerous oil wells are located throughout this unit.

## 5. Ratliff-Faskin-Douro

*Nearly level, moderately deep to very deep, loamy soils on upland plains*

The landscape is characterized by nearly level areas of alluvial and eolian sediments that accumulated around existing vegetation to form small dunes and mounds. Slopes are 0 to 3 percent. The areas of this unit are bordered on the south and west by deep eolian sediments and on the east by the caprock escarpment between the Trans-Pecos and High Plains. The unit is on the leeward side of eolian sands and during windstorms receives sediments that accumulate around vegetation. The native vegetation is mainly middle height grasses and low shrubs.

This map unit makes up about 0.9 percent of the survey area. It is about 50 percent Ratliff soils, 12 percent Faskin soils, and 7 percent Douro soils. The minor soils include Blakeney, Toyah, and Wickett soils.

Ratliff soils are very deep, are well drained, and are underlain by calcareous, alluvial sediments.

Faskin soils are very deep, are well drained, and have a loamy subsoil. They are underlain by calcareous, loamy sediments.

Douro soils are moderately deep, are well drained, and have a loamy subsoil. They are underlain by indurated caliche and calcareous, loamy sediments.

The soils in this unit are suited to livestock ranching, which is the main enterprise for which they are used. Wind erosion is the main hazard affecting rangeland. Overgrazing is a major concern because it leaves the soils susceptible to wind erosion.

## 6. Paisano-Kinco

*Nearly level to hilly, very shallow to very deep, very gravelly and loamy soils on upland plains, ridges, and escarpments*

The landscape is characterized by prominent relief (fig. 3). It is the escarpment between the Trans-Pecos and High Plains. The escarpment consists of exposed bedrock and colluvial footslopes. Numerous short drainageways are notched into the side slopes. Slopes generally range from 0 to 12 percent. The narrow band of the escarpment is almost vertical. The areas of this unit are bordered on the south and west by deep eolian sands. The area above the escarpment on the east side consists of loamy alluvial soils of the High Plains. The native vegetation is mainly short and middle height grasses and drought-tolerant shrubs.

This map unit makes up about 0.6 percent of the survey area. It is about 65 percent Paisano soils and 12 percent Kinco soils. The minor soils include Blakeney, Conger, and Ratliff soils. Also included are areas of exposed Rock outcrop.

The gently undulating and undulating Paisano soils are on the footslopes below the escarpment and in areas directly above the escarpment rim. They are very shallow and shallow over indurated caliche. They are well drained, very gravelly, and loamy.

The nearly level Kinco soils are in the numerous drainageways that dissect the footslopes of the escarpment. They are very deep, well drained, loamy soils that are underlain by calcareous, alluvial and eolian sediments.

The soils in this unit are suited to livestock ranching, which is the main enterprise for which they are used. The slope and the hazard of wind erosion are the main limitations affecting rangeland. Overgrazing is the major concern of ranch management because it can increase the susceptibility of the soils to wind erosion and water erosion.

## 7. Coyanosa-Los Tanos

*Gently sloping to undulating, very shallow to moderately deep, very gravelly and loamy soils on ridges, knolls, and footslopes*

The landscape is characterized by dissected knolls and ridges. The relief consists of gently undulating ridges and gently sloping footslopes. Slopes range from 1 to 8 percent. Numerous short drainageways dissect the footslopes and ridges. These areas are surrounded by gently undulating ridges and nearly level alluvial valleys. The native vegetation is mainly short

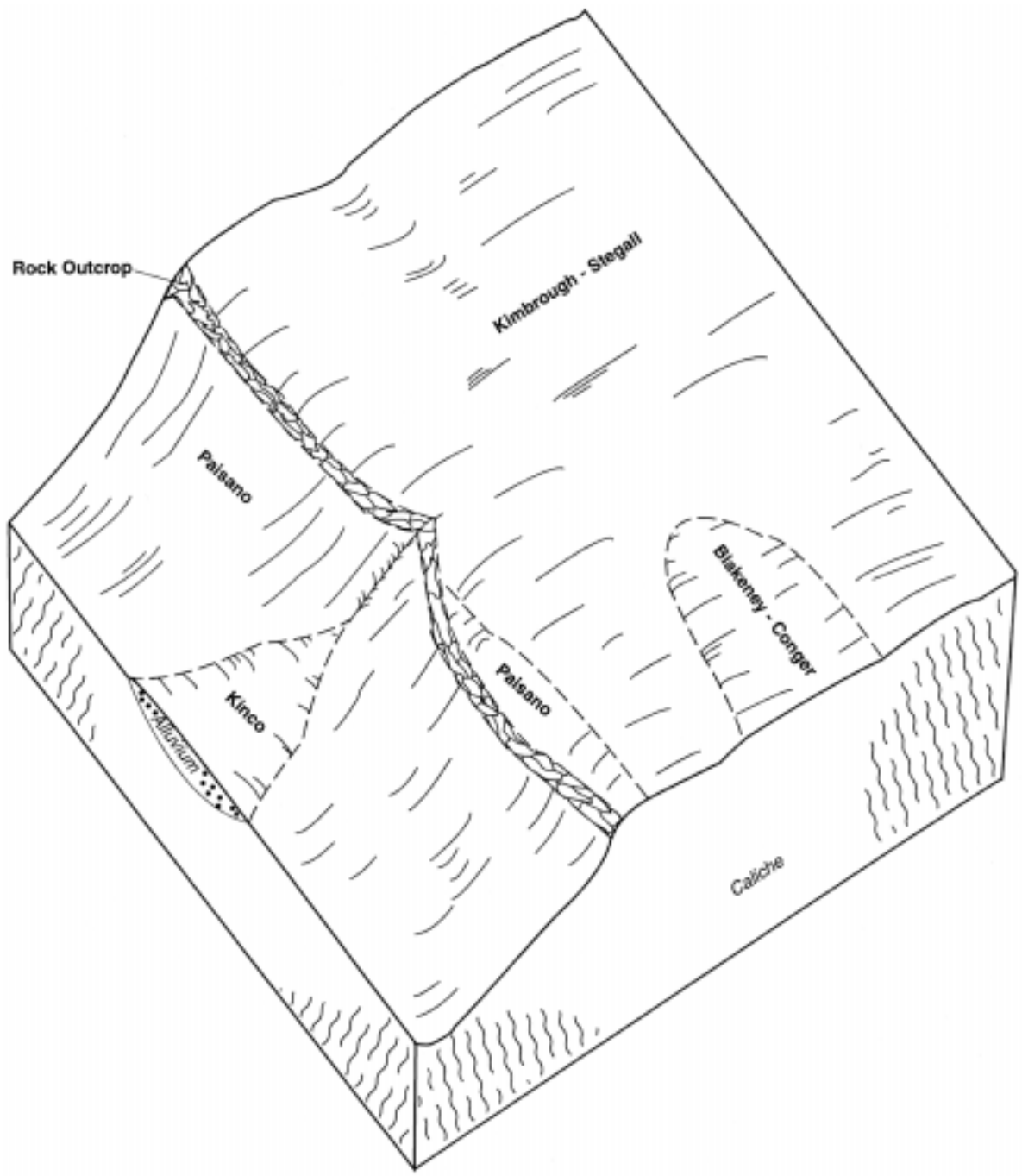


**Figure 3.—Typical pattern of soils and parent materials in the Paisano-Kinco and Kimbrough-Stegall general soil map units.**

and middle height grasses and drought-tolerant shrubs.

This map unit makes up about 0.3 percent of the survey area. It is about 39 percent Coyanosa soils and 25 percent Los Tanos soils. The minor soils include Blakeney, Sharvana, Splotter, and Toyah soils.

The undulating Coyanosa soils are on upland ridges and knolls. They are very shallow and shallow over sandstone bedrock, are well drained, and are very gravelly and loamy.

The gently sloping and gently undulating Los Tanos soils are on footslopes of ridges and knolls. They are moderately deep, well drained fine sandy loam and are underlain by sandstone bedrock.

The soils in this unit are suited to livestock ranching, which is the main enterprise for which they

are used. Slope and the hazard of erosion are the main limitations affecting rangeland. Because of the hazard of erosion, overgrazing is the major concern affecting ranch management. These soils are slow to recover from overuse because of the limited rainfall and droughty soil conditions.

## Areas Dominated by Well Drained, Loamy and Gravelly Soils on Uplands in the Arid Part of the Trans-Pecos

This group of map units makes up about 17 percent of the survey area. The major soils are the Delnorte, Holloman, Mentone, Monahans, Pajarito, Reeves, Splotter, Tencee, and Turney soils. Delnorte and Tencee soils have a very gravelly surface layer and are shallow over strongly cemented caliche. Holloman soils have a loamy surface layer and are shallow over gypsum bedrock. Mentone, Monahans, Pajarito, Reeves, and Turney soils are deep, loamy soils. Splotter soils have a loamy surface layer and are shallow over strongly cemented caliche.

These soils are used as rangeland, except for areas of urban development in the town of Mentone. The native range grasses include black grama, blue grama, burrograss, bush muhly, cane bluestem, plains bristlegrass, sideoats grama, tobosa, and vine-mesquite. Woody species include catclaw acacia, creosotebush, fourwing saltbush, mesquite, range ratney, and white-thorn acacia.

The Delnorte, Holloman, Mentone, Splotter, and Tencee soils are poorly suited to most urban and recreational uses. Limitations include the shallow depth to indurated calcium carbonate or gypsum bedrock and a high content of gravel. Ponding is a limitation in areas of the Mentone soil. The Monahans and Reeves soils are only moderately suited to most urban and recreational uses because of excess gypsum and salt and dusty surface conditions. The Pajarito and Turney soils are well suited to most urban and recreational uses.

### 8. Tencee-Mentone-Delnorte

*Gently undulating to rolling, very shallow to very deep, gravelly and loamy soils on upland plains, ridges, and playas*

The landscape is characterized by gently undulating, gravelly ridges and small playas (fig. 4). The western edge of this map unit, adjacent to the flood plain along the Pecos River, is more dissected with narrow drainageways and has steeper side slopes on the gravelly ridges than the remainder of the unit, which is flanked by areas of sandy loam on ridges and plains. Slopes are mostly 0 to 8 percent, but are as much as 16 percent on the steeper side slopes. The native vegetation on the gravelly ridges is mainly short grasses and drought-tolerant shrubs, such as creosotebush. The vegetation on the playas is mainly vine-mesquite and tobosagrass. Hackberry trees are along the outer perimeter of the larger playas.

This map unit makes up about 6.9 percent of the survey area. It is about 53 percent Tencee soils, 12 percent Mentone soils, and 8 percent Delnorte soils. The minor soils include Chamberino, Splotter, and Toyah soils.

The gently undulating Tencee soils are on convex, gravelly ridges. They are very shallow and shallow over indurated caliche, are well drained, and are very gravelly and loamy. They are underlain by thick beds of caliche.

The nearly level Mentone soils are on playas. They are very deep, well drained, and loamy. They are underlain by stratified loamy alluvium.

The gently undulating and undulating Delnorte soils are on convex, gravelly ridgetops. They are very shallow and shallow, well drained, and gravelly and loamy. They are underlain by thick beds of caliche.

The soils in this unit are suited to livestock ranching, which is the main enterprise for which they are used. The main limitations affecting rangeland are the very shallow and shallow rooting depth and droughty conditions of the gravelly soils and the brief ponding in areas of the soils on playas. Overgrazing is a major concern affecting ranch management because the limited rainfall and droughty conditions make recovery of overused areas a slow process.

### 9. Splotter-Mentone

*Nearly level and gently undulating, very shallow to very deep, loamy soils on upland plains, ridges, and playas*

The landscape is characterized by gently undulating gravelly ridges and slightly depressed playas. Slopes range from 0 to 5 percent. The playas formed when parts of the landscape collapsed. The native vegetation is mainly short and middle height grasses and scattered mesquite on the upland plains and ridges. The vegetation on the playas includes vine-mesquite and tobosa. Hackberry trees are along the outer perimeter of the larger playas.

This map unit makes up about 6.2 percent of the survey area. It is about 63 percent Splotter soils and 14 percent Mentone soils. The minor soils include Delnorte, Sharvana, Tencee, and Toyah soils.

The gently undulating Splotter soils are on convex ridges and plains. They are very shallow and shallow

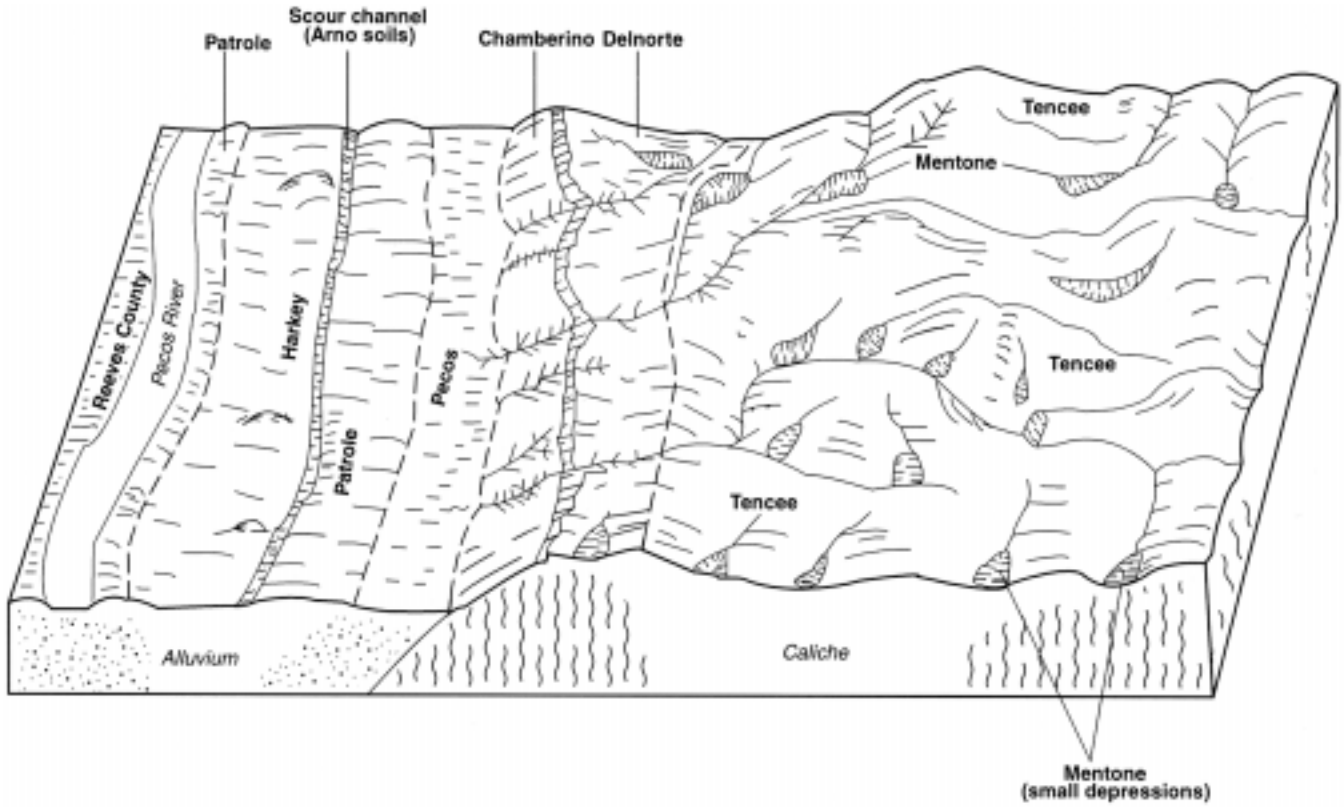


**Figure 4.—Typical pattern of soils and parent materials in the Harkey-Patrole-Pecos and Tencee-Mentone-Delnorte general soil map units.**

over indurated caliche. They are well drained fine sandy loam and are underlain by thick beds of caliche.

The nearly level Mentone soils are in concave playas. They are very deep, well drained, loamy soils that are underlain by stratified loamy alluvium.

The soils in this unit are suited to livestock ranching, which is the main enterprise for which they are used. The main limitations affecting rangeland are the shallow root zone and droughty conditions on the upland ridges and plains and the brief ponding in the playas. Overgrazing is a major concern affecting ranch management because the limited rainfall and droughty conditions make recovery of overused areas a slow process and increase the hazard of wind erosion.

## 10. Holloman-Monahans-Reeves

*Nearly level and gently undulating, very shallow to very deep, loamy soils over gypsiferous sediments on upland plains, knolls, and basins*

The landscape is characterized by nearly level upland plains; small, convex gypsum knolls and ridges; and basins between the knolls and ridges. The soils in this unit formed in material weathered from gypsum bedrock and in gypsum sediments. Slopes are mostly 0 to 3 percent, but are as much as 5 percent on the side slopes of knolls and ridges. Areas of this unit are bordered by gravelly ridges and plains on the west and by sandy eolian sediments on the east. The native vegetation is mainly short and middle height grasses and drought-tolerant shrubs.

This map unit makes up about 2.5 percent of the survey area. It is about 33 percent Holloman soils, 21 percent Monahans soils, and 12 percent Reeves soils. The minor soils include Pajarito, Tencee, and Turney soils.

The nearly level and gently undulating Holloman soils are on the small, convex knolls and ridges. They are very shallow and shallow over gypsum bedrock. They are well drained, loamy gypsiferous soils.

The nearly level and gently sloping Monahans soils are on upland plains. They are very deep, well drained sandy loam underlain by gypsiferous sediments.

The nearly level Reeves soils are on basin floors between gypsum knolls and ridges. They are very deep, well drained, loamy soils that are underlain by gypsiferous sediments.

The soils in this unit are suited to livestock ranching operations. The limited rainfall, droughty conditions, and overgrazing can increase the hazard of wind erosion. Ranch management concerns include the maintenance of an adequate vegetative cover to reduce the hazard of wind erosion.

## 11. Monahans-Turney-Pajarito

*Nearly level, very deep, loamy soils on upland plains and basins*

The landscape is characterized by broad alluvial basins surrounded by nearly level areas of eolian sediments that accumulated around existing vegetation to form small dunes and mounds. Slopes range from 0 to 3 percent. The areas of this unit are bordered on the south and west by gently undulating gravelly soils and shallow sandy loam and on the north and east by deeper eolian sands. The native vegetation is mainly short and middle height grasses and drought-tolerant shrubs.

This map unit makes up about 1.8 percent of the survey area. It is about 24 percent Monahans soils, 23 percent Turney soils, and 18 percent Pajarito soils. The minor soils include Holloman, Splotter, and Tencee soils.

The nearly level Monahans soils are on upland plains. They are very deep, well drained fine sandy loam and are underlain by gypsum alluvium.

The nearly level Turney soils are on alluvial upland basins and plains. They are very deep, well drained, loamy soils that are underlain by alluvial sediments.

The nearly level Pajarito soils are on upland plains. They are very deep, well drained fine sandy loam and are underlain by eolian sediments.

The soils in this unit are suited to livestock ranching, which is the main enterprise for which they are used. Wind erosion is the main hazard affecting rangeland. Overgrazing and acquiring and distributing water for livestock are major concerns affecting ranch management. The limited rainfall hinders the recovery of overused areas and increases the hazard of wind erosion. Water for livestock is provided by wells, and pipelines distribute the water to selected areas.

## Areas Dominated by Well Drained and Moderately Well Drained Soils on Flood Plains in the Trans-Pecos

This group of map units makes up about 2 percent of the survey area. The major soils are the Harkey, Patrole, and Pecos soils. These deep, nearly level soils are on the flood plain along the Pecos River and smaller intermittent drainageways. They are loamy or clayey throughout and are subject to flooding.

The soils in this group are used mainly as rangeland. A limited acreage is used as irrigated cropland. The soils along the Pecos River are moderately saline to extremely saline. Cotton, alfalfa, and barley are the main crops. The native vegetation is mainly alkali sacaton, cane bluestem, giant sacaton, tobosa, and vine-mesquite. Woody species include fourwing saltbush, mesquite, and tamarisk (saltcedar).

The soils in this group are poorly suited to most urban and recreational uses because of the hazard of flooding, low strength, high shrink-swell potential, dusty surface layers, and excess salt.

## 12. Harkey-Patrole-Pecos

*Nearly level, very deep, loamy and clayey soils on the flood plain along the Pecos River*

The landscape is characterized by a convex ridge of coarser soil material adjacent to the Pecos River channel, a broad flood plain of clayey soils with microdepressions and scour channels, and low ridges that define the location of the river channel prior to changing course (fig. 4). Slopes are 0 to 1 percent. The flood plain is bordered by undulating gravelly ridges. The natural vegetation is mainly salt-tolerant grasses, forbs, and shrubs.

About 300 acres of this unit was farmed when irrigation water of sufficient quantity and quality was available from the Pecos River. Most of this acreage has returned to native vegetation because of the lack of a dependable water supply and the economics of producing an irrigated crop.

This map unit makes up about 2 percent of the survey area. It is about 34 percent Harkey soils, 27 percent Patrole soils, and 23 percent Pecos soils. The minor soils include Arno, Monahans, Pajarito, and Wink soils.

The Harkey soils are in nearly level areas near the river channel where the coarser sediments are deposited as the water velocity decreases. They are very deep, well drained, loamy soils that are underlain by strata of very fine sand and silts.

The Patrole soils are adjacent to the river channel and are on low convex ridges where floodwaters first leave the channel. They are very deep, well drained, loamy soils that have a clayey subsoil. They are underlain by stratified loamy and clayey alluvium.

The Pecos soils are in the nearly level areas farther from the river channel. The finer textured clay particles stay in suspension and are carried to the outer extremes of the flood plain and deposited as the floodwaters recede. These soils are very deep,

moderately well drained, and clayey. They are underlain by stratified clayey alluvium.

The soils in this unit are suited to irrigated farming if a dependable supply of quality water is available. The major crops grown include cotton, grain sorghum, alfalfa, sunflowers, and vegetables. Good management of irrigation water is essential to control salinity and to meet plant needs. Preirrigation or applications of excess water during irrigation are needed to leach the salts to below the root zone.

The soils in this unit are suitable for livestock ranching, which is the main enterprise for which they are used. Flooding and salinity are the main limitations affecting range production. Overgrazing, grazing when the soils are wet, and acquiring and distributing water for livestock are the major concerns affecting ranch management. The soils in this unit are slow to recover from overgrazing because the limited rainfall and the salinity limit the amount of forage produced. Some areas have ponds that temporarily hold water for livestock, but the dependable water supplies are from wells. The native vegetation is mainly salt-tolerant grasses, forbs, and shrubs.

## Areas Dominated by Well Drained, Loamy Soils on Uplands in the High Plains

This group of map units makes up about 1 percent of the survey area. The major soils are the Kimbrough and Stegall soils. Kimbrough soils have a loamy surface layer that is very shallow or shallow over indurated caliche. They are in broad, nearly level areas. Stegall soils have a loamy surface layer over a clayey subsoil and are moderately deep over indurated caliche. They are in broad, nearly level to slightly depressional areas.

The soils in this group are used as rangeland. The native vegetation consists of black grama, blue grama, sideoats grama, buffalograss, plains bristlegrass, and tobosa. Woody species include creosotebush, tarbush, catclaw mimosa, and feather dalea.

The soils in this unit are poorly suited to most urban uses. Limitations include depth to indurated caliche, slow percolation, low strength, and moderate shrink-swell potential. Kimbrough soils are poorly suited to most recreational uses because of the depth to indurated caliche and the hazard of erosion. Stegall soils are well suited to most recreational uses.

### 13. Kimbrough-Stegall

*Nearly level, very shallow to moderately deep, loamy soils on upland plains*

The landscape is characterized by nearly level microknolls and microdepressions on upland plains (fig. 3). Slopes range from 0 to 3 percent. The natural vegetation is mainly short and middle height grasses and low shrubs.

This map unit makes up about 0.6 percent of the survey area. It is about 54 percent Kimbrough soils and 27 percent Stegall soils. The minor soils include Blakeney, Conger, and Paisano soils.

The nearly level Kimbrough soils are on convex microknolls. They are very shallow and shallow over indurated caliche. They are well drained, are loamy, and are underlain by indurated caliche and calcareous loamy sediments.

The nearly level Stegall soils are in slightly concave microdepressions. They are moderately deep, well drained, loamy soils that are underlain by indurated caliche and calcareous loamy sediments.

The soils in this unit are suited to livestock ranching, which is the main enterprise for which they are used. Overgrazing is the major concern of ranch management. The limited rainfall makes these soils slow to recover from overuse.

# Detailed Soil Map Units

The map units delineated on the detailed maps at the back of this survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information about each map unit is given under the heading "Use and Management of the Soils."

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

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

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

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, the 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*. The name of a soil phase commonly indicates a feature that affects use or management. For example, Paisano very gravelly loam, undulating, is a phase of the Paisano 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. Blakeney-Conger complex, gently undulating, 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. Chamberino-Delnorte association, rolling, is an example.

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

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

# Soil Descriptions

## BCB—Blakeney-Conger complex, gently undulating

These very shallow and shallow soils are on broad upland ridges and divides. They formed in calcareous loamy materials. Slopes range from 1 to 5 percent. Individual areas are irregular in shape and range from 40 to 7,750 acres.

This complex is 70 percent Blakeney soil, 20 percent Conger soil, and 10 percent other soils. The Blakeney soil is on the slightly higher ridges and has linear to convex slopes. The Conger soil is in nearly level to slightly concave positions. The areas of Blakeney and Conger soils are so intricately intermingled that it was not practical to separate them at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Blakeney soil are—

*Surface layer:*
0 to 4 inches—brown fine sandy loam

*Subsoil:*
4 to 16 inches—pale brown fine sandy loam

*Underlying material:*
16 to 22 inches—white, indurated calcium carbonate with a 1/2-inch-thick laminar cap
22 to 80 inches—pinkish white, weakly to strongly cemented calcium carbonate

The typical sequence, depth, and composition of the layers of the Conger soil are—

*Surface layer:*
0 to 4 inches—brown sandy clay loam

*Subsoil:*
4 to 18 inches—brown sandy clay loam

*Underlying material:*
18 to 24 inches—white, indurated calcium carbonate with a 1/4-inch-thick laminar cap
24 to 80 inches—white carbonatic soil material that is 30 percent strongly cemented fragments of calcium carbonate

Important soil properties—

*Available water capacity:* Very low
*Permeability:* Blakeney—moderately rapid in the upper part and very slow in the indurated layer; Conger—moderate in the upper part and very slow in the indurated layer
*Drainage class:* Well drained
*Runoff:* Medium on 1 to 3 percent slopes and high on 3 to 5 percent slopes
*Root zone:* Very shallow and shallow
*Hazard of water erosion:* Severe
*Hazard of wind erosion:* Severe

Included in this complex are small areas of Kinco, Mentone, Sharvana, and Toyah soils. Kinco soils do not have an indurated layer and are in the lower positions on toeslopes. Mentone soils are very deep and clayey. They are in small, concave playas. Sharvana soils have an increase in clay in the subsoil and are on linear, nearly level ridgetops. Toyah soils are very deep, dark colored, and loamy. They are in small drainageways. Also included is a soil that is similar to the Blakeney soil but has an indurated layer that is at a depth of more than 20 inches. Included soils make up 10 percent of the mapped areas.

The Blakeney and Conger soils are used as rangeland. They produce a moderate amount of native plant forage. The shallow and very shallow rooting depth, the very low available water capacity, and limited rainfall are limitations affecting forage production.

The dominant native vegetation consists of black grama, plains bristlegrass, burrograss, sand dropseed, Arizona cottontop, and mesquite.

This complex is not suited to irrigated cropland because of the very shallow and shallow rooting depth, the very low available water capacity, and the hazard of wind erosion and water erosion.

This complex is poorly suited to most urban and recreational uses. The very shallow and shallow depth to the indurated layer is the main limitation. This cemented layer hinders the absorption of effluent in septic tank absorption fields, increases the cost of excavation, and limits the growth of plants. Seepage is also a limitation affecting sewage lagoons in some areas.

This complex is in capability subclass 6e and is in the Shallow Sandy Loam range site.

## CDD—Chamberino-Delnorte association, rolling

These very shallow and deep, gravelly soils are on upland ridges. They are on dissected ridges adjacent to the flood plain along the Pecos River. Slopes are linear to convex and range from 3 to 16 percent. Individual areas are oblong and range from 40 to 625 acres.

This association is about 50 percent Chamberino soil, 40 percent Delnorte soil, and 10 percent other soils. The Chamberino soil is on the side slopes of ridges and has linear to convex slopes that range from 5 to 16 percent. The Delnorte soil is on ridgetops and has linear to convex slopes that range from 3 to 8 percent. The Chamberino and Delnorte soils were not separated in mapping because they have similar use and management. Mapping was controlled well enough for the anticipated use of the areas involved.

The typical sequence, depth, and composition of the layers of the Chamberino soil are—

*Surface layer:*
0 to 4 inches—light yellowish brown gravelly fine sandy loam

*Subsoil:*
4 to 14 inches—light brown very gravelly fine sandy loam
14 to 41 inches—pink very gravelly loam

*Underlying material:*
41 to 57 inches—light brown gravelly loam
57 to 80 inches—red, stratified, thin layers of sandstone and siltstone having a texture of silt loam

The typical sequence, depth, and composition of the layers of the Delnorte soil are—

*Surface layer:*
0 to 4 inches—light brown very gravelly loam

*Subsoil:*
4 to 8 inches—light brown very gravelly loam

*Underlying material:*
8 to 22 inches—indurated calcium carbonate with a 1-centimeter-thick laminar cap
22 to 80 inches—white carbonatic soil material that has a texture of fine sandy loam and has moderately cemented fragments of calcium carbonate and 25 percent imbedded siliceous pebbles

Important soil properties—

*Available water capacity:* Chamberino—low; Delnorte—very low
*Permeability:* Chamberino—moderate in the upper part and moderately slow in the bedrock; Delnorte—moderately rapid in the upper part and very slow in the indurated layer
*Drainage class:* Well drained
*Runoff:* Chamberino—medium; Delnorte—high on 3 to 5 percent slopes and very high on 5 to 8 percent slopes
*Root zone:* Chamberino—deep; Delnorte—very shallow and shallow
*Hazard of water erosion:* Moderate
*Hazard of wind erosion:* Slight

Included in this association are small areas of Tencee, Toyah, and Wink soils. Tencee soils are similar to the Delnorte soils but have more calcium carbonate. Tencee soils are on the nearly level ridgetops of the dissected ridges. Toyah soils are very deep and are dark colored. They are in the small drainageways between ridges. Wink soils are on footslopes of the ridges. They are deep, loamy soils and have accumulations of calcium carbonate within a depth of 40 inches. Also included are areas where the gravel cap has been eroded from the Chamberino soil and the underlying material is exposed at or near the surface. Included soils make up 10 percent of the mapped areas.

The Chamberino and Delnorte soils are used mainly as rangeland. They produce a small amount of native plant forage. The low available water capacity in the Chamberino soil and the very low available water capacity in the Delnorte soil are limitations affecting forage production.

The native vegetation consists of black grama, bush muhly, slim tridens, sideoats grama, blue grama, plains bristlegrass, Arizona cottontop, cane bluestem, sand dropseed, and mesa dropseed. Woody species include creosotebush, range ratany, and fourwing saltbush.

The Chamberino soil is moderately suited to most urban uses. The main limitations in areas of the Chamberino soil are depth to bedrock, the slope, and rock fragments. The Delnorte soil is poorly suited to most urban uses. The main limitation in areas of the Delnorte soil is the depth to indurated calcium carbonate.

The Chamberino soil is moderately suited to most recreational uses. The slope and the high content of gravel and cobbles are limitations. The Delnorte soil is poorly suited to most recreational uses because of the very shallow and shallow depth to indurated calcium carbonate and a high content of gravel.

**Figure 5.—An area of Coyanosa-Los Tanos complex, undulating. The Coyanosa soil has rocks on the surface and is in the Sandstone Hill and Mountain range site. The Los Tanos soil is on footslopes on the far right. It is in the Sandy Loam range site.**

This association is in capability subclass 7s and is in the Gravelly range site.

## CLC—Coyanosa-Los Tanos complex, undulating

These very shallow and moderately deep soils are on uplands (fig. 5). They formed in sediments weathered from sandstone. Slopes are mainly convex and range from 1 to 8 percent. Individual areas are irregular in shape and range from 40 to 250 acres.

This complex is about 55 percent Coyanosa soil, 35 percent Los Tanos soil, and 10 percent inclusions. The Coyanosa soil is on convex knolls, ridgetops, and escarpments having slopes of 5 to 8 percent. The Los Tanos soil is on footslopes of ridges and in slightly concave drainageways between ridges. The slope of the Los Tanos soil ranges from 1 to 5 percent. The areas of Coyanosa and Los Tanos soils are so intricately intermingled or so small that it was not practical to separate them at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Coyanosa soil are—

*Surface layer:*
0 to 5 inches—brown, calcareous very gravelly loam

*Underlying material:*
5 to 8 inches—fractured sandstone bedrock with soil material filling fractures
8 to 16 inches—unweathered sandstone bedrock

The typical sequence, depth, and composition of the layers of the Los Tanos soil are—

*Surface layer:*
0 to 8 inches—brown, calcareous fine sandy loam

*Subsoil:*
8 to 25 inches—brown, calcareous fine sandy loam
25 to 30 inches—light brown, calcareous fine sandy loam

*Underlying material:*
30 to 50 inches—unweathered, coarsely fractured sandstone bedrock

Important soil properties—

*Available water capacity:* Coyanosa—very low; Los Tanos—low
*Permeability:* Coyanosa—moderate in the upper part and moderately slow in the sandstone bedrock; Los Tanos—moderately rapid in the upper part and very slow in the sandstone bedrock
*Drainage class:* Well drained
*Runoff:* Medium
*Root zone:* Coyanosa—very shallow and shallow; Los Tanos—moderately deep
*Hazard of water erosion:* Coyanosa—moderate; Los Tanos—severe
*Hazard of wind erosion:* Coyanosa—slight; Los Tanos—severe

Included in this complex are small areas of Pajarito, Splotter, Turney, and Tencee soils. Pajarito soils are very deep fine sandy loam. They are in the narrow drainageways and on the lower footslopes of the ridges. Splotter soils are shallow over indurated calcium carbonate, are gently undulating, and are near the outer edges of the mapped areas. Turney soils are very deep and loamy and are in broad, nearly level areas at the lower elevations. Tencee soils are very shallow and shallow over indurated caliche. They have convex slopes and are gently undulating. Also included are small areas of Rock outcrop and a soil that is similar to the Coyanosa soil but supports a native vegetation similar to the Gravelly range site. The Rock outcrop consists of exposed bedrock, mainly along short, steep ledges and escarpments. Inclusions make up about 10 percent of the mapped areas.

The Coyanosa and Los Tanos soils are used mainly as rangeland and for wildlife habitat. They produce a small to moderate amount of forage. The very shallow or shallow depth to bedrock and the very low available water capacity are limitations affecting forage production in areas of the Coyanosa soil. The medium surface runoff, the moderately deep rooting depth, and the low available water capacity are limitations affecting forage production in areas of the Los Tanos soil.

The native vegetation consists of black grama, sideoats grama, plains bristlegrass, cane bluestem, Arizona cottontop, spike dropseed, mesa dropseed, and sand dropseed.

This complex is poorly suited to most urban uses because of the depth to bedrock. Excavation is difficult because the bedrock is close to the surface. This map unit is a poor source of construction materials because of the excess fines and the difficulty in reclaiming the area after materials are removed.

The Coyanosa soil is poorly suited to most recreational uses because of the depth to bedrock, the slope, and the high content of gravel on the surface. The Los Tanos soil is well suited to most recreational uses.

The Coyanosa soil is in capability subclass 7s and is in the Sandstone Hill and Mountain range site. The Los Tanos soil is in capability subclass 6e and is in the Sandy Loam range site.

## DUB—Dune land

This map unit consists of very deep, hummocky, eolian sand deposits on uplands (fig. 6). Slopes generally range from 1 to 3 percent, but range from 2 to 35 percent on side slopes of sand dunes. Individual areas are oval and range from 30 to 6,150 acres.

**Figure 6.—An area of Dune land, which is a miscellaneous land type consisting of mostly active sand dunes that support little or no vegetation.**

This map unit is 90 percent active sand dunes and 10 percent other areas. Individual dunes are 10 to 35 feet high, 1 to 20 acres in size, and typically oriented with the prevailing southwesterly wind. The sand dunes are generally larger and more active on the northeastern side of the mapped areas and are becoming more stabilized on the southwestern side.

The typical sequence, depth, and composition of the layers of Dune land are—

*Surface layer:*
0 to 11 inches—very pale brown, noncalcareous fine sand

*Underlying material:*
11 to 80 inches—light yellowish brown, noncalcareous fine sand

Important properties—

*Available water capacity:* Low
*Permeability:* Rapid
*Drainage class:* Excessively drained
*Runoff:* Negligible
*Hazard of water erosion:* Slight
*Hazard of wind erosion:* Severe

Included in this map unit are small, concave blowout areas that are 20 to 70 feet in diameter. These areas receive more runoff water than the rest of the unit and remain moist for longer periods. They make up only about 5 percent of the map unit, but they produce most of the vegetation. Also included are small areas of Elgee and Penwell soils. Penwell soils are sand dunes that have become stabilized and are producing vegetation. Elgee soils are on the outer edges of the mapped areas and have a subsoil at a depth of 40 to 80 inches.

The Dune land is used mainly as rangeland, but it provides very little forage for livestock. The sparse, scattered vegetation on the active dunes is mainly sandreed and Havard panicum. The dominant native vegetation in the low blowout areas consists of sedges, willows, shin oaks, mesquite, yucca, and annual forbs.

This map unit is not suitable for cultivation because of the hazard of soil blowing.

This map unit is poorly suited to urban and recreational uses.

This map unit is in capability subclass 8e and is not assigned to a range site.

## EPB—Elgee-Penwell complex, gently undulating

These very deep, sandy soils are on upland plains and ridges (fig. 7). They formed in eolian deposits. Slopes generally are convex and range from 1 to 5 percent but are as much as 30 percent on the side slopes of some dunes. Individual areas are irregular in shape and range from 40 to 17,350 acres.

This complex is 50 percent Elgee soil, 40 percent Penwell soil, and 10 percent inclusions. The Elgee soil is nearly level to gently undulating and is stabilized against wind erosion. The Penwell soil is hummocky and is intermixed with and adjacent to active sand dunes. The composition of this map unit was determined by sampling transects across several mapped areas.

The typical sequence, depth, and composition of the layers of the Elgee soil are—

*Surface layer:*
0 to 62 inches—yellowish red, neutral fine sand

*Subsoil:*
62 to 80 inches—red, neutral loamy fine sand

The typical sequence, depth, and composition of the layers of the Penwell soil are—

*Surface layer:*
0 to 9 inches—reddish brown fine sand

*Underlying material:*
9 to 46 inches—yellowish red fine sand
46 to 84 inches—reddish yellow fine sand

Important soil properties—

*Available water capacity:* Elgee—low; Penwell—very low
*Permeability:* Elgee—moderately rapid; Penwell—rapid
*Drainage class:* Elgee—well drained; Penwell—excessively drained
*Runoff:* Negligible on 1 to 3 percent slopes and very low on 3 to 5 percent slopes
*Root zone:* Very deep
*Hazard of water erosion:* Slight
*Hazard of wind erosion:* Severe

Included in this complex are small areas of active sand dunes and areas of Pyote and Wickett soils. The active sand dunes are hummocky areas that are devoid of vegetation because of shifting sands. Pyote soils are in the low blowout areas between active dunes and on the outer edges of mapped areas. They have a loamy subsoil at a depth of 20 to 40 inches. Wickett soils are nearly level and are near the outer edges of mapped areas. They have a loamy subsoil within a depth of 20 inches and indurated calcium carbonate within a depth of 40 inches. Also included is a soil that is similar to the Elgee soil but has 18 to 35 percent clay in the subsoil. Inclusions make up less than 10 percent of the mapped areas.

The Elgee and Penwell soils are used mainly as

**Figure 7.—An area of Elgee-Penwell complex, gently undulating. The Elgee soil is in the nearly level, vegetated areas, and the Penwell soil is on the convex dunes that have little vegetation. Wind erosion is a major management concern in areas of this complex.**

rangeland. They produce a large amount of native forage. The vegetation on these soils responds well to summer showers.

The native vegetation consists of sand bluestem, little bluestem, giant dropseed, spike dropseed, mesa dropseed, sand dropseed, Havard panicum, big sandreed, sand paspalum, plains bristlegrass, sand sagebrush, Havard oak, and mesquite.

This complex is well suited to most building site development. Droughtiness is a limitation affecting lawns and landscaping. The main limitation affecting shallow excavations is the instability of sidewalls. The soils are poorly suited as sites for most sanitary facilities because of seepage, poor filtering capacity, and the sandy texture of the surface layer.

This complex is poorly suited to recreational uses because of the sandy surface layer.

The Elgee soil is in capability subclass 6e, and the Penwell soil is in capability subclass 7e. Both soils are in the Sand Hills range site.

## FDA—Faskin-Douro complex, nearly level

These moderately deep and deep soils are on upland plains. They formed in loamy eolian sediments. Local shifting of soil by wind is evident in places. Slopes range from 0 to 3 percent. Individual areas are irregular in shape and range from 500 to 1,650 acres.

This complex is 50 percent Faskin soil, 30 percent Douro soil, and 20 percent other soils. The Faskin soil is in the slightly higher convex positions, and the Douro soil is in the slightly lower concave positions. The areas of Faskin and Douro soils are so intricately intermingled or so small that they can not be shown separately at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Faskin soil are—

*Surface layer:*
0 to 10 inches—reddish brown fine sandy loam

*Subsoil:*
10 to 26 inches—reddish brown sandy clay loam
26 to 42 inches—red sandy clay loam
42 to 62 inches—red sandy clay loam having 10 percent masses of calcium carbonate in the lower part

*Underlying material:*
62 to 70 inches—pink, indurated calcium carbonate with a 1/4- to 3/4-inch-thick laminar cap

The typical sequence, depth, and composition of the layers of the Douro soil are—

*Surface layer:*
0 to 5 inches—reddish brown fine sandy loam

*Subsoil:*
5 to 24 inches—reddish brown sandy clay loam
24 to 38 inches—red sandy clay loam

*Underlying material:*
38 to 50 inches—pink, indurated calcium carbonate having a 1/2- to 3/4-inch-thick laminar cap
50 to 80 inches—pink carbonatic soil materials having 25 percent weakly to moderately cemented fragments of calcium carbonate

Important soil properties—

*Available water capacity:* Faskin—moderate; Douro—low
*Permeability:* Faskin—moderate; Douro—moderate in the upper part and very slow in the indurated layer
*Drainage class:* Well drained
*Runoff:* Faskin—negligible on 0 to 1 percent slopes and very low on 1 to 3 percent slopes; Douro—very low on 0 to 1 percent slopes and low on 1 to 3 percent slopes
*Root zone:* Faskin—very deep; Douro—moderately deep
*Hazard of water erosion:* Faskin—slight; Douro—moderate
*Hazard of wind erosion:* Faskin—moderate; Douro—severe

Included in this map unit are small areas of Blakeney, Wickett, and Pyote soils. Blakeney soils are on convex knolls at the outer edges of the mapped areas. They are less than 20 inches deep over indurated calcium carbonate and do not have significant accumulations of clay in the subsoil. Wickett and Pyote soils are in landscape positions similar to those of the Faskin and Douro soils but have a surface layer of loamy fine sand and a subsoil of fine sandy loam. Included soils make up 20 percent of the mapped areas.

The Faskin and Douro soils are used mainly as rangeland and for wildlife habitat. They produce a large amount of a mixture of native, short and middle height grasses. Proper grazing management is needed to minimize wind erosion.

The dominant native vegetation consists of black grama, blue grama, sideoats grama, plains bristlegrass, feather bluestem, vine-mesquite, buffalograss, Arizona cottontop, sand dropseed, and hooded windmillgrass.

The Faskin soil is well suited to most urban uses. Seepage is a limitation affecting sewage lagoons. The Douro soil is poorly suited to most urban uses because of the depth to indurated calcium carbonate. Both soils are well suited to recreational uses.

This complex is in capability subclass 4e, nonirrigated, and 3e, irrigated, and is in the Sandy Loam range site.

## HAA—Harkey-Patrole association, occasionally flooded

These very deep, nearly level soils are on the flood plain along the Pecos River. Slopes are linear and less than 1 percent. Individual areas are long and narrow and range from 50 to 3,500 acres. These soils are flooded once in 7 to 20 years for a duration of 2 to 7 days.

This association is 55 percent Harkey soil, 30 percent Patrole soil, and 15 percent other soils. The Harkey soil is near the river channel where water spills over the channel bank during flooding and the coarser sediments are deposited as the water velocity decreases. The Harkey soil also occurs throughout the mapped areas in long, narrow areas adjacent to where the river channel existed prior to changing course. The

Harkey soil has a linear to convex slope. The Patrole soil is adjacent to the river channel and is on low convex ridges where floodwaters first leave the channel. The Harkey and Patrole soils were not separated in mapping because they have similar use and management. Mapping was controlled well enough for the anticipated use of the areas involved.

The typical sequence, depth, and composition of the layers of the Harkey soil are—

*Surface layer:*
0 to 8 inches—light brown loam

*Underlying material:*
8 to 34 inches—light brown silt loam
34 to 42 inches—light brown loam
42 to 56 inches—light brown very fine sandy loam
56 to 60 inches—light brown silt loam

The typical sequence, depth, and composition of the layers of the Patrole soil are—

*Surface layer:*
0 to 10 inches—brown very fine sandy loam

*Underlying material:*
10 to 24 inches—brown silt loam
24 to 50 inches—brown clay
50 to 80 inches—brown silty clay loam

Important soil properties—

*Available water capacity:* Harkey—moderate; Patrole—low
*Permeability:* Harkey—moderate; Patrole—moderately slow to very slow
*Drainage class:* Well drained
*Runoff:* Harkey—negligible; Patrole—very low
*Root zone:* Very deep
*Salinity:* Moderate
*Hazard of water erosion:* Moderate
*Hazard of wind erosion:* Moderate

Included in this association are small areas of Pecos soils. Pecos soils are clayey throughout the profile. They are at the outer edges of the mapped areas, farther from the channels than the Harkey and Patrole soils. Also included is a soil that is similar to the Harkey soil but contains more coarse sand. It is in landscape positions similar to those of the Harkey soil. Included soils make up 15 percent of the mapped areas.

Most areas of the Harkey and Patrole soils are used as rangeland and for wildlife habitat. This association produces a large amount of native, salt-tolerant plant forage. The extra water that is received from flooding and runoff contributes to the high production.

The dominant native vegetation consists of alkali sacaton, twoflower trichloris, cane bluestem, spike dropseed, sand dropseed, fourwing saltbush, and mesquite.

A few areas of this association are used as irrigated cropland when a sufficient quantity of adequate-quality water is available from the Pecos River. Major irrigated crops include cotton, forage sorghum, small grains, alfalfa, and sunflowers. Crop production is dependent upon the quantity and quality of the irrigation water. Salinity management is critical. Salinity can be controlled by carefully leaching the salts to below the root zone during preirrigation or irrigation. Applying excess irrigation water can create a perched water table that drown crops and increases the salinity of the soil. The selection of crops based on their salt tolerance is necessary.

This association is poorly suited to most urban uses because of the hazard of flooding, wetness, and excess salt. These soils are an improbable source for construction materials because of excess fines and salts.

The Harkey soil is poorly suited to recreational development because of the hazard of flooding, excess salt, and the hazard of erosion. The Patrole soil is poorly suited to most recreational uses because of the hazard of flooding, excess salt, and dusty surface conditions.

The Harkey soil is in capability subclass 7s, nonirrigated, and 3s, irrigated. The Patrole soil is in capability subclass 7s, nonirrigated, and 4s, irrigated. Both soils are in the Salty Bottomland range site.

## HMB—Holloman-Monahans complex, gently undulating

These very shallow and very deep soils are on upland plains, knolls, and basins. They formed in alluvium containing significant amounts of calcium carbonate and gypsum. Slopes are linear to convex and range from 0 to 5 percent. Individual areas are irregular in shape and range from 40 to 1,900 acres.

This complex consists of 45 percent Holloman soil, 35 percent Monahans soil, and 20 percent other soils. The Holloman soil is on the slightly higher convex knolls. The Monahans soil is in the lower positions between knolls. The areas of Holloman and Monahans soils are so intricately intermingled or so small that it was not practical to separate them at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Holloman soil are—

*Surface layer:*
0 to 2 inches—light brown, calcareous loam

*Underlying material:*
2 to 8 inches—light gray, gypsiferous loam
8 to 34 inches—light gray, unweathered gypsum stratified with thin layers of soft gypsum
34 to 60 inches—light gray, hard gypsum (alabaster) stratified with thin layers of soft gypsum

The typical sequence, depth, and composition of the layers of the Monahans soil are—

*Surface layer:*
0 to 8 inches—brown fine sandy loam

*Subsoil:*
8 to 30 inches—pale brown fine sandy loam

*Underlying material:*
30 to 60 inches—white, gypsiferous sandy clay loam with visible calcium carbonate and gypsum crystals

Important soil properties—

*Available water capacity:* Holloman—very low; Monahans—moderate
*Permeability:* Holloman—moderate in the upper part and moderately slow in the underlying material; Monahans—moderate
*Drainage class:* Well drained
*Runoff:* Negligible on 0 to 1 percent slopes, very low on 1 to 3 percent slopes, and low on 3 to 5 percent slopes
*Root zone:* Holloman—very shallow and shallow; Monahans—very deep
*Hazard of water erosion:* Holloman—severe; Monahans—moderate
*Hazard of wind erosion:* Severe

Included in this complex are small areas of Pajarito, Reeves, and Wink soils. Pajarito and Wink soils are not underlain by gypsum. They are in landscape positions similar to those of the Monahans soil. Reeves soils are underlain by gypsum at a depth of 20 to 40 inches. They are in nearly level areas between areas of the Holloman soil. Also included is a soil that is similar to the Holloman soil but does not have indurated gypsum. Included soils make up 20 percent of the mapped areas.

The Holloman and Monahans soils are used as rangeland. The Holloman soil produces a small amount of forage. The very low available water capacity and the very shallow and shallow rooting depth are limitations affecting forage production in areas of the Holloman soil. The Monahans soil produces a moderate amount of forage. The limited rainfall and moderate available water capacity are limitations affecting forage production in areas of the Monahans soil.

The dominant native vegetation consists of black grama, chino grama, alkali sacaton, gypgrass, sand dropseed, mesa dropseed, sand muhly, plains bristlegrass, cane bluestem, bush muhly, perennial threeawns, rough coldenia, fourwing saltbush, and butterfly bush. Maintaining an adequate vegetative cover is essential for minimizing wind erosion.

The Holloman soil is poorly suited to most urban uses because of the depth to gypsum bedrock, excess salt, excess gypsum, and the hazard of subsidence. The Monahans soil is moderately suited to most urban uses. Seepage and the slope are limitations on sites for sewage lagoons. Excess salt and excess gypsum are the main limitations affecting urban uses in areas of the Monahans soil. The Holloman and Monahans soils are underlain by gypsum that dissolves when wet, forming sink holes or solution caverns.

The Holloman soil is poorly suited to most recreational uses. The depth to gypsum bedrock and excess gypsum are limitations. The Monahans soil is well suited to most recreational uses.

The Holloman soil is in capability subclass 7s and is in the Gyp range site. The Monahans soil is in capability subclass 7e and is in the Sandy Loam range site.

## HRA—Holloman-Reeves complex, nearly level

These very shallow to very deep soils are on upland plains, knolls, and basins. They formed in alluvial sediments and materials weathered from gypsum. Slopes are linear to convex and range from 0 to 3 percent. Individual areas are irregular in shape and range from 40 to 1,850 acres.

This complex is 50 percent Holloman soil, 30 percent Reeves soil, and 20 percent other soils. The Holloman soil is on the slightly higher knolls and has convex slopes. The Reeves soil is on nearly level basins between knolls and has linear slopes. The areas of Holloman and Reeves soils are so intricately intermingled or so small that it was not practical to separate them at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Holloman soil are—

*Surface layer:*
0 to 5 inches—very pale brown loam

*Underlying material:*
5 to 11 inches—very pale brown, gypsiferous soil material that has a texture of loam
11 to 32 inches—white, hard gypsum lenses that are 3 to 7 inches thick interlayered with soft gypsum

32 to 60 inches—white, soft gypsum with many cemented 2- to 4-inch-thick gypsum lenses

The typical sequence, depth, and composition of the layers of the Reeves soil are—

*Surface layer:*
0 to 14 inches—light yellowish brown loam

*Subsoil:*
14 to 23 inches—light yellowish brown loam with common concretions and threads of calcium carbonate
23 to 34 inches—very pale brown loam with common calcium carbonate concretions and gypsum crystals and few hard gypsum lenses
34 to 60 inches—white, gypsiferous, loamy soil material that has common gypsum crystals and lenses and concretions of calcium carbonate

Important soil properties—

*Available water capacity:* Holloman—very low; Reeves—low
*Permeability:* Holloman—moderate in the upper part and moderately slow in the underlying material; Reeves—moderate
*Drainage class:* Well drained
*Runoff:* Negligible on 0 to 1 percent slopes and very low on 1 to 3 percent slopes
*Root zone:* Holloman—very shallow and shallow; Reeves—moderately deep
*Hazard of water erosion:* Holloman—severe; Reeves—moderate
*Hazard of wind erosion:* Holloman—severe; Reeves—moderate

Included in this complex are small areas of Mentone, Monahans, Toyah, and Turney soils. The Mentone soils are in small, concave depressional areas. They have a dark colored surface layer and a subsoil of silty clay loam. They do not contain gypsum. Monahans soils are along the outer edges of the mapped areas. Toyah soils are in small drainageways and do not contain gypsum. Turney soils are in linear, nearly level alluvial areas that are similar to the areas of the Reeves soil, but the Turney soils do not have gypsum in the subsoil. Also included is a soil that is similar to the Holloman soil but does not have hard gypsum and a soil that is similar to the Reeves soil but is 40 to 60 inches deep over gypsum. Included soils make up about 20 percent of the mapped areas.

The Holloman and Reeves soils are used as rangeland and for wildlife habitat. The Holloman soil produces a small amount of forage. The very low available water capacity and the very shallow and shallow rooting depth are limitations affecting the production of forage in areas of the Holloman soil. The Reeves soil produces a moderate amount of forage. Limited rainfall and the low available water capacity are limitations affecting forage production in areas of the Reeves soil.

The native vegetation consists of black grama, chino grama, alkali sacaton, gypgrass, sand dropseed, burrograss, plains bristlegrass, cane bluestem, and rough coldenia.

The Holloman and Reeves soils are poorly suited to most urban uses because of the depth to gypsum bedrock, excess salt, excess gypsum, and the hazard of subsidence. Both soils are underlain by gypsum that dissolves when wet, forming sink holes or solution caverns.

The Holloman soil is poorly suited to most recreational uses because of the very shallow and shallow depth to gypsum bedrock, excess salt, and the hazard of erosion. The Reeves soil is moderately suited to most recreational uses. The main limitations are excess salt, dusty surface conditions, and the hazard of erosion.

The Holloman soil is in capability subclass 7s and is in the Gyp range site. The Reeves soil is in capability subclass 7e, nonirrigated, and 3e, irrigated. It is in the Loamy range site.

## KAA—Kimbrough-Stegall complex, nearly level

These very shallow and moderately deep soils are on upland plains. They formed in eolian material over thick deposits of calcium carbonate. Slopes are linear to concave and range from 0 to 3 percent. Individual areas are irregular in shape and range from 1,900 to 5,900 acres.

This complex is 60 percent Kimbrough soil, 30 percent Stegall soil, and 10 percent other soils. The Kimbrough soil is on the slightly convex ridges and knolls. The Stegall soil is in the low, slightly concave positions. The areas of Kimbrough and Stegall soils are so intricately intermingled or so small that it was not practical to separate them at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Kimbrough soil are—

*Surface layer:*
0 to 4 inches—brown fine sandy loam

*Subsoil:*
4 to 16 inches—brown loam

*Underlying material:*
16 to 27 inches—indurated calcium carbonate that has a $^1/_4$- to $^1/_2$-inch-thick laminar cap

27 to 80 inches—stratified, soft carbonatic soil material and weakly cemented fragments of calcium carbonate

The typical sequence, depth, and composition of the layers of the Stegall soil are—

*Surface layer:*
0 to 7 inches—brown clay loam

*Subsoil:*
7 to 15 inches—reddish brown clay loam
15 to 26 inches—reddish brown clay loam with few fine threads of calcium carbonate

*Underlying material:*
26 to 38 inches—pink, indurated calcium carbonate that has a 1/2- to 3/4-inch-thick laminar cap
38 to 60 inches—pink carbonatic soil material that has common weakly cemented nodules of calcium carbonate

Important soil properties—

*Available water capacity:* Kimbrough—very low; Stegall—low
*Permeability:* Kimbrough—moderate in the upper part and very slow in the indurated layer; Stegall—moderately slow in the upper part and very slow in the indurated layer
*Drainage class:* Well drained
*Runoff:* Kimbrough—low on 0 to 1 percent slopes and medium on 1 to 3 percent slopes; Stegall—very low on 0 to 1 percent slopes and low on 1 to 3 percent slopes
*Root zone:* Kimbrough—very shallow and shallow; Stegall—moderately deep
*Hazard of water erosion:* Kimbrough—severe; Stegall—moderate
*Hazard of wind erosion:* Kimbrough—severe; Stegall—moderate

Included in this complex are small areas of Conger and Mentone soils and a soil that is similar to the Stegall soil but does not have indurated calcium carbonate within a depth of 60 inches. Conger soils are lighter colored than the Kimbrough soil and are on the slightly convex ridges and knolls at the outer edges of the mapped areas. Mentone soils are very deep and loamy. They are in concave playas. Included soils make up 10 percent of the mapped areas.

The Kimbrough and Stegall soils are used mainly as rangeland. The Kimbrough soil produces a small amount of forage. The very shallow and shallow rooting depth and the very low available water capacity are the main limitations affecting forage production in areas of the Kimbrough soil. The Stegall soil produces a large amount of forage because it is moderately deep and is in concave positions that receive runoff water.

The dominant native vegetation consists of short and middle height grasses, such as black grama, sideoats grama, blue grama, feathery bluestems, buffalograss, plains bristlegrass, perennial threeawns, and tobosa.

The Kimbrough soil is poorly suited to most urban uses because of the very shallow and shallow depth to indurated calcium carbonate. Careful design and installation can minimize the affects of this limitation. The Stegall soil is poorly suited to most urban uses because of the indurated layer of calcium carbonate, restricted permeability, low strength, and the moderate shrink-swell potential.

The Kimbrough soil is poorly suited to most recreational uses. It erodes easily, and the depth to indurated calcium carbonate is a limitation. The Stegall soil is well suited to most recreational uses.

The Kimbrough soil is in capability subclass 6e, nonirrigated, and 4s, irrigated. It is in the Very Shallow range site. The Stegall soil is in capability subclass 3e, nonirrigated and irrigated, and is in the Clay Loam range site.

## KBA—Kinco-Blakeney complex, nearly level

These very shallow and very deep soils are on upland plains and knolls. They formed in calcareous loamy materials of eolian and alluvial origin. Slopes are linear to convex and range from 0 to 3 percent. Individual areas are irregular in shape and range from 40 to 7,600 acres.

This complex is 45 percent Kinco soil, 40 percent Blakeney soil, and 15 percent other soils. The Kinco soil is on nearly level, linear or slightly concave upland plains. The Blakeney soil is on the slightly higher knolls and has linear to convex slopes. The areas of Kinco and Blakeney soils are so intricately intermingled or so small that it was not practical to separate them at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Kinco soil are—

*Surface layer:*
0 to 8 inches—brown fine sandy loam

*Subsoil:*
8 to 30 inches—light brown fine sandy loam
30 to 46 inches—pink fine sandy loam with common masses and concretions of calcium carbonate
46 to 60 inches—light brown fine sandy loam with few masses and concretions of calcium carbonate

The typical sequence, depth, and composition of the layers of the Blakeney soil are—

*Surface layer:*
0 to 8 inches—brown fine sandy loam

*Subsoil:*
8 to 19 inches—light brown fine sandy loam

*Underlying material:*
19 to 26 inches—white, indurated calcium carbonate
26 to 80 inches—pinkish white carbonatic soil material that has a texture of fine sandy loam and 20 percent weakly cemented fragments of calcium carbonate

Important soil properties—

*Available water capacity:* Kinco—moderate; Blakeney—very low
*Permeability:* Kinco—moderately rapid; Blakeney—moderately rapid in the upper part and very slow in the indurated layer
*Drainage class:* Well drained
*Runoff:* Kinco—negligible; Blakeney—low on 0 to 1 percent slopes and medium on 1 to 3 percent slopes
*Root zone:* Kinco—very deep; Blakeney—very shallow and shallow
*Hazard of water erosion:* Kinco—slight; Blakeney—severe
*Hazard of wind erosion:* Severe

Included in this complex are small areas of Conger and Sharvana soils. Conger soils are in landscape positions similar to those of the Blakeney soils but have more clay in the subsoil than the Blakeney and Kinco soils. Sharvana soils have a layer of clay accumulation over indurated calcium carbonate and are in landscape positions similar to those of the Blakeney soils. Also included is a soil that is similar to the Blakeney soil but is 20 to 40 inches deep over the indurated layer. Included soils make up 15 percent of the mapped areas.

The Kinco and Blakeney soils are used as rangeland and for wildlife habitat. The Kinco soil produces a large amount of native range forage, and the Blakeney soil produces a moderate amount. The very shallow and shallow rooting depth and very low available water capacity are limitations affecting forage production in areas of the Blakeney soil.

The dominant native vegetation consists of black grama, sand dropseed, mesa dropseed, plains bristlegrass, Arizona cottontop, spike dropseed, bush muhly, blue grama, and sideoats grama. Woody species include fourwing saltbush, yucca, ephedra, catclaw, javelina brush, and mesquite.

The Kinco soil is well suited to most urban uses. Seepage is a limitation affecting sewage lagoons in areas of the Kinco soil. The Blakeney soil is poorly suited to most urban uses because of the very shallow and shallow depth to indurated calcium carbonate and excessive seepage.

The Kinco soil is well suited to most recreational uses. The Blakeney soil is poorly suited to most recreational uses because of the very shallow and shallow depth to indurated calcium carbonate and dusty surface conditions.

This complex is in capability subclass 6e. The Kinco soil is in the Sandy Loam range site, and the Blakeney soil is in the Shallow Sandy Loam range site.

## MPA—Monahans-Pajarito complex, nearly level

These very deep, nearly level soils are on upland plains. They formed in sandy alluvial sediments. Slopes are linear to convex and range from 0 to 3 percent. Individual areas are irregular in shape and range from 40 to 1,750 acres.

This complex is 50 percent Monahans soil, 40 percent Pajarito soil, and 10 percent other soils. The Monahans and Pajarito soils are in the same landscape positions. The Monahans soil is adjacent to soils that are shallow over gypsum, and the Pajarito soil is along the outer edges of the mapped areas. The areas of Monahans and Pajarito soils are so intricately intermingled or so small that it was not practical to separate them at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Monahans soil are—

*Surface layer:*
0 to 4 inches—brown fine sandy loam
4 to 12 inches—light brown fine sandy loam

*Subsoil:*
12 to 32 inches—yellowish red sandy clay loam
32 to 40 inches—pinkish white sandy clay loam with common masses of calcium carbonate and gypsum
40 to 60 inches—pink sandy clay loam with common masses of calcium carbonate and gypsum

The typical sequence, depth, and composition of the layers of the Pajarito soil are—

*Surface layer:*
0 to 4 inches—light reddish brown fine sandy loam

*Subsoil:*
4 to 14 inches—reddish yellow fine sandy loam

14 to 30 inches—light red fine sandy loam
30 to 60 inches—light red fine sandy loam with few siliceous pebbles and fragments of calcium carbonate

Important soil properties—

*Available water capacity:* Moderate
*Permeability:* Monahans—moderate; Pajarito—moderately rapid
*Drainage class:* Well drained
*Runoff:* Monahans—negligible on 0 to 1 percent slopes and very low on 1 to 3 percent slopes; Pajarito—negligible
*Hazard of water erosion:* Monahans—moderate; Pajarito—slight
*Hazard of wind erosion:* Severe

Included in mapping are small areas of Holloman, Reeves, Turney, and Wink soils. Holloman soils are very shallow and shallow over gypsum bedrock. They are on nearly level gypsum deposits or small convex knolls. Reeves soils have more clay in the subsoil than the Monahans and Pajarito soils and are underlain by gypsum at a depth of 20 to 40 inches. Reeves soils are on nearly level to gently sloping uplands. Turney soils have more clay in the subsoil than the Monahans and Pajarito soils and have significant accumulations of calcium carbonate within a depth of 40 inches. Turney soils are in broad, nearly level areas in the lower positions on the landscape. Wink soils have significant accumulations of calcium carbonate within a depth of 40 inches and are in landscape positions similar to those of the Monahans and Pajarito soils. Included soils make up 10 percent of the mapped areas.

The Monahans and Pajarito soils are used as rangeland and for wildlife habitat. They produce a moderate amount of native plant forage. Limited rainfall and the moderate available water capacity are the main limitations affecting forage production.

The native vegetation consists of black grama, sand dropseed, mesa dropseed, plains bristlegrass, Arizona cottontop, spike dropseed, bush muhly, blue grama, and sideoats grama. Shrubs include fourwing saltbush, yucca, and catclaw.

The Monahans soil is moderately suited to most sanitary facilities. The main limitations are seepage and excess salt. The Monahans soil is poorly suited to most building site development because of excess gypsum. The gypsum dissolves when wet, forming sink holes or solution caverns. The Pajarito soil is well suited to most urban uses.

This complex is well suited to most recreational uses.

The Monahans soil is in capability subclass 7e, nonirrigated, and 2e, irrigated. The Pajarito soil is in capability subclass 7c, nonirrigated, and 2e, irrigated. Both soils are in the Sandy Loam range site.

## PAC—Paisano very gravelly loam, undulating

These very shallow and shallow soils are on upland ridges. They formed in gravelly alluvium. Slopes are convex and range from 1 to 8 percent. Individual areas are irregular in shape and range from 75 to 2,700 acres.

The typical sequence, depth, and composition of the layers of the Paisano soil are—

*Surface layer:*
0 to 3 inches—light brown very gravelly loam

*Subsoil:*
3 to 8 inches—light brown very gravelly loam

*Underlying material:*
8 to 16 inches—indurated calcium carbonate with a laminar cap
16 to 60 inches—pinkish white carbonatic soil material that is 50 percent moderately to strongly cemented fragments of calcium carbonate

Important soil properties—

*Available water capacity:* Very low
*Permeability:* Moderately rapid in the upper part and very slow in the indurated layer
*Drainage class:* Well drained
*Runoff:* Medium on 1 to 3 percent slopes, high on 3 to 5 percent slopes, and very high on 5 to 8 percent slopes
*Root zone:* Very shallow and shallow
*Hazard of water erosion:* Severe
*Hazard of wind erosion:* Slight

Included with this soil in mapping are small areas of Kinco soils and a soil that is similar to the Paisano soil but has less than 35 percent coarse fragments above indurated caliche. Kinco soils are deep sandy loam and are in slightly concave positions. Included soils make up less than 20 percent of the mapped areas.

The Paisano soil is used as rangeland and for wildlife habitat. It produces a small amount of a mixture of short grasses. The very shallow and shallow rooting depth and the very low available water capacity are the main limitations affecting forage production. Maintaining an adequate vegetative cover helps to protect the soil from wind erosion and water erosion.

The native vegetation consists of black grama, bush muhly, sideoats grama, blue grama, Arizona cottontop,

**Figure 8.—The caprock escarpment that separates the Trans-Pecos and High Plains in northeastern Winkler County. Paisano soil is on the footslopes of the escarpment, and bedrock is exposed on the steeper slopes. Ratliff fine sandy loam, nearly level, is in the foreground.**

slim tridens, cane bluestem, and plains bristlegrass. Woody species include creosotebush and fourwing saltbush.

This soil is poorly suited to most urban uses because of the very shallow and shallow depth to indurated calcium carbonate. Also, seepage is a limitation affecting sewage lagoon areas and the high content of gravel is a limitation affecting lawns, landscaping, and golf fairways.

This soil is poorly suited to most recreational uses. The very shallow and shallow depth to indurated calcium carbonate and the high content of gravel are the main limitations.

This soil is in capability subclass 7s and is in the Gravelly range site.

## PAF—Paisano-Rock outcrop association, hilly

This unit consists of very shallow and shallow Paisano soils and exposed bedrock on upland footslopes, ridges, and escarpments (fig. 8). Slopes are convex and range from 10 to 30 percent. Individual areas are long and narrow and follow the contour of the caprock escarpment between the Trans-Pecos and High Plains. Individual areas range from 40 to 1,600 acres.

This association is 80 percent Paisano soil, 15 percent Rock outcrop, and 5 percent other soils. The Paisano soil is on footslopes below the caprock escarpment and has slopes of 1 to 12 percent. The Rock outcrop consists of exposed conglomerate, limestone, and sandstone bedrock along the caprock escarpment between the High Plains and Trans-Pecos in Winkler County. Mapping was controlled well enough for the anticipated use of the areas involved.

The typical sequence, depth, and composition of the layers of the Paisano soil are—

*Surface layer:*
0 to 4 inches—brown very gravelly fine sandy loam

*Subsoil:*
4 to 10 inches—brown very gravelly fine sandy loam

*Underlying material:*
10 to 26 inches—pink, indurated calcium carbonate that is laminar in the upper $^1/_2$ to $^3/_4$ inch
26 to 80 inches—pink, loamy carbonatic soil material that is 50 percent limestone and strongly cemented fragments of calcium carbonate

Important properties of the Paisano soil—

*Available water capacity:* Very low
*Permeability:* Moderately rapid in the upper part and very slow in the indurated layer
*Drainage class:* Well drained
*Runoff:* Very high
*Root zone:* Very shallow and shallow
*Hazard of water erosion:* Severe
*Hazard of wind erosion:* Slight

Included in this association are small areas of Blakeney, Conger, and Kimbrough soils. The included soils have less calcium carbonate and fewer coarse fragments in the subsoil than the Paisano soil. Also, the Blakeney soils have less clay in the subsoil than the Paisano soil and the Kimbrough soils have a darker surface layer.

This association is used as rangeland. It produces a small amount of native plant forage. The very shallow and shallow rooting depth and very low available water capacity in the Paisano soil and the large extent of exposed bedrock are the main limitations affecting forage production. Management concerns include proper livestock stocking, controlled grazing, and brush management.

The dominant native vegetation consists of drought-tolerant, short and middle height grasses, such as black grama, bush muhly, slim tridens, sideoats grama, blue grama, plains bristlegrass, cane bluestem, sand dropseed, and mesa dropseed. Native woody species include range ratany, fourwing saltbush, and creosotebush.

This association is poorly suited to most urban and recreational uses. The very shallow and shallow depth to indurated calcium carbonate or bedrock, the slope, and the high content of gravel are the main limitations.

The Paisano soil is in capability subclass 7s and is in the Gravelly range site. The Rock outcrop is not assigned to a capability subclass or range site.

## PEA—Pecos-Arno-Patrole association, occasionally flooded

These very deep, nearly level soils are on the flood plain along the Pecos River. Slopes are mostly linear and less than 1 percent. Flooding occurs about once in 7 to 20 years for a duration of 2 to 7 days, usually in July through September. Individual areas are long and narrow and range from 125 to 5,000 acres.

This association is 35 percent Pecos soil, 30 percent Arno soil, 25 percent Patrole soils, and 10 percent other soils. The Pecos soil is on the outer edges of the flood plain farthest from the river channel and between old scour channels. It has mostly linear slopes. The Arno soil is in the old scour channels and has linear or slightly concave slopes. The Patrole soil is adjacent to the river channel or near where the river channel existed prior to changing courses. It is in long, narrow areas and has linear to convex slopes. The composition of this map unit was determined by sampling transects across mapped areas. The Pecos, Arno, and Patrole soils were not separated in mapping because they have similar use and management. Mapping was controlled well enough for the anticipated use of the areas involved.

The typical sequence, depth, and composition of the layers of the Pecos soil are—

*Surface layer:*
0 to 4 inches—brown silty clay loam

Subsoil:
4 to 13 inches—brown silty clay with common fine masses of calcium carbonate and other salts
13 to 22 inches—brown clay with common fine masses of calcium carbonate and other salts
22 to 40 inches—reddish brown clay with common fine masses of calcium carbonate and other salts
40 to 52 inches—reddish brown silty clay with common fine masses of salts
52 to 62 inches—dark gray clay with strong brown redoximorphic features and common fine gypsum crystals and salt masses

*Underlying material:*
62 to 80 inches—pale brown very fine sandy loam with common salt masses

The typical sequence, depth, and composition of the layers of the Arno soil are—

*Surface layer:*
0 to 6 inches—reddish brown clay

*Subsoil:*
6 to 38 inches—reddish brown clay with common salt masses

*Underlying material:*
38 to 70 inches—dark brown clay with redoximorphic features in shades of gray and brown and common salt masses
70 to 80 inches—very dark gray clay with common salt masses

The typical sequence, depth, and composition of the layers of the Patrole soil are—

*Surface layer:*
0 to 8 inches—light brown silty clay loam

*Underlying material:*
8 to 28 inches—brown silt loam
28 to 50 inches—weak red clay with common gypsum crystals
50 to 80 inches—stratified brown sandy clay loam with few salic threads and gypsum crystals

Important soil properties—

*Available water capacity:* Low
*Permeability:* Pecos—slow; Arno—very slow; Patrole—moderately slow in the upper 28 inches and very slow below a depth of 28 inches
*Drainage class:* Pecos and Arno—moderately well drained; Patrole—well drained
*Runoff:* Pecos and Arno—low; Patrole—very low
*Root zone:* Very deep
*Salinity:* Moderate
*Shrink-swell potential:* Pecos and Arno—high; Patrole—low in the upper 28 inches and high below a depth of 28 inches
*Hazard of water erosion:* Pecos and Arno—slight; Patrole—moderate
*Hazard of wind erosion:* Moderate

Included in this association are small areas of Harkey soils. Harkey soils have a loamy subsoil and are on small, convex ridges parallel to the old channel of the Pecos River. Also included is a soil that is similar to the Pecos soil but does not have a dark colored surface layer. Included soils make up 10 percent of the mapped areas.

The Pecos, Arno, and Patrole soils are used mainly as rangeland. They produce a large amount of forage. They are on flood plains and receive extra water, which increases forage production.

The native vegetation consists of alkali sacaton, big sacaton, vine-mesquite, plains bristlegrass, twoflower trichloris, and tobosa. Woody species include fourwing saltbush, saltcedar, and mesquite.

A few small, otherwise abandoned, cultivated fields are used as irrigated cropland when a sufficient quantity of adequate-quality water is available from the Pecos River. Crops include cotton, grain sorghum, and alfalfa. Management concerns include the selection of salt-tolerant crops and the management of irrigation water and salinity.

This association is poorly suited to most urban uses. The hazard of flooding, the high shrink-swell potential, excess salt, clayey texture, restricted permeability, and low strength are the main limitations.

This association is poorly suited to most recreational uses because of the hazard of flooding, clayey texture, droughty conditions, and excess salt.

This association is in capability subclass 7s, nonirrigated, and 4s, irrigated. It is in the Salty Bottomland range site.

## PND—Penwell-Dune land complex, hummocky

This complex consists of a very deep soil and sandy eolian deposits on upland plains. Slopes generally are convex and range from 1 to 3 percent but are as much as 30 percent on the side slopes of some dunes. Individual areas are irregular in shape and range from 40 to 9,000 acres.

This complex is 60 percent Penwell soil, 30 percent active sand dunes, and 10 percent other soils. The Penwell soil is on the more stabilized dunes that support vegetation. The active sand dunes are devoid of vegetation because of the shifting sands during windstorms. The areas of Penwell soils and Dune land are so intricately intermingled or so small that it was not practical to separate them at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Penwell soil are—

*Surface layer:*
0 to 15 inches—reddish brown fine sand

*Underlying material:*
15 to 32 inches—yellowish red fine sand
32 to 80 inches—reddish yellow fine sand

Important soil properties—

*Available water capacity:* Very low
*Permeability:* Rapid
*Drainage class:* Excessively drained
*Runoff:* Negligible
*Hazard of water erosion:* Slight
*Hazard of wind erosion:* Severe

Included in this complex are small areas of Elgee and Pyote soils. These soils are in the low, interdune blowout areas and near the outer edges of the mapped areas. Elgee soils have a subsoil of loamy fine sand at a depth of 40 to 75 inches. Pyote soils have a subsoil of fine sandy loam at a depth of 20 to 40 inches. Included soils make up 10 percent of the mapped areas.

This complex is used as rangeland. The Penwell soil produces a large amount of native forage. It makes efficient use of summer showers for forage production. The Dune land is devoid of vegetation. Shifting sands reduce the extent of germination and the seedling survival rate on the active dunes. Maintaining a vegetative cover minimizes wind erosion.

The native vegetation consists of sand bluestem,

Havard panicum, giant dropseed, big sandreed, little bluestem, spike dropseed, mesa dropseed, sand dropseed, plains bristlegrass, sand paspalum, Havard oak, and sand sagebrush.

This complex is moderately suited to most urban uses. Droughty conditions and the instability of sidewalls are the main limitations affecting building site development. Seepage, poor filtering capacity, and sandy textures are the main limitations affecting sanitary facilities.

This complex is poorly suited to recreational uses because of the sandy texture and droughty conditions. Wind erosion is a severe hazard.

The Penwell soil is in capability subclass 7e and is in the Sand Hills range site. The Dune land is in capability subclass 8s and is not assigned to a range site.

## POB—Pyote fine sand, gently undulating

This very deep, gently undulating, hummocky soil is on upland plains. It formed in sandy sediments of eolian or alluvial origin. Slopes are generally convex and range from 0 to 5 percent. Individual areas are irregular in shape and range from 40 to 12,400 acres.

The typical sequence, depth, and composition of the layers of the Pyote soil are—

*Surface layer:*
0 to 36 inches—yellowish red fine sand

*Subsoil:*
36 to 74 inches—yellowish red fine sandy loam
74 to 80 inches—white fine sandy loam with 20 percent strongly cemented fragments of calcium carbonate

Important soil properties—

*Available water capacity:* Low
*Permeability:* Moderately rapid
*Drainage class:* Well drained
*Runoff:* Negligible on 0 to 3 percent slopes and very low on 3 to 5 percent slopes
*Root zone:* Very deep
*Hazard of water erosion:* Slight
*Hazard of wind erosion:* Severe

Included with this soil in mapping are Elgee, Penwell, Sharvana, and Wickett soils and small areas of active sand dunes. Elgee soils have a subsoil of loamy fine sand at a depth of 40 to 75 inches. Penwell soils do not have a subsoil within a depth of 80 inches and are near the active dunes. Sharvana soils have a layer of indurated caliche within a depth of 20 inches. Wickett soils have a layer of indurated caliche at a depth of 20 to 40 inches. Sharvana and Wickett soils are on the higher ridgetops, and the Pyote and Elgee soils are in the lower valleys and basins. The active sand dunes are eolian sand knolls and are devoid of vegetation. Included soils and active sand dunes make up less than 20 percent of the mapped areas.

The Pyote soil is used as rangeland. It produces a large amount of middle height and tall native grasses. Maintaining a vegetative cover helps to minimize wind erosion.

The dominant native vegetation consists of mesa dropseed, sand dropseed, giant dropseed, spike dropseed, sand bluestem, little bluestem, bush muhly, and black grama. Woody species include sand sagebrush, Havard oak, catclaw acacia, and mesquite.

This soil is moderately suited to most urban uses. Seepage, poor filtering capacity, and the sandy texture are the main limitations affecting sanitary facilities. The instability of sidewalls is the main limitation affecting shallow excavations. The sandy texture and droughty conditions are limitations affecting lawns, landscaping, and golf fairways.

This soil is poorly suited to recreational uses because of the sandy surface.

This soil is in capability subclass 6e, nonirrigated, and 4e, irrigated, and is in the Loamy Sand range site.

## PPB—Pyote-Penwell complex, gently undulating

These very deep, well drained soils are on upland plains. They formed in eolian sands. Slopes are linear to convex and generally range from 1 to 5 percent but are as much as 30 percent on the side slopes of some dunes. Individual areas are irregular in shape and range from 40 to 8,350 acres.

This complex is 55 percent Pyote soil, 30 percent Penwell soil, and 15 percent active sand dunes and other soils. The Pyote soil is on nearly level sand deposits. The Penwell soil is on convex, gently undulating plains that are hummocky. The areas of Pyote and Penwell soils are so intricately intermingled that it was not practical to separate them at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Pyote soil are—

*Surface layer:*
0 to 36 inches—brown fine sand

*Subsoil:*
36 to 70 inches—reddish yellow fine sandy loam
70 to 80 inches—reddish yellow loamy fine sand

The typical sequence, depth, and composition of the layers of the Penwell soil are—

*Surface layer:*
0 to 14 inches—reddish brown fine sand

*Underlying material:*
14 to 50 inches—yellowish red fine sand
50 to 80 inches—reddish yellow fine sand

Important soil properties—

*Available water capacity:* Pyote—low; Penwell—very low
*Permeability:* Pyote—moderately rapid; Penwell—rapid
*Drainage class:* Pyote—well drained; Penwell—excessively drained
*Runoff:* Negligible on 0 to 3 percent slopes and very low on 3 to 5 percent slopes
*Root zone:* Very deep
*Hazard of water erosion:* Slight
*Hazard of wind erosion:* Severe

Included in this complex are small areas of Elgee soils and active sand dunes. Elgee soils are in the lower interdune areas and adjacent to active sand dunes. Elgee soils have a subsoil of loamy fine sand at a depth of 40 to 75 inches. The active sand dunes are devoid of vegetation because of shifting sands. Included soils and active sand dunes make up 15 percent of the mapped areas.

The Pyote and Penwell soils are used as rangeland and for wildlife habitat. They produce a large amount of native forage. They use summer showers efficiently to produce forage. Maintaining an adequate vegetative cover minimizes wind erosion.

The middle height and tall native vegetation consists of sand bluestem, Havard panicum, giant dropseed, big sandreed, little bluestem, spike dropseed, mesa dropseed, sand dropseed, plains bristlegrass, sand paspalum, bush muhly, black grama, Havard oak, and sand sagebrush.

This complex is moderately suited to most urban uses. Because of the sandy texture and rapid and moderately rapid permeability, the soils may not adequately filter effluent. Seepage is a limitation affecting most sanitary facilities. The walls of shallow excavations may be unstable and slough. Frequent, light applications of water are needed for lawns, landscapes, and golf fairways because of the very low available water capacity, the rapid and moderately rapid permeability, and droughty conditions.

This complex is poorly suited to most recreational uses because of the sandy surface layer. These soils are droughty, and the hazard of wind erosion is severe if the soils are disturbed.

The Pyote soil is in capability subclass 6e, nonirrigated, and 4e, irrigated, and is in the Loamy Sand range site. The Penwell soil is in capability subclass 7e and is in the Sand Hills range site.

## RAA—Ratliff fine sandy loam, nearly level

This very deep, nearly level soil is on upland plains. Slopes are linear and range from 0 to 3 percent. Individual areas are irregular to oval in shape and range from 70 to 3,400 acres.

The typical sequence, depth, and composition of the layers of the Ratliff soil are—

*Surface layer:*
0 to 9 inches—brown fine sandy loam

*Subsoil:*
9 to 22 inches—brown sandy clay loam
22 to 46 inches—pink sandy clay loam with 25 percent masses and concretions of calcium carbonate
46 to 60 inches—pink sandy clay loam with 10 percent masses and concretions of calcium carbonate

Important soil properties—

*Available water capacity:* Moderate
*Permeability:* Moderate
*Drainage class:* Well drained
*Runoff:* Negligible on 0 to 1 percent slopes and very low on 1 to 3 percent slopes
*Root zone:* Very deep
*Hazard of water erosion:* Slight
*Hazard of wind erosion:* Severe

Included with this soil in mapping are small areas of Blakeney, Conger, Kinco, and Toyah soils. Blakeney and Conger soils are very shallow and shallow over indurated calcium carbonate. Also, Blakeney soils have less clay in the subsoil than the Ratliff soil. Kinco soils are in landscape positions similar to those of the Ratliff soil but have less clay in the subsoil. Toyah soils are in small, concave drainageways that flood during high intensity rainstorms. Toyah soils are darker in color and receive more moisture than the Ratliff soils. Included soils make up 15 percent of the mapped areas.

The Ratliff soil is used as rangeland. It produces a moderate amount of native forage. Limited rainfall and the moderate available water capacity are the main limitations affecting forage production.

The dominant native vegetation consists of black grama, sand dropseed, mesa dropseed, plains bristlegrass, Arizona cottontop, spike dropseed, bush muhly, blue grama, sideoats grama, and fourwing saltbush.

This soil is well suited to most urban and recreational uses. Seepage is a limitation affecting

sewage lagoons. Low strength is a limitation affecting local roads and streets. Careful design and installation can minimize the effects of this limitation.

This soil is in capability subclass 4e, nonirrigated, and 3e, irrigated, and is in the Sandy Loam range site.

## SHA—Sharvana fine sandy loam, nearly level

This very shallow and shallow, nearly level soil is on upland plains and ridges. Slopes are linear to convex and range from 0 to 3 percent. Individual areas are irregular in shape and range from 40 to 5,375 acres.

The typical sequence, depth, and composition of the layers of the Sharvana soil are—

*Surface layer:*
0 to 4 inches—reddish brown fine sandy loam

*Subsoil:*
4 to 18 inches—yellowish red fine sandy loam

*Underlying material:*
18 to 26 inches—indurated calcium carbonate with a $^{1}/_{2}$-inch-thick laminar cap
26 to 60 inches—alternating layers of 2- to 20-inch thick carbonate soil material and 2- to 4-inch-thick strongly cemented lenses of calcium carbonate

Important soil properties—

*Available water capacity:* Very low
*Permeability:* Moderate in the upper part and very slow in the indurated layer
*Drainage class:* Well drained
*Runoff:* Low on 0 to 1 percent slopes and medium on 1 to 3 percent slopes
*Root zone:* Very shallow and shallow
*Hazard of water erosion:* Moderate
*Hazard of wind erosion:* Severe

Included in this map unit are small areas of Blakeney, Mentone, and Wickett soils. Blakeney soils do not have an increase in clay in the subsoil and are on the slightly higher convex ridges. Mentone soils are very deep and are dark colored. They are in slightly depressional playas. Wickett soils are 20 to 40 inches deep over indurated caliche, are in small drainageways, and have linear to concave slopes. Included soils make up 20 percent of the mapped areas.

The Sharvana soil is used as rangeland and for wildlife habitat. It produces a large amount of native plant forage. It makes efficient use of summer showers for forage production.

The dominant native vegetation consists of black grama, sand dropseed, mesa dropseed, spike dropseed, bush muhly, Arizona cottontop, plains bristlegrass, blue grama, and sideoats grama.

This soil is poorly suited to most urban and recreational uses because of the very shallow and shallow depth to indurated calcium carbonate.

This soil is in capability subclass 6s, nonirrigated, and 4s, irrigated, and is in the Shallow Sandy Loam range site.

## SMB—Splotter-Mentone complex, gently undulating

This map unit consists of very shallow and very deep soils on upland plains, ridges, and playas. Slopes range from 0 to 5 percent. Individual areas are irregular in shape and range from 100 to 8,300 acres.

This complex is 70 percent Splotter soil, 15 percent Mentone soil, and 15 percent other soils. The Splotter soil is gently undulating and has convex slopes of 1 to 5 percent. The Mentone soil is in slightly depressed playas and has concave slopes of less than 1 percent. The Mentone soil may be ponded 1 or 2 times per year for 2 to 7 days, generally from July through September. The areas of Splotter and Mentone soils are so intricately intermingled or so small that it was not practical to separate them at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Splotter soil are—

*Surface layer:*
0 to 3 inches—yellowish brown gravelly fine sandy loam

*Subsoil:*
3 to 11 inches—yellowish brown very cobbly fine sandy loam

*Underlying material:*
11 to 17 inches—white, indurated caliche with a 1- to 6-millimeter-thick laminar cap
17 to 36 inches—white, moderately to strongly cemented caliche with 5- to 6-inch-thick laminar plates with laminar caps
36 to 80 inches—white carbonatic soil material that is 40 percent cemented caliche fragments

The typical sequence, depth, and composition of the layers of the Mentone soil are—

*Surface layer:*
0 to 2 inches—grayish brown silty clay loam
2 to 13 inches—dark brown silty clay loam

*Subsoil:*
13 to 41 inches—dark brown silty clay loam

41 to 60 inches—dark brown silty clay loam with few calcium carbonate masses

Important soil properties—

*Available water capacity:* Splotter—very low; Mentone—high
*Permeability:* Splotter—moderately rapid in the upper part and very slow in the indurated layer; Mentone—moderately slow
*Drainage class:* Well drained
*Runoff:* Splotter—medium on 1 to 3 percent slopes and high on 3 to 5 percent slopes; Mentone—negligible
*Root zone:* Splotter—very shallow and shallow; Mentone—very deep
*Shrink-swell potential:* Splotter—low; Mentone—moderate
*Hazard of water erosion:* Splotter—severe; Mentone—slight
*Hazard of wind erosion:* Splotter—severe; Mentone—moderate

Included in this complex are small areas of Delnorte, Sharvana, Tencee, Toyah, and Wink soils. Delnorte soils are on the steeper slope breaks and contain more than 35 percent rock fragments. Sharvana soils have an increase in clay in the subsoil and are in landscape positions similar to those of the Splotter soils. Tencee soils have more rock fragments and calcium carbonate in the subsoil than the Splotter soils and are in landscape positions similar to those of the Splotter soils. Toyah soils are very deep and loamy. They are on flood plains along small drainageways. Wink soils are in the lower basins and valleys and have less clay than the Mentone soil. Also included is a soil that is similar to the Splotter soil but is 20 to 40 inches deep over indurated calcium carbonate. Included soils make up 15 percent of the mapped areas.

The Splotter and Mentone soils are used as rangeland and for wildlife habitat. The Splotter soil produces a moderate amount of native plant forage. The very shallow and shallow rooting depth and the very low available water capacity are the main limitations affecting the production of forage. The Mentone soil produces a large amount of native plant forage. It has a very deep rooting depth, a high available water capacity, and is in playas that receive runoff water.

The dominant native vegetation on the Splotter soil consists of black grama, bush muhly, plains bristlegrass, sand dropseed, mesa dropseed, slim tridens, and blue grama. The native vegetation on the Mentone soil consists of vine-mesquite, tobosa, and white tridens. Also, hackberry trees grow along the outer perimeter of the playas.

This complex is poorly suited to most urban uses. The shallow depth to indurated calcium carbonate is the main limitation in areas of the Splotter soil. Ponding is a limitation affecting most urban uses in areas of the Mentone soil.

The Splotter soil is poorly suited to most recreational uses. The depth to indurated calcium carbonate and the high content of gravel in the surface layer are limitations. The Mentone soil is poorly suited to most recreational uses because of ponding.

The Splotter soil is in capability subclass 7s and in the Shallow Sandy Loam range site. The Mentone soil is in capability subclass 6c and is in the Lakebed range site.

## TMB—Tencee-Mentone complex, gently undulating

This map unit consists of very shallow, shallow, and very deep soils on upland plains, ridges, and playas. This map unit is in the western part of Loving County. Slopes range from 0 to 5 percent. Individual areas are irregular in shape and range from 40 to 9,100 acres.

This complex is 70 percent Tencee soil, 15 percent Mentone soil, and 15 percent other soils. The Tencee soil is on gently undulating ridges. The ridgetops have linear to convex slopes of 0 to 5 percent. The Mentone soil is in the depressed, concave playas and has slopes of 0 to 1 percent. The Mentone soil may be ponded 1 or 2 times per year for 2 to 7 days, generally from July through September. The areas of Tencee and Mentone soils are so intricately intermingled or so small that it was not practical to separate them at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Tencee soil are—

*Surface layer:*
0 to 2 inches—grayish brown gravelly loam

*Subsoil:*
2 to 8 inches—grayish brown very gravelly loam
8 to 12 inches—grayish brown extremely gravelly loam

*Underlying material:*
12 to 22 inches—white, indurated calcium carbonate with a 15-millimeter-thick laminar cap
22 to 80 inches—pink carbonatic soil material that is 30 percent cemented caliche fragments and 15 percent siliceous pebbles

The typical sequence, depth, and composition of the layers of the Mentone soil are—

*Surface layer:*
0 to 5 inches—brown silty clay loam

5 to 13 inches—dark grayish brown silty clay loam

*Subsoil:*
13 to 27 inches—dark grayish brown silty clay loam
27 to 40 inches—brown clay loam
40 to 47 inches—yellowish brown loam
47 to 64 inches—brown loam
64 to 80 inches—brown silt loam

Important soil properties—

*Available water capacity:* Tencee—very low; Mentone—high
*Permeability:* Tencee—moderate in the upper part and very slow in the indurated layer; Mentone—moderately slow
*Drainage class:* Well drained
*Runoff:* Tencee—low on 0 to 1 percent slopes, medium on 1 to 3 percent slopes, and high on 3 to 5 percent slopes; Mentone—negligible
*Root zone:* Tencee—very shallow and shallow; Mentone—very deep
*Shrink-swell potential:* Tencee—low; Mentone—moderate
*Hazard of water erosion:* Tencee—severe; Mentone—slight
*Hazard of wind erosion:* Tencee—slight; Mentone—moderate

Included in this complex are small areas of Delnorte, Pajarito, Splotter, Toyah, and Wink soils. Delnorte soils are in landscape positions similar to those of the Tencee soil, but they have less calcium carbonate. Pajarito and Wink soils are on the lower footslopes of ridges near the outer edges of the mapped areas. The Pajarito and Wink soils are very deep fine sandy loam. Also, the Wink soils have accumulations of calcium carbonate within a depth of 40 inches. Splotter soils are in landscape positions similar to those of the Tencee soil but have fewer coarse fragments and less calcium carbonate above the indurated caliche. Toyah soils are very deep and loamy. They are on flood plains along small drainageways. Included soils make up 15 percent of the mapped areas.

The Tencee and Mentone soils are used as rangeland and for wildlife habitat. The Tencee soil produces a small amount of native plant forage. The very shallow and shallow rooting depth and the very low available water capacity are the main limitations affecting the production of forage. The Mentone soil produces a large amount of native plant forage. It has a very deep rooting depth, has a high available water capacity, and is in playas that receive runoff water.

The dominant native vegetation on the Tencee soil consists of black grama, bush muhly, slim tridens, sideoats grama, blue grama, plains bristlegrass, sand dropseed, mesa dropseed, and cane bluestem. Woody species on the Tencee soil include range ratany, fourwing saltbush, and creosotebush. The native vegetation on the Mentone soil consists of vine-mesquite, tobosa, white tridens, cane bluestem, and Arizona cottontop. Woody species on the Mentone soil include hackberry, western soapberry, fourwing saltbush, and butterfly bush.

This complex is poorly suited to most urban and recreational uses. The shallow depth to indurated caliche is the main limitation in areas of the Tencee soil. Ponding is the main limitation in areas of the Mentone soil.

The Tencee soil is in capability subclass 7s and is in the Gravelly range site. The Mentone soil is in capability subclass 6c and is in the Lakebed range site.

## TOA—Toyah clay loam, occasionally flooded

This very deep, nearly level soil is on flood plains along small drainageways. Slopes are linear or slightly concave and are less than 1 percent. Individual areas are long and narrow and range from 35 to 350 acres. Flooding occurs about once in 2 to 5 years for a duration of less than one day.

The typical sequence, depth, and composition of the layers of the Toyah soil are—

*Surface layer:*
0 to 18 inches—brown clay loam

*Subsoil:*
18 to 60 inches—reddish brown clay loam

Important soil properties—

*Available water capacity:* High
*Permeability:* Moderate
*Drainage class:* Well drained
*Runoff:* Negligible
*Root zone:* Very deep
*Hazard of water erosion:* Slight
*Hazard of wind erosion:* Moderate

Included with this soil in mapping are small areas of Turney soils and a soil that is similar to the Toyah soil but has more than 35 percent clay in the profile. Turney soils have a light colored surface layer and an accumulation of calcium carbonate in the subsoil. They are on upland plains adjacent to areas of the Toyah soil. Included soils make up 10 percent of the mapped areas.

The Toyah soil is used as rangeland. It produces a large amount of native forage. It has a very deep root zone, a high available water capacity, and a favorable overflow position.

The dominant native vegetation consists of sideoats grama, cane bluestem, vine-mesquite, alkali sacaton, plains bristlegrass, and tobosa. Woody species include fourwing saltbush, mesquite, and tarbush.

This soil is poorly suited to most urban uses and moderately suited to most recreational uses because of the hazard of flooding.

This soil is in capability subclass 6w, nonirrigated, and 2w, irrigated, and is in the Draw range site.

## TUA—Turney loam, nearly level

This very deep, nearly level soil is on upland plains and basins. It formed in loamy alluvial deposits. Individual areas are irregular in shape and range from 40 to 6,400 acres. Slopes are linear and range from 0 to 2 percent.

The typical sequence, depth, and composition of the layers of the Turney soil are—

*Surface layer:*
0 to 8 inches—brown loam

*Subsoil:*
8 to 25 inches—pale brown loam with few nodules of calcium carbonate
25 to 36 inches—very pale brown clay loam with common nodules and threads of calcium carbonate
36 to 49 inches—very pale brown loam with many masses, threads, and nodules of calcium carbonate
49 to 60 inches—very pale brown fine sandy loam with common threads and nodules of calcium carbonate

Important soil properties—

*Available water capacity:* High
*Permeability:* Moderate
*Drainage class:* Well drained
*Runoff:* Negligible on 0 to 1 percent slopes and very low on 1 to 2 percent slopes
*Root zone:* Very deep
*Hazard of water erosion:* Moderate
*Hazard of wind erosion:* Moderate

Included with this soil in mapping are small areas of Splotter and Wink soils. Splotter soils are very shallow and shallow over indurated caliche and are on slightly convex knolls and ridges. Wink soils are in areas adjacent to the Turney soil and have less clay in the subsoil. Also included is a soil that is similar to the Turney soil but has strong accumulations of calcium carbonate within a depth of 20 inches. Included soils make up 15 percent of the mapped areas.

The Turney soil is used as rangeland and for wildlife habitat. It produces a moderate amount of native forage. The low rainfall is a limitation affecting forage production.

The dominant native vegetation consists of tobosa, blue grama, burrograss, black grama, bush muhly, mesa dropseed, sideoats grama, plains bristlegrass, cane bluestem, and Arizona cottontop. Woody species include fourwing saltbush, creosotebush, tarbush, and mesquite.

This soil is well suited to most urban uses and moderately suited to most recreational uses. The dusty surface is the main limitation affecting recreational uses.

This soil is in capability subclass 7e and is in the Loamy range site.

## WCB—Wickett-Pyote complex, gently undulating

These moderately deep to very deep soils are on upland plains. They formed in loamy and sandy materials deposited by wind and water. Slopes are convex and range from 1 to 5 percent. Individual areas are irregular in shape and range from 40 to 12,200 acres.

This complex is 55 percent Wickett soil, 30 percent Pyote soil, and 15 percent other soils. The Wickett soil is on convex, sandy ridges and has slopes of 1 to 3 percent. The Pyote soil is on side slopes and in valleys between ridges and has slopes of 1 to 5 percent. The areas of Wickett and Pyote soils are so intricately intermingled that it was not practical to separate them at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Wickett soil are—

*Surface layer:*
0 to 9 inches—yellowish red loamy fine sand

*Subsoil:*
9 to 34 inches—red fine sandy loam

*Underlying material:*
34 to 42 inches—indurated calcium carbonate with a $^{1}/_{4}$-inch-thick laminar cap
42 to 80 inches—carbonatic soil material that has strongly cemented lenses and is 20 percent fragments of calcium carbonate

The typical sequence, depth, and composition of the layers of the Pyote soil are—

*Surface layer:*
0 to 36 inches—yellowish red fine sand

*Subsoil:*
36 to 45 inches—red fine sandy loam

45 to 57 inches—red fine sandy loam with a few reddish yellow mottles

*Underlying material:*
57 to 65 inches—pink fine sand with disseminated calcium carbonate

Important soil properties—

*Available water capacity:* Low
*Permeability:* Wickett—moderately rapid in the upper part and very slow in the indurated layer; Pyote—moderately rapid
*Drainage class:* Well drained
*Runoff:* Wickett—low; Pyote—negligible on 1 to 3 percent slopes and very low on 3 to 5 percent slopes
*Root zone:* Wickett—moderately deep; Pyote—very deep
*Hazard of water erosion:* Wickett—moderate; Pyote—slight
*Hazard of wind erosion:* Severe

Included in mapping are small areas of Elgee, Kinco, and Sharvana soils. Elgee soils have a surface layer that is more than 40 inches thick and are in landscape positions similar to those of the Pyote soil. Kinco soils do not have an increase in content of clay in the subsoil. They are on the outer edges of the mapped areas and in some drainageways. Sharvana soils are less than 20 inches deep over indurated caliche and are on the upper slopes and ridgetops. Included soils make up 15 percent of the mapped areas.

The Wickett and Pyote soils are used mainly as rangeland and for wildlife habitat. They produce a large amount of native range forage. The relationship between soils, plants, and water is favorable in this complex, and the soils make efficient use of summer showers to produce forage.

The dominant native vegetation consists of little bluestem, sand bluestem, giant dropseed, black grama, spike dropseed, mesa dropseed, sand dropseed, sand sagebrush, and Havard oak.

The Wickett soil is poorly suited to most urban uses. Depth to indurated caliche and seepage are the main limitations. The Pyote soil is moderately suited to most building site development and is poorly suited to most sanitary facilities. The sandy texture, seepage, poor filtering capacity, and the instability of sidewalls are the main limitations.

The Wickett soil is well suited to most recreational uses. The Pyote soil is poorly suited to most recreational uses because of the sandy texture of the surface layer.

This complex is in capability subclass 6e, nonirrigated, and 4e, irrigated, and is in the Loamy Sand range site.

## WKA—Wickett-Sharvana complex, gently undulating

These very shallow and moderately deep soils are on upland plains, on ridges, and in valleys in the central part of the survey area. These soils formed in sandy and loamy eolian materials over thick beds of caliche. Slopes are mainly linear to convex and range from 1 to 5 percent. Individual areas are irregular in shape and range from 70 to 10,600 acres.

This complex is 50 percent Wickett loamy fine sand, 40 percent Sharvana loamy fine sand, and 10 percent other soils. The Wickett soil is on the lower side slopes of ridges and in small concave valleys between ridges. It has slopes of 1 to 3 percent. The Sharvana soil is on upper side slopes and convex ridgetops. It has slopes of 1 to 5 percent. The areas of Wickett and Sharvana soils are so intricately intermingled that it was not practical to separate them at the scale selected for mapping.

The typical sequence, depth, and composition of the layers of the Wickett soil are—

*Surface layer:*
0 to 5 inches—brown loamy fine sand
5 to 15 inches—yellowish red loamy fine sand

*Subsoil:*
15 to 29 inches—yellowish red fine sandy loam
29 to 36 inches—yellowish red fine sandy loam with few masses of calcium carbonate in the lower part

*Underlying material:*
36 to 63 inches—white, indurated caliche with a $^1/_8$- to $^1/_2$-inch-thick laminar cap
63 to 80 inches—white gravelly loamy fine sand with 20 percent strongly cemented fragments of calcium carbonate

The typical sequence, depth, and composition of the layers of the Sharvana soil are—

*Surface layer:*
0 to 4 inches—reddish brown loamy fine sand

*Subsoil:*
4 to 18 inches—reddish brown fine sandy loam

*Underlying material:*
18 to 28 inches—indurated caliche with a $^1/_2$-inch-thick laminar cap
28 to 80 inches—pinkish white gravelly fine sandy

loam with 30 percent moderately to strongly cemented fragments of calcium carbonate

Important soil properties—

*Available water capacity:* Wickett—low; Sharvana—very low
*Permeability:* Wickett—moderately rapid in the upper part and very slow in the indurated layer; Sharvana—moderate in the upper part and very slow in the indurated layer
*Drainage class:* Well drained
*Runoff:* Wickett—low; Sharvana—medium on 1 to 3 percent slopes and high on 3 to 5 percent slopes
*Root zone:* Wickett—moderately deep; Sharvana—very shallow and shallow
*Hazard of water erosion:* Moderate
*Hazard of wind erosion:* Severe

Included in this complex are small areas of Blakeney, Kinco, and Pyote soils. Blakeney soils do not have an increase in content of clay in the subsoil and are in landscape positions similar to those of the Sharvana soil. Kinco soils do not have an increase in content of clay in the subsoil or an indurated layer. They are in small concave valleys and at the outer edges of the mapped areas. Pyote soils are 20 to 40 inches deep to the subsoil and do not have an indurated layer within a depth of 60 inches. They are on stabilized sand dunes. Included soils make up 10 percent of the mapped areas.

The Wickett and Sharvana soils are used as rangeland and for wildlife habitat. They produce a large amount of native range forage. They make efficient use of summer showers for forage production. Maintaining an adequate vegetative cover minimizes wind erosion.

The dominant native vegetation consists of sand bluestem, little bluestem, giant dropseed, spike dropseed, mesa dropseed, sand dropseed, bush muhly, black grama, Arizona cottontop, plains bristlegrass, blue grama, and sideoats grama. Woody species include Havard oak, sand sagebrush, mesquite, fourwing saltbush, and catclaw acacia.

The Wickett soil is moderately suited to most urban uses because of the depth to indurated caliche and seepage. The Sharvana soil is poorly suited because of the very shallow and shallow depth to indurated caliche.

The Wickett soil is well suited to most recreational uses. The Sharvana soil is poorly suited to most recreational uses because of the very shallow and shallow depth to indurated caliche.

The Wickett soil is in capability subclass 6e, nonirrigated, and 4e, irrigated, and is in the Loamy Sand range site. The Sharvana soil is in capability subclass 6s, nonirrigated, and 4e, irrigated, and is in the Shallow Sandy Loam range site.

## WNA—Wink fine sandy loam, nearly level

This very deep, nearly level soil is on upland plains. It formed in calcareous eolian and alluvial sediments. Slopes are linear to convex and range from 0 to 3 percent. Individual areas are long and narrow and range from 40 to 720 acres.

The typical sequence, depth, and composition of the layers of the Wink soil are—

*Surface layer:*
0 to 9 inches—pale brown fine sandy loam

*Subsoil:*
9 to 22 inches—very pale brown fine sandy loam
22 to 35 inches—white fine sandy loam with moderately cemented plates and concretions of calcium carbonate

*Underlying material:*
35 to 60 inches—very pale brown fine sandy loam with few concretions of calcium carbonate

Important soil properties—

*Available water capacity:* Low
*Permeability:* Moderately rapid
*Drainage class:* Well drained
*Runoff:* Negligible
*Root zone:* Very deep
*Hazard of water erosion:* Slight
*Hazard of wind erosion:* Severe

Included with this soil in mapping are small areas of Monahans, Splotter, Tencee, and Turney soils. Monahans soils are in landscape positions similar to those of the Wink soil but are underlain by gypsum within a depth of 40 inches. Splotter and Tencee soils have indurated caliche within a depth of 20 inches. Also, Tencee soils have more than 40 percent calcium carbonate and more than 35 percent coarse fragments in the subsoil. Splotter and Tencee soils are on convex slopes along the outer edges of the mapped areas. Turney soils have more than 18 percent clay in the subsoil. They are on linear, nearly level alluvial flats.

The Wink soil is used as native rangeland. It produces a moderate amount of forage. The limitations affecting forage production are low rainfall; the low available water capacity; high, dry winds; and brush infestation.

The native vegetation consists of black grama, blue

grama, plains bristlegrass, sand dropseed, mesa dropseed, Arizona cottontop, sideoats grama, and spike dropseed. Woody species include mesquite, creosotebush, allthorn, and yucca.

This soil is well suited to most urban and recreational uses. Seepage is a limitation affecting sanitary facilities. Careful design and installation can minimize this limitation.

This soil is in capability subclass 7e and is in the Sandy Loam range site.

# Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

## Crops and Pasture

Only about 300 acres in the survey area is used for crops and pasture. The potential for growing crops is very low in most areas because of the low rainfall and the lack of suitable irrigation water. The suitability of each soil for use as cropland is indicated by the capability classification given at the end of each map unit description in the section “Detailed Soil Map Units.”

### Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops *(USDA, 1961).* Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. Only class and subclass are used in this survey.

*Capability classes*, the broadest groups, are designated by numerals 1 through 8. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class 5 soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation.

Class 7 soils have very severe limitations that make them unsuitable for cultivation.

Class 8 soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

*Capability subclasses* are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, 2e. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *w, s,* or *c* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

## Rangeland

George L. Peacock, area resource conservationist, Natural Resources Conservation Service, helped prepare this section.

Rangeland is land on which the native vegetation is predominantly grasses, grasslike plants, forbs, shrubs, and trees. The composition and production of the natural plant community varies from place to place and is determined mainly by soil, climate, and topography. The management needed to conserve soil and water resources and improve production includes balancing livestock numbers with forage production and rotating livestock to allow desirable plants to improve vigor, produce seed, and establish seedlings.

Most of the land area of Loving and Winkler Counties is used for grazing of livestock. Most ranches are cow-calf operations that produce stocker calves for the fall market. When additional forage is produced, stocker calves may be raised for later markets.

Growth of native vegetation in Loving and Winkler Counties is quite variable because of large variations in annual and seasonal rainfall. Droughts are very common. Low, inconsistent rainfall combined with high evaporation rates cause a depletion in soil moisture and a corresponding decrease in forage production. Growth of forage plants is usually greatest in late summer and early fall, which is when nearly half of the annual rainfall occurs. Rains in the spring are lighter and produce less forage growth. Grazing management should be flexible and closely correlated to plant growth curves and to fluctuations in seasonal and annual forage production.

### Range Sites and Range Condition

Soils vary in their capability to produce grasses and other plants suitable for grazing. Soils that produce about the same kinds and amounts of forage are grouped into a range site.

A range site is a distinctive kind of rangeland that produces a characteristic natural plant community. This community differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. This natural plant community is also referred to as the climax plant community or climax vegetation because it is the product of all the environmental factors responsible for its development.

Generally, the climax vegetation consists of the plants that were present when the area was first settled. If a site contains at least 75 percent of the plants that characterize the climax vegetation, the plant community is relatively stable. It reproduces itself so that plant composition does not change significantly as long as the environment remains unchanged. If the area is undisturbed and improved plants are not introduced, the most productive combination of forage plants on a range site is the climax vegetation.

Range sites are subject to many influences that modify or even temporarily destroy vegetation. Examples are drought, overgrazing, wild fires, and short-term tillage. If these conditions are not too severe, the plant community recovers and returns to climax vegetation. Severe deterioration of the range site, however, can permanently alter the potential of the site.

Grazing can change the quality and quantity of forage on a range site by changing the composition of the plant community.

*Decreasers* are plants in the climax vegetation that tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and the most palatable to livestock.

*Increasers* are plants in the climax vegetation that increase in relative amount as the more desirable decreasers are reduced by close grazing. They are commonly shorter than decreasers and are generally less palatable to livestock.

*Invaders* are plants that are normally not included in the climax plant community because they cannot compete with the climax vegetation for moisture, nutrients, and light. They invade the site and grow along with increasers only after the climax vegetation has been reduced by continual heavy grazing. Most invader species have little grazing value.

Range management requires a knowledge of the kinds of soil and of the climax or 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 climax plant community on a particular range site. The more closely the existing community resembles the climax community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning about the present plant community in a given use.

Four range condition classes are used to show the degree of departure from the potential, or climax, vegetation brought about by grazing or other uses. A range site is in excellent condition if 76 to 100 percent of the present plant community is the same as the climax vegetation; in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is 25 or less.

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during their growing season.

### Range Trend

One of the most important parts of a rangeland inventory is the determination of the direction of change in range condition. Range trend is the improvement or deterioration of the condition of a range site in response to the current grazing management. Indicators of an improving range trend are an abundance of new seedlings and young plants, an increase in accumulation of plant residues, an increase in palatable climax plants, an increase in plant vigor, and a decrease in the amount of bare ground.

The range site concept, in conjunction with range condition classification and determination of range trend, provides a sound ecological basis for the inventory and evaluation of rangeland resources. The range site aids the land user in identifying areas of rangeland that have different potential for vegetative production, regardless of what is currently being produced. Range condition provides an approximate measure of changes that have taken place in the plant community over time. Range trend allows the land user to determine what is currently occurring within the plant community.

Table 5 shows, for each soil that supports rangeland vegetation suitable for grazing, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years.

A *range site* and the assigned vegetative or climatic zone is indicated for each soil. Range sites in the Trans-Pecos Land Resource Area are grouped according to vegetative zones. The range sites in the Trans-Pecos part of the survey area are in the “desert grassland” vegetative zone. Range sites in the High Plains Land Resource Area are grouped according to climatic zones. The range sites in the northeastern part of Winkler County are in the “PE 19-25” climatic zone.

*Potential annual production* is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year’s growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Fourteen range sites are in the survey area. A brief description of each follows.

**Clay Loam range site** (PE 19-25). The Stegall soil in map unit KAA is in this range site. This site occurs as nearly level to gently sloping soils on uplands. The climax plant community is an open grassland. It is dominated by middle height and short grasses. A vegetative cover is necessary to minimize erosion and surface crusting. If the range deteriorates to poor condition, recovery is very slow due to a lack of desirable seed plants, crusted soils, and heavy infestations by woody plants.

The climax plant community consists of 30 percent blue grama, 20 percent buffalograss, 10 percent tobosa, 5 percent plains bristlegrass, 5 percent Arizona cottontop, 5 percent black grama, 5 percent vine-mesquite, and 5 percent cane bluestem. Under continuous heavy grazing, blue grama and sideoats grama decrease and buffalograss, tobosa, and sand dropseed increase. Further deterioration results in an invasion of perennial threeawns, hairy tridens, broom snakeweed, catclaw, and mesquite. Annuals, such as little barley, Texas filaree, evax, plantains, and common broomweed, invade bare areas during wet springs. Common perennial forbs that invade the site include western ragweed, silverleaf nightshade, and Dakota verbena.

**Draw range site** (desert grassland). The Toyah soil in map unit TOA is in this range site. This site is along narrow, natural drainage courses that are frequently overflowed and that receive runoff from adjoining sites and remote higher elevations. This site has the appearance of a savanna in which trees and shrubs are dominant in aspect. Tall bunchgrasses, middle height grasses, and rhizomatous and stoloniferous short grasses, however, have the greatest annual production. There is also an abundant variety of forbs in the understory. Under natural conditions in most areas, this site continually cycles from dominantly trees and shrubs to a successional stage of grasses and forbs.

The climax plant community consists of approximately 10 percent cane bluestem and silver bluestem; 10 percent Arizona cottontop and plains bristlegrass; 10 percent sideoats grama; 10 percent alkali sacaton and big sacaton; 5 percent blue grama; 5 percent black grama and bush muhly; 5 percent vine-mesquite; 5 percent green sprangletop; 5 percent tobosa; 10 percent perennial forbs, such as globemallow, bushsunflower, hairy tubetongue, and Mexican sagewort; 10 percent fourwing saltbush and butterfly bush; and 5 percent other shrubs, such as wolfberry, littleleaf sumac, desert willow, and ephedra. As retrogression occurs, such grasses as sideoats grama, cane bluestem, silver bluestem, Arizona cottontop, and plains bristlegrass, decrease and short grasses, such as tobosa and burrograss, increase. Other short grasses and forbs, such as ragweed, sneezeweed, broom snakeweed, and paperflower, increase or invade the site. Continued site deterioration and suppression of fires enhance the increase or invasion of woody plants, such as mesquite, whitebrush, tarbush, creosotebush, and cacti. If retrogression is prolonged, this site can become heavily brush infested.

The soils of this site are deep and are slowly permeable to moderately permeable. The relationships among plants, soils, air, and moisture are good on this site. These properties, in conjunction with the extra water the site receives, contribute to high productivity. If left unprotected by vegetative cover, however, the soil forms a thick crust and becomes susceptible to severe gully erosion.

**Gravelly range site** (desert grassland). The Chamberino, Delnorte, Paisano, and Tencee soils in map units CDD, PAC, PAF, and TMB are in this range site. This site is dominated by drought-tolerant, bunch and stoloniferous, short and middle height grasses. Shrubs and half shrubs are scattered and evenly distributed. Forb production varies considerably from year to year and season to season. A few small areas of slightly depressional soils that support a greater abundance of middle height grasses are scattered throughout the site.

The climax plant community consists of approximately 15 percent black grama, 10 percent bush muhly, 5 percent slim tridens, 5 percent sideoats grama, 5 percent blue grama, 5 percent plains bristlegrass, 5 percent Arizona cottontop, 5 percent cane bluestem, 5 percent sand dropseed and mesa dropseed, 5 percent range ratany, 3 percent fourwing saltbush, and 5 percent creosotebush. Under continuous heavy grazing, the plant community deteriorates to a more sparsely vegetated community and an increasing amount of bare ground. Black grama, bush muhly, sideoats grama, Arizona cottontop, cane bluestem, plains bristlegrass, and fourwing saltbush decrease and threeawns, fluffgrass, burrograss, catclaw mimosa, tarbush, cacti, and yucca increase. Creosotebush also increases and commonly becomes the dominant species. Some mesquite also invades in areas where the soil is deeper.

The plants that are adapted to these soils are those that can utilize moisture quickly and tolerate long periods of drought. The vegetative cover deteriorates very quickly if the site is mismanaged. Range recovery is extremely slow.

**Gyp range site** (desert grassland). The Holloman soils in map units HMB and HRA are in this range site. This site is a grassland that has patches of bare ground between clumps of vegetation. The plant community varies considerably due to wide variations in depth of soil. Where there is little or no soil above gypsum, only rough coldenia may be present. Bare areas are common and can be quite extensive. In areas where the surface layer is deeper, the vegetation consists of black grama, chino grama, and fourwing saltbush and, in lower areas, alkali sacaton.

The climax plant community consists of approximately 15 percent black grama; 15 percent chino grama; 10 percent alkali sacaton; 10 percent gypgrass; 5 percent sand dropseed; 5 percent sand muhly; 5 percent plains bristlegrass and cane bluestem; 3 percent bush muhly; 3 percent perennial threeawns; 5 percent rough coldenia; 5 percent other forbs, such as nama, leather-weed croton, and halfshrub sundrop; 5 percent fourwing saltbush and butterfly bush; and 5 percent other shrubs, such as littleleaf sumac, torrey ephedra, javelina brush, and allthorn. If retrogression occurs, black grama, chino grama, and alkali sacaton decrease and are replaced by gypgrass, sand muhly, and burrograss. Continued deterioration results in the site becoming dominated by rough coldenia and by some gypgrass and sand muhly. Annual plants may seasonally become more prevalent in more favorable pockets of soil. During times of

extremely droughty conditions, the site may be only bare ground and nama.

This site has a droughty appearance because of the inability of the soils to support a dense stand of vegetation. The soils have moderate permeability and low available water capacity. If unprotected by vegetative cover or organic residue, the soils become highly susceptible to wind erosion and water erosion.

**Lakebed range site** (desert grassland). The Mentone soils in map units SMB and TMB are in this range site. This site is dominated by rhizomatous and stoloniferous, middle height and short grasses. Some climax forbs, including some annuals, are present. Woody species occur around the periphery of the depressions and may eventually occur intermittently over the entire site. The composition of species and forage production fluctuate with frequency and duration of inundation.

The climax plant community consists of approximately 40 percent vine-mesquite; 35 percent tobosa; 10 percent white tridens; 5 percent cane bluestem and Arizona cottontop; 2 percent hackberry; 2 percent western soapberry, fourwing saltbush, and butterfly bush; and 2 percent forbs. The playas that have a larger drainage area have a higher percentage of vine-mesquite than the playas that have a smaller drainage area, which are dominated by tobosa. Under continuous heavy grazing, many of the climax perennial grasses are replaced by sneezeweed, groundsels, and annuals; mesquite, catclaw, lotebush, and tasajillo invade the site; and western soapberry may increase strongly.

This site occurs in depressional areas that usually receive runoff from adjacent areas. The water makes the site very productive. Livestock prefer this site because the grass is greener and is more palatable over a longer period of time. Because this site is commonly in very small areas within a much larger grazing unit, careful management is necessary to prevent overgrazing.

**Loamy range site** (desert grassland). The Reeves and Turney soils in map units HRA and TUA are in this range site. This site is dominated by drought-tolerant, short and middle height grasses and has sparse, evenly distributed shrubs and half shrubs. Small, slightly depressed areas support larger amounts of middle height grasses. The site supports an abundant variety of forbs.

The climax plant community consists of approximately 25 percent tobosa; 20 percent blue grama; 10 percent black grama; 3 percent sideoats grama; 3 percent bush muhly; 3 percent burrograss; 5 percent plains bristlegrass, Arizona cottontop, and cane bluestem; 3 percent perennial threeawns; 3 percent sand dropseed or mesa dropseed; 5 percent perennial forbs, such as leather-weed croton, globemallow, and Mexican sagewort; and 3 percent fourwing saltbush and butterfly bush. Under continuous heavy grazing, blue grama, black grama, sideoats grama, plains bristlegrass, Arizona cottontop, cane bluestem, and palatable forbs and shrubs, such as Mexican sagewort, fourwing saltbush, and butterfly bush, decrease and sand muhly, burrograss, tobosa, perennial threeawn, ear muhly, sand dropseed, and annuals increase. Tarbush, allthorn, and javelina brush increase as the site deteriorates, and creosotebush becomes a prolific invader. Herbaceous species, such as fluffgrass, sixweeks grama, annual threeawns, dogweed, and broom snakeweed, also invade if the site becomes severely deteriorated.

**Loamy Sand range site** (desert grassland). The Pyote and Wickett soils in map units POB, PPB, WCB, and WKA are in this range site. This range site occurs as nearly level to undulating soils on sandy plains and scattered, low stabilized dunes. The climax plant community is an open grassland dominated by middle height grasses and some tall grasses. Shrubs are sparse, evenly distributed, and commonly occur on small stabilized dunes throughout the plant community. The site supports an abundant variety of annual and perennial forbs, which fluctuate from year to year due to seasonal variations in distribution and amount of moisture.

The climax plant community consists of approximately 10 percent sand bluestem, 10 percent little bluestem, 10 percent giant dropseed, 10 percent spike dropseed, 10 percent mesa dropseed and sand dropseed, 5 percent bush muhly, 5 percent black grama, 5 percent sand sagebrush, and 5 percent Havard oak. Havard oak and sand sagebrush are primary soil stabilizers and commonly occur on small stabilized dunes. Under continuous heavy grazing, bluestems, giant dropseed, bush muhly, and black grama decrease and mesa dropseed, sand dropseed, sand sagebrush, yucca, and Havard oak increase. Further regression results in threeawns, fall witchgrass, signalgrass, and numerous annuals becoming the dominant herbaceous vegetation and in mesquite, catclaw acacia, broom snakeweed, and groundsels invading the site.

If proper grazing management is applied, this site is highly productive. If the site is mismanaged and the protective plant cover is removed, the soils become highly susceptible to wind erosion. Havard oak is toxic to livestock if consumed during the middle to late bud

stage. If the number of Havard oaks increases to above the number in the climax condition, livestock losses can occur.

**Salty Bottomland range site** (desert grassland). The Arno, Harkey, Patrole, and Pecos soils in map units HAA and PEA are in this range site. This site is dominated by salt-tolerant grasses in association with halophytic forbs and shrubs. The composition of species on the site varies with soil salinity, soil texture, amount of overflow, and depth of the water table. Where salinity is slight, alkali sacaton is the primary grass in association with middle height grasses, such as vine-mesquite, tobosa, twoflower trichloris, and plains bristlegrass. Fourwing saltbush is found in favorable locations. Sites that have a higher salinity level are primarily occupied by just alkali sacaton.

The climax plant community consists of approximately 35 percent alkali sacaton, 5 percent big sacaton, 5 percent vine-mesquite, 5 percent tobosa, 3 percent twoflower trichloris, 3 percent plains bristlegrass, 3 percent sand dropseed or mesa dropseed, 5 percent halophytic forbs, and 10 percent fourwing saltbush. As retrogression occurs, alkali sacaton, big sacaton, and vine-mesquite are replaced by tobosa and inland saltgrass. Further retrogression results in increasing amounts of bare ground, seepweed, and other annual halophytes. Mesquite invades readily and becomes quite dense. Saltcedar invades along stream channels or in areas that have a high water table.

This site is suitable for grazing during all seasons; however, the vast majority of the forage that is most palatable to livestock is produced in the summer and is most effectively used at that time. Range seeding generally is not feasible on this site.

**Sand Hills range site** (desert grassland). The Elgee and Penwell soils in map units EPB, PND, and PPB are in this range site. This site occurs as undulating to rolling soils on sandy plains and scattered sand dunes. It is an open grassland. Tall and middle height grasses dominate the plant community. Shrubs are sparse and evenly distributed. The site supports an abundant variety of annual and perennial forbs, which fluctuate from year to year due to seasonal variations in distribution and amounts of moisture. Frequently shifting sands and irregular dunes produce considerable variation and frequent fluctuations in structure and composition of the plant community. Low successional species, such as annuals and some dropseeds, usually dominate the less stable areas.

The climax plant community consists of approximately 10 percent sand bluestem, 10 percent Havard panicum, 10 percent giant dropseed, 5 percent big sandreed, 5 percent little bluestem, 5 percent spike dropseed, 5 percent mesa dropseed, 5 percent sand dropseed, 5 percent plains bristlegrass, 3 percent sand paspalum, 5 percent Havard oak, and 3 percent sand sagebrush. Under continuous heavy grazing, the dominant tall grasses, such as sand bluestem, Havard panicum, giant dropseed, and big sandreed, are replaced by middle height and short grasses and sand dropseed, mesa dropseed, signalgrass, threeawns, annual sandbur, and numerous annual forbs increase strongly. Havard oak and sand sagebrush also increase strongly, and mesquite may invade the site.

This site is highly productive and responds well to a system of management that rotates the season of use. Havard oak is toxic to livestock if consumed during the middle to late bud stage. If the number of Havard oaks increases to above the number in the climax condition, livestock losses can occur. If the vegetative cover is removed, the soils become very susceptible to wind erosion and active sand dunes and blowouts may develop.

**Sandstone Hill and Mountain range site** (desert grassland). The Coyanosa soil in map unit CLC is in this range site. This site occurs as rolling to steep sandstone hills and mountains. The climax plant community is characterized by middle height and short grasses and an abundance and large variety of forbs and woody shrubs.

The climax plant community consists of approximately 20 percent black grama; 15 percent sideoats grama; 5 percent Arizona cottontop; 5 percent cane bluestem; 5 percent green sprangletop; 5 percent plains bristlegrass; 5 percent vine-mesquite and bush muhly; 5 percent tobosa; 5 percent hairy grama, mesa dropseed, and perennial threeawn; 5 percent sand dropseed, fall witchgrass, Halls panicum, and rough tridens; 5 percent perennial forbs, such as menodora, crotons, blackfoot, and angel trumpets; 5 percent range ratany, feather dalea, and skeleton golden-eye; 5 percent littleleaf sumac, ephedra, hackberry, and narrowleaf forestiera; and 5 percent fourwing saltbush, javelina brush, catclaw, agarito, sotol, and whitebrush. Under continuous heavy grazing, sideoats grama, black grama, cane bluestem, Arizona cottontop, and plains bristlegrass decrease and perennial threeawns, hairy tridens, burrograss, and fluffgrass increase. Woody species, such as catclaw, creosote, white-thorn acacia, and mesquite, continue to increase as retrogression occurs.

**Sandy Loam range site** (desert grassland). The Kinco, Los Tanos, Monahans, Pajarito, Ratliff, and Wink soils in map units CLC, HMB, KBA, MPA, RAA, and WNA are in this range site. The climax plant

community is an open grassland. It is dominated by middle height and short grasses and has sparsely and evenly distributed shrubs and yucca. Ephemeral forbs are a characteristic component and occasionally appear as aspect dominants. The production of annuals fluctuates from year to year due to seasonal variations in distribution and amount of rainfall.

The climax plant community consists of approximately 35 percent black grama; 10 percent sand dropseed and mesa dropseed; 5 percent plains bristlegrass and Arizona cottontop; 3 percent spike dropseed; 3 percent bush muhly; 3 percent blue grama; 3 percent sideoats grama; 5 percent fourwing saltbush; 3 percent yucca; 3 percent catclaw; 5 percent perennial forbs, such as leather-weed croton, globemallow, sandlily, and halfshrub sundrop; and 5 percent annual forbs. Under continuous heavy grazing, black grama, blue grama, sideoats grama, bush muhly, plains bristlegrass, Arizona cottontop, and fourwing saltbush decrease and dropseeds and threeawns increase. If retrogression continues, signalgrass, fall witchgrass, annual sandbur, and annual forbs continue to increase and replace some of the dropseeds. Woody species, such as sand sagebrush, catclaw, javelina brush, wolfberry, and lotebush, gain greater prominence in the deteriorated plant community. As retrogression continues, mesquite invades strongly and may eventually become dominant. Broom snakeweed and groundsel also invade.

**Sandy Loam range site** (PE 19-25). The Douro and Faskin soils in map unit FDA are in this range site. This site occurs on nearly level to moderately sloping soils on uplands. The climax plant community is an open grassland dominated by middle height and short grasses. The production of annual and perennial forbs fluctuates from year to year due to seasonal variations in distribution and amount of rainfall.

The climax plant community consists of approximately 20 percent black grama; 15 percent blue grama; 10 percent sideoats grama; 10 percent plains bristlegrass; 5 percent feathery bluestems; 5 percent vine-mesquite; 5 percent buffalograss; 5 percent Arizona cottontop; 5 percent sand dropseed; 5 percent hooded windmillgrass; and 5 percent perennial forbs, such as guara, dotted gayfeather, croton, and prairie sunflower. Under continuous heavy grazing, blue grama, sideoats grama, and plains bristlegrass decrease and less desirable middle height and short grasses, such as hooded windmillgrass, fall witchgrass, hairy grama, and perennial threeawns, become the dominant grasses. Mesquite, catclaw, yucca, cacti, and perennial broomweed rapidly invade the site as the result of range deterioration. If the site further deteriorates, invading grasses, such as gummy lovegrass, bristle panicum, fringed signalgrass, tumble windmillgrass, sandbur, and a variety of annuals, become the dominant grasses.

**Shallow Sandy Loam range site** (desert grassland). The Blakeney, Conger, Sharvana, and Splotter soils in map units BCB, KBA, SHA, SMB, and WKA are in this range site. This site is an open grassland that is sparsely dotted with shrubs (fig. 9). It is dominated by short and middle height grasses. Black grama is the dominant plant in both aspect and composition. Some perennial forbs and occasional woody shrubs occur. Production of forbs fluctuates from year to year and season to season.

The climax plant community consists of approximately 60 percent black grama; 5 percent sand dropseed and mesa dropseed; 5 percent spike dropseed; 5 percent bush muhly; 5 percent Arizona cottontop and plains bristlegrass; 2 percent blue grama; 3 percent sideoats grama; 10 percent perennial forbs, such as leather-weed croton, trailing ratany, rough menodora, and plains blackfoot; and 5 percent woody species, such as fourwing saltbush, yucca, ephedra, catclaw, and javelina brush. As retrogression occurs, black grama, bush muhly, plains bristlegrass, Arizona cottontop, blue grama, sideoats grama, many of the perennial forbs, and fourwing saltbush decrease sharply and threeawns, fluffgrass, and annuals increase. Continued retrogression results in an increase in bare ground and catclaw, javelina brush, mesquite, creosotebush, and pricklypear.

Because of the loamy texture of the soils, this site responds rapidly to proper management. The soils are shallow and have only very low to moderate available water capacity; however, these properties do not significantly limit the potential production of the site. If left unprotected by plant cover, these soils are susceptible to wind erosion.

**Very Shallow range site** (PE 19-25). The Kimbrough soil in map unit KAA is in this range site. This site occurs as nearly level to moderately sloping soils on uplands. The soils are shallow and very shallow, which limits their ability to store moisture over long periods of time. The site is dominated by warm-season bunchgrasses. Due to the shallow and very shallow soil depth, forage production is limited. The hazard of water erosion is severe in overgrazed areas.

The climax plant community consists of approximately 25 percent black grama; 10 percent sideoats grama; 10 percent blue grama; 10 percent feathery bluestems; 5 percent plains bristlegrass; 5 percent Arizona cottontop; 5 percent buffalograss; 5 percent perennial threeawns; 5 percent tobosa; and 5 percent perennial forbs, such as dotted gayfeather,

**Figure 9.—An area of Sharvana fine sandy loam, nearly level, which is in the Shallow Sandy Loam range site.**

orange zexmenia, bushsunflower, and trailing ratany. Under continuous heavy grazing, sideoats grama, blue grama, and black grama decrease and perennial threeawns, dropseeds, and hairy grama increase. Continued deterioration results in the site being invaded by catclaw, mesquite, broom snakeweed, hairy tridens, and burrograss.

## Recreation

The soils in the survey area are rated in table 6 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 the table, 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 the table can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 9 and interpretations for dwellings without basements and for local roads and streets in table 8.

*Camp areas* require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

*Picnic areas* are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

*Playgrounds* require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

*Paths and trails* for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

*Golf fairways* are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

## Wildlife Habitat

Stephen A. Nelle, biologist, Natural Resources Conservation Service, helped 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.

Wildlife is an important natural resource in Loving and Winkler Counties. The kinds and numbers of wildlife have changed considerably since the settlement of the area by Europeans. Prior to early settlement, the desert grasslands supported huge migrating herds of bison and other associated species, including pronghorn antelope, gray wolf, and lesser prairie chicken. At that time, natural water was somewhat more abundant than it is now. The Pecos River was deep, wide, and swift, and some of its tributaries were perennial streams. Settlers reported that some of the numerous playa lakes supported surface water for many months after rain.

Factors that contributed to the early changes in wildlife include unregulated hunting, heavy grazing by cattle, and range fencing, which allowed continuous grazing instead of seasonal grazing. Even after these changes, the soils and vegetation of Loving and Winkler Counties support a surprising diversity and abundance of wildlife.

The basic habitat needs of any wildlife population are food, cover, and water in the right combination and arrangement. Each species of animal has its own unique requirements for these habitat elements. In order for wildlife to inhabit an area, the land must either naturally provide the needed habitat or be managed so that the specific habitat needs are provided.

Soils influence the kinds and amounts of vegetation that are available for wildlife food and cover. Soils also influence the distribution of surface water for wildlife use. In many cases, however, the management of the land has a greater influence on wildlife than the soil properties. Each soil and its characteristic vegetation can be managed to either harm or benefit wildlife

habitat. Therefore, a good understanding of soils and vegetation is essential to proper wildlife management. In the survey area, management practices that influence wildlife include grazing management, livestock water development, oil field activity, and illegal hunting.

The great majority of wildlife in the survey area is considered nongame wildlife. These species either do not exist in surplus numbers or are not in demand for recreational hunting. Even though the survey area is not specifically managed for these nongame mammals, birds, reptiles, and amphibians, they are nevertheless important to the ecological balance.

About 45 native species of mammals inhabit the survey area. About 25 kinds of rodents inhabit the area, including various species of ground squirrel, gopher, pocket mouse, mouse, kangaroo rat, cotton rat, wood rat, porcupine, and, probably, muskrat. The burrowing activities of most rodents are considered beneficial, providing natural soil cultivation, increasing the penetration of rainfall, and incorporating organic matter into the soil. Some of these rodents consume insects; most eat seeds or foliage. Many of the seeds consumed include those of noxious or invading species, such as mesquite, creosotebush, broom snakeweed, nightshade, tumbleweed, cactus, yucca, and grassbur. This consumption possibly hinders the spread of these species. The rodents, however, also consume the seeds and foliage of more desirable grasses and forbs. If the number of rodents becomes too high, the rodents can have a detrimental effect upon the range resource. An abundance of natural predators normally prevents the number from becoming too high.

Cottontail rabbits inhabit the area, and jackrabbits are common and periodically abundant. When the number of jackrabbits is excessive, they overgraze and are detrimental to the vegetative resource and to ranching operations. However, predators play an important role in keeping the number in balance.

About 11 species of predatory mammals inhabit the area, including raccoon, skunk, badger, fox, coyote, bobcat, and, occasionally, mountain lion. The important role that these predators play is described above. Some trapping occurs, especially when fur prices are high. The hunting of coyote, which are abundant, is a common sport but has very little effect on coyote numbers. Several kinds of bats inhabit the area and are regarded as beneficial because of their voracious appetite for insects.

Big game mammals that inhabit the area include mule deer, whitetail deer, pronghorn antelope, and javelina. Although these species are classified as game animals and hunting seasons are designated for them within the survey area, these species occur in such low numbers that hunting them is neither encouraged nor widely practiced by landowners.

A very low number of mule deer is scattered throughout the survey area. They are concentrated along the Pecos River in areas of the Harkey, Patrole, and Pecos soils. A very low number of whitetail deer is scattered throughout areas of the Penwell soils and Dune land. Both species of deer require a considerable amount of brush for cover. They rely on browse and forbs for their food supply and generally stay within about a mile of permanent water. Pronghorn antelope, which were once common in the survey area, may still exist in very small numbers in the northern part of Winkler County. They rely on forbs for the bulk of their diet but also consume significant amounts of browse.

Some of the more important perennial forbs used by deer and antelope include globemallow, menodora, groundcherry, plains blackfoot, sundrop, gaura, croton, and bladderpod. Annual forbs are heavily utilized when available, but prevailing dry conditions make them of only minor importance. Important browse species in the survey area include fourwing saltbush, butterfly bush, Havard oak, Western soapberry, range ratany, littleleaf sumac, catclaw acacia, white-thorn acacia, and javelina brush. Seasonal foods, such as mesquite beans, pricklypear fruit, yucca flowers, and acorns, may also be important.

The population of deer and antelope is kept low by a combination of three factors: The habitat does not provide a stable, year-round food supply of high quality forbs and browse; reproduction is kept at a low level due to heavy predation by coyote on fawns; and adult populations are suppressed by illegal trespassing and hunting.

Scattered bands of javelina inhabit the survey area, primarily where the thickest brush occurs but especially in and near areas of the Harkey, Patrole, and Pecos soils and in areas of the Penwell soils that support Havard oak. Javelina feed primarily on cactus stems and fruits, mesquite beans, yucca roots and flowers, acorns, and various grasses, forbs, and browse. They also eat some insects, rodents, and carrion. They require thick brush for escape cover.

Feral hogs have been introduced into the area and mainly inhabit areas of the Penwell soils and Dune land. They eat a wide variety of plant and animal matter, including acorns; the succulent roots of cattail, bulrush, and other wetland plants; and burrowing rodents.

The bird life in Loving and Winkler Counties includes an amazing variety for a desert grassland. Song birds, predatory birds, shore birds, and migratory and nonmigratory game birds are all present in good numbers. Most of the bird species are migratory,

spending either the nesting period or the winter in the survey area. Some species are year-round residents. A number of birds associated with water are found on the Pecos River and Red Bluff Lake. Periodically after heavy rains, the playa lakes that temporarily form in areas of the Mentone soils attract water birds also. Shore birds include heron, egret, stilt, avocet, curlew, yellowlegs, sandpiper, gull, and tern. Waterfowl include diving ducks, such as canvasback, bufflehead, and goldeneye, and dabbling ducks, such as pintail, gadwall, shoveler, widgeon, mallard, and teal. White-fronted geese also inhabit the area. Other birds associated with water include white pelican, cormorant, kingfisher, osprey, and sandhill crane.

Raptorial birds of prey in the survey area include red-tailed hawk, Swainson's hawk, sharp-shinned hawk, Cooper's hawk, marsh hawk, Mississippi kite, kestrel, burrowing owl, and great horned owl. Turkey vultures and ravens are the primary carrion eating birds. Insect-eating birds include nighthawk, whippoorwill, woodpecker, flycatcher, swallow, wren, loggerhead shrike, and roadrunner. Other songbirds, which eat a variety of seeds, fruits, and insects, include sparrow, bunting, grosbeak, pyrrhuloxia, goldfinch, waxwing, mockingbird, robin, titmouse, oriole, meadowlark, cowbird, and starling.

Upland game birds are common in the survey area. The two most important species are scaled quail and mourning dove. Other less common species include bobwhite quail in the eastern part of the survey area and Gambel's quail in the western part. Small, unstable populations of turkey inhabit areas of the Harkey, Patrole, and Pecos soils and areas of the Penwell soils and Dune land. Very small numbers of the once-abundant lesser prairie chicken may still inhabit areas of the Penwell soils in the northern part of Winkler County. Scaled quail and dove are hunted throughout the area, and the leasing of hunting rights is an economic asset to some ranching operations. Some landowners perform specific management practices to increase the numbers of these birds.

Scaled quail live their entire life in a rather small area and must therefore have all of their habitat needs closely arranged. Quail numbers range from very abundant to very few from year to year based on rainfall and nesting success. Nesting cover consists of large clumps of grass left from the previous year. Heavy grazing can limit nesting success by allowing nest predators to more easily locate nests. A lack of grazing can also limit quail production because a buildup of excess grass limits food production and seed availability. Quail feed primarily on the hard seeds of forbs, grasses, and woody plants; on insects; and on succulent greens when they are available. In many cases, the weedy kinds of plants provide the best quail food. Some of the better food plants for quail in the survey area include cowpen daisy, sunflower, pigweed, croton, spurge, broom snakeweed, Russian thistle, filaree, buffalo-bur, plains bristlegrass, panicums, mesquite, white-thorn acacia, pricklypear, and tasajillo. Many of these plants grow best on soil that is periodically disturbed. Quail need significant areas of bare ground on which to scratch for seeds and low-growing brush for escape cover. The best habitat for quail; therefore, consists of areas that have scattered, low-growing bushes interspersed with bunchgrasses, bare ground, and forbs. The presence of surface water is not considered essential to quail. In dry years, however, water sources are heavily utilized and increase the quail survival rate.

Mourning doves, which are migratory, can fly long distances to find suitable food, cover, and water. They nest equally well in trees or on the ground. They eat almost exclusively seeds, including those of many of the same species used by quail. Unlike quail, however, they do not scratch for seeds and must have seeds visible on areas of bare soil. They require daily drinking water and fly some distance from feeding grounds to water. The development of livestock water throughout the area has increased dove and quail numbers. However, traditional livestock water troughs do not provide ideal watering locations for birds. Water troughs can be modified to provide ground-level water by installing an overflow pipe that leads to a small, nearby depression.

Amphibians are restricted to the Pecos River, Red Bluff Lake, playa lakes, and the natural wetland areas in the Penwell-Dune land complex. Several kinds of salamanders, toads, and frogs and numerous reptiles inhabit the area. The reptiles include the ornate box turtle; several types of water turtles; snakes, such as the coachwhip, bull snake, hognose, king snake, and diamondback rattlesnake; and lizards, including the collared lizard, side blotched lizard, whiptail, earless lizard, prairie lizard, and horned lizard. The dunes sagebrush lizard is not found in Texas except on the active sand dunes in and near the survey area.

The fishery resource of the survey area is restricted to the permanent water of the Pecos River and Red Bluff Lake. Since the construction of several dams on the Pecos River, the quality and quantity of water has declined considerably. High salinity levels, widely fluctuating water levels, and periodic toxic plankton blooms combine to make water quality less than ideal for native freshwater species. Natural reproduction is low, and periodic fish die-offs have limited such species as sunfish, black bass, and channel and blue catfish. Stable populations of buffalo, carp, and gar

exist; these so-called “rough” fish are not considered a problem.

Introductions of the salt-tolerant, hybrid striped bass and striped bass into Red Bluff Lake have been successful. A healthy population of these popular game fish exists and is supported by a strong forage base of gizzard shad, silverside minnows, and grass shrimp. These fish also exist in the Pecos River because of the release of irrigation water.

Wildlife are a valuable part of the natural resources in the survey area. They have esthetic value, enriching the lives of the people who enjoy seeing them. They have ecological value; each species playing a role in the complex balance of nature. Some species have scientific value that may not yet be recognized. Some kinds of wildlife also have legitimate economic value, which encourages proper habitat management. The conservation of wildlife is an important part of land stewardship.

In table 7, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

*Grain and seed crops* are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

*Grasses and legumes* are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

*Wild herbaceous plants* are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

*Shrubs* are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountainmahogany, bitterbrush, snowberry, and big sagebrush.

*Wetland plants* are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, cordgrass, rushes, sedges, and reeds.

*Shallow water areas* have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

*Habitat for openland wildlife* consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

*Habitat for wetland wildlife* consists of open, marshy or swampy shallow water areas. Some of the wildlife

attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

*Habitat for rangeland wildlife* consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, sage grouse, meadowlark, and lark bunting.

## Engineering

Claude Thompson, Jr., civil engineer, and Cleon W. Namken, agricultural engineer, Natural Resources Conservation Service, helped prepare 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" section.

*Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

*The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.*

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

### Building Site Development

Table 8 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

*Shallow excavations* are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

*Dwellings* and *small commercial buildings* are

structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

*Local roads and streets* have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

*Lawns and landscaping* require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

### Sanitary Facilities

Table 9 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

The table also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

*Septic tank absorption fields* are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

*Sewage lagoons* are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

The table gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

*Sanitary landfills* are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in the table are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

*Daily cover for landfill* is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

**Construction Materials**

Table 10 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

*Roadfill* is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

*Sand* and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications

for each use vary widely. In the table, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

*Topsoil* is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

### Water Management

Table 11 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas 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. A high water table affects the amount of usable material. It also affects trafficability.

*Irrigation* is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by

depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

*Terraces and diversions* are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind erosion or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

# 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.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

## Engineering Index Properties

Table 12 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

*Depth* to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

*Texture* is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

*Classification* of the soils is determined according to the Unified soil classification system *(ASTM, 1993)* and the system adopted by the American Association of State Highway and Transportation Officials *(AASHTO, 1986)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

*Rock fragments* 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

*Percentage (of soil particles) passing designated sieves* is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The

sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

*Liquid limit* and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

## Physical and Chemical Properties

Table 13 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

*Clay* as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

*Moist bulk density* is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $^1/_3$-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

*Permeability* refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

*Soil reaction* is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

*Salinity* is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

*Shrink-swell potential* is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; *high*, more than 6 percent; and *very high*, greater than 9 percent.

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.64. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

*Erosion factor T* is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

*Wind erodibility groups* are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.
8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition. In the table, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

## Soil and Water Features

Table 14 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

*Hydrologic soil groups* are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

*Flooding*, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

The table 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). 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.

*High water table* (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on observations of the water table at selected sites and on the evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. Indicated in the table are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in the table.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. “More than 6.0” indicates that the water table is below a depth of 6 feet or that it is within a depth of 6 feet for less than a month.

*Depth to bedrock* is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

A *cemented pan* is a cemented or indurated subsurface layer within a depth of 5 feet. Such a pan causes difficulty in excavation. Pans are classified as thin or thick. A thin pan is less than 3 inches thick if continuously indurated or less than 18 inches thick if discontinuous or fractured. Excavations can be made by trenching machines, backhoes, or small rippers. A thick pan is more than 3 inches thick if continuously indurated or more than 18 inches thick if discontinuous or fractured. Such a pan is so thick or massive that blasting or special equipment is needed in excavation.

*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.

## Physical and Chemical Analyses of Selected Soils

The results of physical analyses of several typical pedons in the survey area are given in table 15 and the results of chemical analyses in table 16. The data are for

soils sampled at carefully selected sites. The pedons are typical of the series. They are described in the section "Soil Series and Their Morphology." Soil samples were analyzed by the National Soil Survey Laboratory, Natural Resources Conservation Service, Lincoln, Nebraska.

Most determinations, except those for grain-size analysis and bulk density, were made on soil material smaller than 2 millimeters in diameter. Measurements reported as percent or quantity of unit weight were calculated on an ovendry basis. The methods used in obtaining the data are indicated in the list that follows. The codes in parentheses refer to published methods *(USDA, 1996)*.

*Coarse materials*—(2-250 mm fraction) volume estimates of the percentages of all material greater than 2 mm (3B2).

*Sand*—(0.05-2.0 mm fraction) weight percentages of material less than 2 mm (3A1).

*Silt*—(0.002-0.05 mm fraction) pipette extraction, weight percentages of all material less than 2 mm (3A1).

*Clay*—(fraction less than 0.002 mm) pipette extraction, weight percentages of material less than 2 mm (3A1).

*Water retained*—pressure extraction, percentage of ovendry weight of less than 2 mm material; 1/3- or 1/10-bar (4B1), 15-bars (4B2).

*Bulk density*—of less than 2 mm material, saran-coated clods field moist (4A1a), 1/3-bar (4A1d), ovendry (4A1h).

*Coefficient of linear extensibility*—change in clod dimension based on whole soil (4D).

*Extractable cations*—ammonium acetate pH 7.0, atomic absorption; calcium (6N2e), magnesium (6O2d), sodium (6P2b), potassium (6Q2b).

*Cation-exchange capacity*—ammonium acetate, pH 7.0, steam distillation (5A8b).

*Reaction (pH)*—1:1 water dilution (8C1f).

*Reaction (pH)*—calcium chloride (8C1f).

*Electrical conductivity*—saturated paste (8I).

*Sodium adsorption ratio* (5E).

*Carbonate as calcium carbonate*—(fraction less than 2 mm) manometric (6E1g).

# Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(USDA, 1975; USDA, 1992)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Psamment (*Psamm*, meaning sandy, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Torripsamments (*Torri*, meaning hot and dry, plus *psamments*, the suborder of the Entisols that is generally sandy throughout).

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 *Ustic* identifies the subgroup that borders on the ustic moisture regime. An example is Ustic Torripsamments.

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 siliceous, thermic Ustic Torripsamments.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile.

## Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" *(USDA, 1993)*. Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" *(USDA, 1975)* and in "Keys to Soil Taxonomy" *(USDA, 1992)*. 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."

### Arno Series

The Arno series consists of very deep, moderately well drained, very slowly permeable soils that formed in saline, clayey alluvium. These nearly level soils are on the flood plain along the Pecos River. Slopes are linear to concave and are 0 to 1 percent. These soils are fine, montmorillonitic, thermic Halic Haplotorrerts.

Typical pedon of Arno clay in an area of Pecos-Arno-Patrole association, occasionally flooded, in Loving

County; 2.4 miles southeast on a county road from Mentone, Texas, 1.5 miles southwest on an oil-field road, 50 feet east in range:

A—0 to 6 inches; reddish brown (5YR 5/3) clay, reddish brown (5YR 4/3) moist; weak fine subangular blocky structure; hard, firm, moderately sticky and moderately plastic; common fine and medium roots; common very fine and fine interstitial and tubular pores; cracks that are about 1 inch wide and about 20 inches apart extending through horizon; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bz—6 to 16 inches; reddish brown (5YR 5/3) clay, reddish brown (5YR 4/3) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; very hard, very firm, very sticky and very plastic; common fine and medium roots; few very fine and fine interstitial and tubular pores; 3/4-inch-wide cracks extending through horizon; very few faint patchy clay films on faces of peds; distinct continuous pressure faces; common fine and medium irregular salt masses; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bssz—16 to 38 inches; reddish brown (5YR 5/3) clay, reddish brown (5YR 4/3) moist; weak coarse prismatic structure parting to moderate fine and medium angular blocky; extremely hard, extremely firm, very sticky and very plastic; few fine roots; many intersecting slickensides and wedge-shaped aggregates; cracks that are more than 1/4 inch wide extending below 24 inches; thin discontinuous layers of silty and loamy materials; weak bedding planes evident; many distinct pressure faces; common fine and medium irregular salt masses; strongly effervescent; moderately alkaline; clear smooth boundary.

BCssz—38 to 70 inches; dark brown (10YR 3/3) clay, very dark grayish brown (10YR 3/2) moist; common medium distinct dark gray (10YR 4/1), light gray (10YR 7/2), and brown (7.5YR 4/2) redoximorphic features; weak coarse prismatic structure parting to weak medium and coarse angular blocky; very hard, very firm, moderately sticky and moderately plastic; common grooved intersecting slickensides that decrease in number with depth; few fine irregular gypsum crystals; common fine and medium irregular salt masses; violently effervescent; moderately alkaline; clear smooth boundary.

BCz—70 to 80 inches; very dark gray (10YR 3/1) clay, very dark gray (10YR 3/1) moist; common medium distinct white (10YR 8/1) and dark grayish brown (10YR 4/2) redoximorphic features; massive; very hard, very firm, moderately sticky and moderately plastic; very few faint discontinuous pressure faces on faces of peds; few fine irregular gypsum crystals; common fine and medium irregular salt masses; violently effervescent; moderately alkaline.

The average content of clay in the 10- to 40-inch control section ranges from 40 to 60 percent. Bedding planes are evident within a depth of 50 inches. These soils, when dry, have cracks that are 1 to 2 centimeters wide at a depth of 20 inches. Electrical conductivity is greater than 15 dS/m in some layer above 40 inches that is at least 6 inches thick.

The A horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is clay or silty clay. Electrical conductivity ranges from 2 to 16 dS/m.

The B horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is clay or silty clay. In some pedons it has thin, discontinuous layers of brown to olive material that has a texture of silt loam. Electrical conductivity ranges from 8 to 16 dS/m, and the horizon is moderately affected by salinity.

The BC horizon has hue of 7.5YR or 10YR, value of 2 to 5, and chroma of 1 to 4. It is clay or silty clay. In some pedons it has thin, discontinuous layers of brown to olive clay loam to fine sandy loam. Electrical conductivity ranges from 8 to more than 32 dS/m, and the horizon is moderately to strongly affected by salinity.

## Blakeney Series

The Blakeney series consists of well drained soils that are very shallow or shallow over a petrocalcic horizon. These soils are moderately rapidly permeable over the very slowly permeable petrocalcic horizon. They formed in calcareous loamy materials. They are nearly level and gently undulating and are on upland ridges and divides. Slopes are linear to convex and range from 0 to 5 percent. These soils are loamy, mixed, thermic, shallow Ustollic Paleorthids.

Typical pedon of Blakeney fine sandy loam, in an area of Kinco-Blakeney complex, nearly level, in Winkler County; from the junction of Texas Highway 115 and Farm Road 1232 in Wink, 1.5 miles northwest on Farm Road 1232, west 7.9 miles on County Road 201, and 30 feet north in range:

A—0 to 8 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, very friable; common fine and medium roots; 5 percent calcium carbonate fragments; slightly effervescent; slightly alkaline; clear smooth boundary.

Bw—8 to 19 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; soft, very friable; common fine roots; 5 percent calcium carbonate fragments; strongly effervescent; slightly alkaline; abrupt wavy boundary.

Bkm—19 to 26 inches; white, indurated calcium carbonate that is laminar in the upper 1/2 inch and strongly cemented below; abrupt wavy boundary.

BCk—26 to 80 inches; pinkish white carbonatic soil material that has a texture of fine sandy loam; 20 percent weakly cemented fragments of calcium carbonate; massive; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to a petrocalcic horizon range from 7 to 20 inches. The solum is fine sandy loam, loam, or cobbly fine sandy loam. The content of clay in the solum ranges from 8 to 18 percent. The content of coarse fragments above the petrocalcic horizon ranges from 5 to 20 percent.

The A and Bw horizons have hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 6.

The Bkm horizon is laminar in the upper 0.5 inch to 2 inches and is strongly cemented and massive in the lower part.

The BCk horizon is loamy calcareous materials with weakly cemented fragments of calcium carbonate.

## Chamberino Series

The Chamberino series consists of deep, well drained, moderately permeable soils underlain by moderately slowly permeable bedrock. These soils formed in loamy and gravelly alluvium from mixed sources. They are undulating and rolling and are on the side slopes of dissected ridges adjacent to the flood plain along the Pecos River. Slopes are linear to convex and range from 5 to 15 percent. These soils are loamy-skeletal, mixed, thermic Typic Calciorthids.

Typical pedon of Chamberino gravelly fine sandy loam, in an area of Chamberino-Delnorte association, rolling, in Loving County; from the junction of U.S. Highway 285 and Texas Highway 652 in Orla, 2.7 miles north on U.S. Highway 285, east 2.7 miles to Red Bluff Reservoir, 1.75 miles east across the Red Bluff Reservoir dam, 1.5 miles northeast on a gravel road, 4.4 miles east on a gravel road, 2.7 miles south on a gravel road, 0.45 mile northeast on an oil-field dirt road, 0.15 mile south on an oil-field road to an oil well, on a vertical cut south of the oil-well pad:

A—0 to 4 inches; light yellowish brown (10YR 6/4) gravelly fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak fine granular structure; soft, very friable; common fine and medium roots; 20 percent igneous and sedimentary pebbles; surface covered with 85 percent gravel and cobbles of mixed mineralogy; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk1—4 to 14 inches; light brown (7.5YR 6/4) very gravelly fine sandy loam, brown (7.5YR 5/4) moist; weak fine granular structure; soft, very friable; common fine and medium and few coarse roots matted around rock fragments; rock fragments partially cemented with calcium carbonate; distinct pinkish white (7.5YR 8/2) calcium carbonate coatings on faces of peds; common fine and medium irregular masses of calcium carbonate; 40 percent igneous and sedimentary pebbles and 5 percent igneous and sedimentary cobbles; violently effervescent; moderately alkaline; clear smooth boundary.

Bk2—14 to 41 inches; pink (7.5YR 7/4) very gravelly loam, light brown (7.5YR 6/4) moist; weak fine and medium subangular blocky structure parting to weak fine granular; soft, friable; common fine and medium and few coarse roots; few distinct pinkish white (7.5YR 8/2) calcium carbonate coatings; common fine rounded calcium carbonate concretions; 35 percent igneous and sedimentary pebbles and 5 percent igneous and sedimentary cobbles; violently effervescent; moderately alkaline; clear wavy boundary.

2BCk—41 to 57 inches; light brown (7.5YR 6/4) gravelly loam, brown (7.5YR 5/4) moist; weak fine and medium subangular blocky structure; soft, friable; common fine and medium roots; few fine dendritic calcium carbonate threads; 20 percent igneous and sedimentary pebbles; strongly effervescent; moderately alkaline; clear smooth boundary.

2Cr—57 to 80 inches; red (2.5YR 5/6) stratified thin layers of sandstone and siltstone and soft weathered materials that have a texture of silt loam, red (2.5YR 4/6) moist; common fine and medium roots; soft weathered material is noncalcareous and has few fine dendritic carbonate threads along fractures; strongly effervescent; moderately alkaline.

The depth to a calcic horizon ranges from 4 to 30 inches. The depth to the Cr horizon ranges from 40 to 60 inches.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 2 to 4. It is gravelly or very gravelly fine sandy loam or loam.

The Bk horizon has hue of 7.5YR or 10YR, value of

6 to 8, and chroma of 2 to 4. It is very gravelly fine sandy loam or loam. The content of clay ranges from 17 to 27 percent clay. The content of coarse fragments ranges from 35 to 75 percent. In some pedons it is weakly cemented to moderately cemented with calcium carbonate, but it is not continuous or indurated enough to be petrocalcic.

The 2BCk horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. It is fine sandy loam, loam, gravelly fine sandy loam, or gravelly loam.

The 2Cr horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 8. It is stratified layers of unweathered sandstone and siltstone and weathered soil materials having a texture of silt loam.

The Chamberino soils in this survey area are outside the range in characteristics of the series because the depth to bedrock is less than 60 inches. This difference does not significantly affect use and management.

## Conger Series

The Conger series consists of well drained soils that are very shallow and shallow over a petrocalcic horizon. These soils are moderately permeable over the very slowly permeable petrocalcic horizon. They formed in calcareous loamy materials. They are gently undulating and are on upland plains. Slopes are linear to concave and range from 1 to 5 percent. These soils are loamy, mixed, thermic, shallow Ustollic Paleorthids.

Typical pedon of Conger sandy clay loam, in an area of Blakeney-Conger complex, gently undulating, in Winkler County; from the Andrews-Winkler County line on Farm Road 1218, south 3,000 feet on Farm Road 1218, east 2,300 feet in range:

A—0 to 4 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, very friable; many fine roots; 5 percent calcium carbonate fragments, mostly less than 3/4 inch in diameter; strongly effervescent; moderately alkaline; clear smooth boundary.

Bw—4 to 18 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable; common fine roots; 10 percent calcium carbonate fragments, mostly less than 3/4 inch in diameter; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Bkm—18 to 24 inches; white (10YR 8/2), indurated calcium carbonate with a 1/2-inch-thick laminar cap; abrupt wavy boundary.

BCk—24 to 80 inches; white (10YR 8/2) carbonatic soil material that has a texture of gravelly loam; massive; 30 percent strongly cemented fragments of calcium carbonate; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to a petrocalcic horizon range from 8 to 20 inches. The content of clay in the control section ranges from 18 to 35 percent.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 or 3. Where the moist value is 3, the A horizon is less than 7 inches thick. The texture is loam or sandy clay loam.

The Bw horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 to 4. It is loam or sandy clay loam. The solum contains from 0 to 10 percent strongly cemented fragments of calcium carbonate and in some pedons qualifies as a Bk horizon.

The Bkm horizon has cemented plates that are 1 to 4 inches in thickness and is laminar in the upper 1/2 inch to 2 inches. This horizon is indurated or strongly cemented.

The BCk horizon is white, pink, or pinkish white carbonatic soil material that is weakly to strongly cemented with calcium carbonate.

## Coyanosa Series

The Coyanosa series consists of well drained soils that are very shallow and shallow over sandstone bedrock. These soils are moderately permeable over the moderately slowly permeable sandstone bedrock. They formed in colluvium and residuum weathered from sandstone bedrock. They are moderately sloping to steep and are on upland knolls, hills, and ridges. Slopes are convex and range from 5 to 45 percent.

The soils of the Coyanosa series are loamy-skeletal, mixed, nonacid, thermic Lithic Ustic Torriorthents. However, the Coyanosa soils in this survey area are taxadjuncts to the series because the mineralogy class is mixed (calcareous). This difference does not significantly affect use and management.

Typical pedon of Coyanosa very gravelly loam, in an area of Coyanosa-Los Tanos complex, undulating, in Loving County; from the junction of Texas Highway 302 and County Road 1933 in Mentone, 0.75 mile north on County Road 1933, northeast 12.6 miles on an oil-field gravel road, 1.8 miles east on a gravel road, 100 feet south of an intersection, 200 feet east of the road in range:

A—0 to 5 inches; brown (7.5YR 5/4) very gravelly loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure parting to weak fine granular; soft, friable; common fine and medium

roots; distinct patchy calcium carbonate coatings on rock fragments; 45 percent sandstone pebbles; surface covered with 70 percent fragments, mostly sandstone and a few calcium carbonate fragments that are less than 3/4 inch in diameter; strongly effervescent; mildly alkaline; abrupt wavy boundary.

R/A—5 to 8 inches; 90 percent fractured sandstone bedrock and 10 percent material from the A horizon filling the cracks; thin patchy calcium carbonate coatings on fracture faces; common fine and medium roots in cracks; abrupt smooth boundary.

R—8 to 16 inches; light reddish brown (2.5YR 6/4) unweathered sandstone bedrock.

The thickness of the solum and the depth to sandstone bedrock range from 4 to 14 inches.

The A horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 2 to 4. It is very gravelly sandy loam, fine sandy loam, or loam. The content of clay ranges from 15 to 25 percent, and the content of coarse fragments ranges from 35 to 60 percent.

## Delnorte Series

The Delnorte series consists of well drained soils that are very shallow and shallow over a petrocalcic horizon. These soils are moderately rapidly permeable over the very slowly permeable petrocalcic horizon. They formed in calcareous loamy and gravelly materials. They are nearly level to rolling and are on upland ridges. Slopes are linear to convex and range from 3 to 8 percent. These soils are loamy-skeletal, mixed, thermic, shallow Typic Paleorthids.

Typical pedon of Delnorte very gravelly loam, in an area of Chamberino-Delnorte association, rolling, in Loving County; from the junction of Texas Highway 302 and County Road 1933 in Mentone, 8.9 miles north on County Road 1933, west 10.45 miles on the north Lindley Ranch road, 0.7 mile south, 30 feet west of the road in range:

A—0 to 4 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, friable; common very fine and fine roots; 35 percent igneous, metamorphic, and sedimentary pebbles; surface covered with 80 percent coarse fragments, mostly less than 2 inches across; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk—4 to 8 inches; light brown (7.5YR 6/4) very gravelly loam, brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; soft, very friable; common very fine and fine roots; 50 percent limestone and siliceous pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

Bkm—8 to 22 inches; white (10YR 8/2), indurated calcium carbonate with a 1-centimeter-thick laminar cap; few imbedded siliceous pebbles; abrupt wavy boundary.

BCk—22 to 80 inches; white (10YR 8/2) carbonatic soil material that has a texture of fine sandy loam imbedded with 30 percent moderately cemented calcium carbonate fragments and 25 percent siliceous pebbles; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to a petrocalcic horizon range from 7 to 20 inches. The average content of coarse fragments in the control section ranges from 35 to 75 percent.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. It is very gravelly fine sandy loam or very gravelly loam. The content of clay ranges from 15 to 25 percent. The content of coarse fragments ranges from 35 to 60 percent. The fragments are mostly rounded, igneous and siliceous pebbles and cobbles.

The Bk horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. It is sandy loam or loam. The content of coarse fragments ranges from 35 to 75 percent.

The Bkm horizon has a laminar cap that ranges from 1/8 inch to 2 inches in thickness. This horizon is indurated in the upper part and strongly cemented in the lower part with alternating cemented plates. The plates range from 1 to 4 inches in thickness.

The BCk horizon has hue of 7.5YR or 10YR, value of 7 or 8, and chroma of 2 or 3. It is soft calcium carbonate imbedded with weakly to strongly cemented calcium carbonate fragments and siliceous pebbles.

## Douro Series

The Douro series consists of well drained soils that are moderately deep over a petrocalcic horizon. These soils are moderately permeable over the very slowly permeable petrocalcic horizon. They formed in eolian sediments. They are nearly level and gently sloping and are on upland plains. Slopes are linear and range from 0 to 3 percent. These soils are fine-loamy, siliceous, thermic Petrocalcic Ustollic Paleargids.

Typical pedon of Douro fine sandy loam, in an area of Faskin-Douro complex, nearly level, in Winkler County; from the junction of Texas Highways 18 and 115 in Kermit, 18.8 miles northeast on Texas Highway 115, southeast 1.3 miles to the V Ranch headquarters,

2.15 miles east on a ranch road, 100 feet north of the road in range, about 200 feet west of a pond dam:

A—0 to 5 inches; reddish brown (5YR 5/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; slightly hard, friable; common very fine and fine roots; common very fine and fine interstitial and tubular pores; slightly alkaline; clear smooth boundary.

Bt1—5 to 24 inches; reddish brown (2.5YR 4/4) sandy clay loam, dark reddish brown (2.5YR 3/4) moist; moderate medium subangular blocky structure; hard, firm; common very fine and fine roots; few very fine and fine interstitial and tubular pores; distinct patchy clay films on faces of peds; neutral; clear smooth boundary.

Bt2—24 to 38 inches; red (2.5YR 4/6) sandy clay loam, dark red (2.5YR 3/6) moist; moderate medium subangular blocky structure; hard, firm; few very fine and fine roots; distinct patchy clay films on faces of peds; neutral; abrupt smooth boundary.

Bkm—38 to 50 inches; pink (7.5YR 8/4), indurated and strongly cemented calcium carbonate that is laminar in the upper 1/2 to 3/4 inch; violently effervescent; abrupt smooth boundary.

BCk—50 to 80 inches; pink (7.5YR 8/4) carbonatic soil material that has a texture of gravelly loam, pink (7.5YR 7/4) moist; 25 percent weakly cemented to moderately cemented calcium carbonate fragments; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to a petrocalcic horizon range from 20 to 40 inches. The average content of clay in the control section ranges from 18 to 35 percent.

The A horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 3 or 4. It is loamy fine sand or fine sandy loam. Reaction is neutral or slightly alkaline.

The Bt horizon has hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 4 to 6. It is sandy clay loam or clay loam. Reaction ranges from neutral to moderately alkaline. In some pedons the lower part of the horizon is calcareous and contains a few calcium carbonate pebbles.

The Bkm horizon is indurated calcium carbonate that is laminar in the upper 1/2 inch to 3 inches.

The BCk horizon is loamy carbonatic soil materials that contain 25 to 60 percent weakly to strongly cemented calcium carbonate fragments.

## Elgee Series

The Elgee series consists of very deep, well drained, moderately rapidly permeable soils that formed in sandy eolian materials (fig. 10). These nearly level and gently undulating soils are on upland plains. Slopes are linear to convex and range from 0 to 5 percent. These soils are sandy, siliceous, thermic Arenic Ustalfic Haplargids.

Typical pedon of Elgee fine sand, in an area of Elgee-Penwell complex, gently undulating, in Winkler County; from the junction of Texas Highways 115 and 18 in Kermit, 4.25 miles north on Texas Highway 18, west 1.0 mile on an oiled road, 0.15 mile north on a caliche road, 60 feet east in range:

A—0 to 19 inches; yellowish red (5YR 5/6) fine sand, yellowish red (5YR 4/6) moist; single grain; loose; common very fine and fine and few medium and coarse roots; slightly effervescent; neutral; gradual smooth boundary.

E1—19 to 52 inches; yellowish red (5YR 5/6) fine sand, yellowish red (5YR 4/6) moist; single grain; loose; few fine, medium, and coarse roots; neutral; gradual smooth boundary.

E2—52 to 62 inches; yellowish red (5YR 5/6) fine sand, yellowish red (5YR 4/6) moist; single grain; loose; few fine and medium roots; neutral; abrupt smooth boundary.

Bt1—62 to 72 inches; red (2.5YR 5/6) loamy fine sand, red (2.5YR 4/6) moist; moderate coarse subangular blocky structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable; few very fine and medium roots; few fine and medium discontinuous tubular pores; common distinct clay films on faces of peds and bridging sand grains; neutral; clear smooth boundary.

Bt2—72 to 80 inches; red (2.5YR 5/6) loamy fine sand, red (2.5YR 4/6) moist; moderate coarse subangular blocky structure parting to moderate medium and coarse subangular blocky; slightly hard, very friable; few medium and coarse roots; few very fine and fine discontinuous tubular pores; few faint discontinuous clay films on faces of peds, lining pores, and bridging sand grains; neutral.

The solum is more than 80 inches thick. Reaction is neutral or slightly alkaline. The depth to an argillic horizon ranges from 40 to 75 inches. Some pedons have a layer of indurated calcium carbonate below a depth of 60 inches.

The A and E horizons have hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 4 to 8. They are fine sand or loamy fine sand. The content of clay ranges from 1 to 7 percent. The combined thickness of the A and E horizons ranges from 40 to 75 inches.

The Bt horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 4 to 8. It is loamy fine sand or fine sandy loam. The content of clay ranges from 8 to 15 percent.

The C or BCk horizon, where present, has hue of 5YR or 7.5YR, value of 6 to 8, and chroma of 3 to 8. The texture is loamy fine sand or fine sand.

## Faskin Series

The Faskin series consists of very deep, well drained, moderately permeable soils that formed in loamy eolian sediments. These nearly level to very gently sloping soils are on upland plains. Slopes are linear to convex and range from 0 to 3 percent. These soils are fine-loamy, siliceous, thermic Ustollic Haplargids.

Typical pedon of Faskin fine sandy loam, in an area of Faskin-Douro complex, nearly level, in Winkler County; from the junction of Texas Highways 18 and 115 in Kermit, 18.8 miles northeast on Texas Highway 115, southeast 1.2 miles on the V Ranch headquarters road, 0.7 mile south on a ranch road, 100 feet west of the road in range:

A—0 to 10 inches; reddish brown (5YR 4/4) fine sandy loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; slightly hard, friable; common very fine and fine roots; common very fine and fine interstitial and tubular pores; neutral; clear smooth boundary.

Bt1—10 to 26 inches; reddish brown (2.5YR 4/4) sandy clay loam, dark reddish brown (2.5YR 3/4) moist; weak medium subangular blocky structure; hard, firm; common very fine and fine roots; few very fine and fine interstitial and tubular pores; distinct patchy clay films on faces of peds; slightly alkaline; clear smooth boundary.

Bt2—26 to 42 inches; red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) moist; moderate medium subangular blocky structure; hard, firm; few very fine and fine roots; distinct continuous clay films on faces of peds; slightly alkaline; clear smooth boundary.

Btk—42 to 62 inches; red (2.5YR 5/6) sandy clay loam, red (2.5YR 4/6) moist; weak medium subangular blocky structure; hard, firm; faint patchy clay films on faces of peds; 10 percent masses of calcium carbonate; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bkm—62 to 70 inches; pink (7.5YR 7/4), indurated calcium carbonate that is laminar in the upper 1/4 to 3/4 inch, pink (7.5YR 8/4) moist; violently effervescent.

The solum is more than 60 inches thick. The upper 20 inches of the Bt horizon is loam, sandy clay loam, or clay loam. The content of clay in the upper 20 inches of the Bt horizon ranges from 20 to 35 percent. The depth to a calcic horizon ranges from 40 to 60 inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It is loamy fine sand or fine sandy loam. Reaction is neutral or slightly alkaline.

The Bt1 and Bt2 horizons have hue of 2.5YR or 5YR, value of 4 or 5, and chroma of 3 to 6. They are loam, sandy clay loam, or clay loam. The content of clay ranges from 20 to 35 percent. Reaction is slightly alkaline or moderately alkaline.

The Btk horizon has hue of 2.5YR or 5YR and value and chroma of 4 to 6. It is loam, sandy clay loam, and clay loam. Masses of calcium carbonate make up 10 to 30 percent of the horizon.

The Bkm horizon, where present, has hue of 7.5YR or 10YR, value of 6 to 8, and chroma of 2 to 6. It is strongly cemented to indurated calcium carbonate. In most pedons it has a 1/4- to 3/4-inch-thick laminar cap. This horizon is below a depth of 60 inches.

## Harkey Series

The Harkey series consists of very deep, well drained, moderately permeable soils that formed in calcareous, loamy alluvium. These nearly level soils are on the flood plain along the Pecos River. Slopes are linear and are 0 to 1 percent. These soils are coarse-silty, mixed (calcareous), thermic Typic Torrifluvents.

Typical pedon of Harkey loam, in an area of Harkey-Patrole association, occasionally flooded, in Loving County; from the junction of Texas Highway 302 and County Road 1933 in Mentone, 6.6 miles north on County Road 1933, west 4.2 miles to Lindley Ranch headquarters, 2.0 miles southwest on an unpaved ranch road to a pipeline road, 0.9 mile west on the pipeline road, 2.6 miles southwest on an unpaved road, 1.9 miles west on an unpaved road to corrals, 50 feet east in range, 400 feet from the channel of the Pecos River:

A—0 to 8 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable; common very fine and fine roots; common very fine interstitial and tubular pores; strongly effervescent; slightly alkaline; clear smooth boundary.

C1—8 to 22 inches; light brown (7.5YR 6/4) silt loam, brown (7.5YR 4/4) moist; massive; soft, very friable; common very fine and fine roots; common very fine interstitial and tubular pores; strongly effervescent; slightly alkaline; clear smooth boundary.

C2—22 to 34 inches; light brown (7.5YR 6/4) silt loam, brown (7.5YR 4/4) moist; few fine faint strong brown (7.5YR 5/6) and few fine distinct brown (10YR 4/3) redoximorphic features; massive; soft,

very friable; few very fine and fine roots; stratified; evidence of bedding planes; strongly effervescent; slightly alkaline; clear smooth boundary.

C3—34 to 42 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 4/4) moist; massive; soft, very friable; few very fine and fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.

C4—42 to 56 inches; light brown (7.5YR 6/4) very fine sandy loam, brown (7.5YR 4/4) moist; massive; soft, very friable; strongly effervescent; moderately alkaline; clear smooth boundary.

C5—56 to 60 inches; light brown (7.5YR 6/4) silt loam, brown (7.5YR 4/4) moist; common fine distinct strong brown (7.5YR 5/6) and common medium distinct dark grayish brown (10YR 4/2) redoximorphic features; massive; soft, very friable; common small masses of salts; few fine irregular masses of gypsum; strongly effervescent; moderately alkaline.

Electrical conductivity ranges from 2 to 16 dS/m. The depth to the seasonal high water table ranges from 4 to 6 feet. The soil is calcareous throughout. Reaction is slightly alkaline or moderately alkaline.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 or 4. It is very fine sandy loam, loam, or silt loam.

The C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 or 4. It is very fine sandy loam, loam, or silt loam.

## Holloman Series

The Holloman series consists of very shallow and shallow, well drained, moderately permeable soils. These soils are underlain by moderately slowly permeable gypsum bedrock. They formed in loamy, calcareous, and gypsiferous sediments. These nearly level and gently undulating soils are on upland plains and knolls. Slopes range from 0 to 5 percent. These soils are loamy, gypsic, thermic, shallow Typic Torriorthents.

Typical pedon of Holloman loam, in an area of Holloman-Monahans complex, gently undulating, in Loving County; from the junction of U.S. Highway 285 and Texas Highway 652 in Orla, 2.7 miles north on U.S. Highway 285, east 2.7 miles to Red Bluff Reservoir, 1.75 miles east across the Red Bluff Reservoir dam, 5.05 miles north-northwest on a caliche road, 900 feet east in range, about 200 feet southeast of a windmill:

A—0 to 2 inches; light brown (7.5YR 6/4) loam, strong brown (7.5YR 4/6) moist; weak thin platy structure parting to weak fine subangular blocky; slightly hard, very friable; few fine and medium roots throughout; few mixed waterworn pebbles on surface; strongly effervescent; slightly alkaline; abrupt wavy boundary.

Cky—2 to 8 inches; light gray (10YR 7/2) gypsiferous soil material that has a texture of loam, light brownish gray (10YR 6/2) moist; massive; hard, firm; strongly effervescent; slightly alkaline; abrupt wavy boundary.

Cry1—8 to 34 inches; light gray (10YR 7/2) gypsum materials, light brownish gray (10YR 6/2) moist; massive; stratified 2- to 6-inch-thick layers of hard gypsum having a hardness of less than 3 on Mohs' scale and 2- to 16-inch-thick layers of soft gypsum; strongly effervescent; slightly alkaline; abrupt wavy boundary.

Cry2—34 to 60 inches; light gray (10YR 7/2) gypsum materials, light brownish gray (10YR 6/2) moist; massive; stratified 2- to 8-inch-thick hard gypsum (alabaster) having a hardness of less than 3 on Mohs' scale and soft white (10YR 8/2) and pink (7.5YR 8/4), 2- to 12-inch-thick layers of gypsum; strongly effervescent; slightly alkaline.

The depth to hard gypsum is less than 20 inches.

The A horizon has hue of 5YR to 10YR, value of 5 to 7, and chroma of 2 to 4. It is fine sandy loam, loam, or silt loam.

The C horizon has hue of 5YR to 10YR, value of 6 or 7, and chroma of 2 to 4. It is gypsiferous soil material that has a texture of fine sandy loam, loam, or silt loam.

The Cr layer has hue of 7.5YR or 10YR, value of 6 or 7, and chroma of 2 to 4. It is stratified hard, massive gypsum and soft gypsiferous materials.

## Kimbrough Series

The Kimbrough series consists of well drained soils that are very shallow and shallow over a petrocalcic horizon. These soils are moderately permeable over the very slowly permeable petrocalcic horizon. They formed in loamy eolian sediments. They are nearly level and gently sloping and are on upland plains. Slopes range from 0 to 3 percent. These soils are loamy, mixed, thermic, shallow Petrocalcic Calciustolls.

Typical pedon of Kimbrough fine sandy loam, in an area of Kimbrough-Stegall complex, nearly level, in Winkler County; from Notrees, 0.2 mile east on Texas Highway 302, northwest 8.1 miles on a county road, 1.4 miles west-southwest on a ranch road, 50 feet north of the road in range:

A—0 to 4 inches; brown (7.5YR 4/2) fine sandy loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable; common very fine and fine roots; 10 percent calcium carbonate pebbles; slightly effervescent; slightly alkaline; clear smooth boundary.

Bw—4 to 16 inches; brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, friable; common very fine and fine roots; 10 percent calcium carbonate pebbles; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bkm—16 to 27 inches; white (7.5YR 8/1), indurated calcium carbonate that is laminar in the upper 1/4 to 1/2 inch; abrupt wavy boundary.

BCk—27 to 80 inches; pinkish gray (7.5YR 7/2), soft carbonatic soil materials having 30 percent weakly cemented calcium carbonate fragments; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to a petrocalcic horizon range from 4 to 16 inches.

The A horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4. It is fine sandy loam, loam, or gravelly loam.

The Bw horizon has hue of 7.5YR or 10YR, value of 3 or 4, and chroma of 2 to 4. It is loam or gravelly loam.

The Bkm horizon has hue of 7.5YR or 10YR, value of 6 to 8, and chroma of 2 to 4. It consists of indurated plates of calcium carbonate and has a 1/4- to 3/4-inch-thick laminar cap.

The BCk horizon has hue of 7.5YR or 10YR, value of 7 or 8, and chroma of 1 to 3. It consists of soft carbonatic soil materials and is 25 to 60 percent weakly cemented to moderately cemented fragments of calcium carbonate.

## Kinco Series

The Kinco series consists of very deep, well drained, moderately rapidly permeable soils that formed in calcareous loamy materials of eolian and alluvial origins. These nearly level to very gently sloping soils are on upland plains and footslopes of escarpments and ridges. Slopes range from 0 to 3 percent. These soils are coarse-loamy, mixed, thermic Ustochreptic Calciorthids.

Typical pedon of Kinco fine sandy loam, in an area of Kinco-Blakeney complex, nearly level, in Winkler County; from the junction of Texas Highway 115 and County Road 1232 in Wink, 1.5 miles northwest on Farm Road 1232, southwest 7.4 miles on County Road 201, north 50 feet in range:

A—0 to 8 inches; brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; common fine and medium roots; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bw—8 to 30 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable; common fine and medium roots; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk1—30 to 46 inches; pink (7.5YR 7/4) fine sandy loam, light brown (7.5YR 6/4) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable; few fine and medium roots; 10 percent fine and medium irregular masses of calcium carbonate and 10 percent fine and medium rounded calcium carbonate concretions; violently effervescent; moderately alkaline; clear smooth boundary.

Bk2—46 to 60 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable; 10 percent fine and medium irregular masses of calcium carbonate and 5 percent fine and medium rounded concretions of calcium carbonate; violently effervescent; moderately alkaline.

The solum is more than 60 inches thick. The depth to a calcic horizon ranges from 24 to 40 inches. The soil is calcareous throughout. The content of coarse fragments ranges from 0 to 10 percent. The fragments are igneous, limestone, and calcium carbonate pebbles. The average content of clay in the control section ranges from 10 to 18 percent. Some pedons have a thin mantle of eolian sand on the surface.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 or 4. It is loamy fine sand or fine sandy loam.

The Bw horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 3 or 4. It is fine sandy loam or loam. Secondary carbonates range from few in number to about 10 percent of the horizon.

The Bk horizon has hue of 5YR or 7.5YR, value of 6 to 8, and chroma of 2 to 6. It is fine sandy loam or loam. The content of calcium carbonate ranges from 15 to 60 percent. The calcium carbonate is in the form of masses, threads, and weakly cemented concretions.

The BCk horizon, where present, has hue of 5YR or 7.5YR, value of 6 to 8, and chroma of 2 to 6. It is loamy fine sand, fine sandy loam, or loam. The content of calcium carbonate is at least 5 percent less than that of the Bk horizon.

## Los Tanos Series

The Los Tanos series consists of well drained soils that are moderately deep over sandstone bedrock. These soils are moderately rapidly permeable over the very slowly permeable sandstone bedrock. They formed in loamy sediments from weathered sandstone. They are nearly level and undulating and are on upland knolls, ridges, and mesas. Slopes range from 0 to 8 percent. These soils are coarse-loamy, mixed, thermic Ustollic Camborthids.

Typical pedon of Los Tanos fine sandy loam, in an area of Coyanosa-Los Tanos complex, undulating, in Loving County; from the junction of Texas Highway 302 and County Road 1933 in Mentone, 0.6 mile northeast on County Road 1933, northeast 9.4 miles on a gravel ranch road, 4.6 miles east-northeast on a gravel ranch road to an intersection with a pipeline road, 2,800 feet east on the pipeline road, 400 feet south along the base of a sandstone outcrop in range:

A—0 to 8 inches; brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; weak thin platy structure parting to weak fine and medium subangular blocky and fine granular; slightly hard, very friable; common fine and medium roots; few fine rounded calcium carbonate nodules; 2 percent sandstone and limestone pebbles; 1 percent sandstone and limestone cobbles; surface covered with 20 percent sandstone and limestone fragments; slightly effervescent; slightly alkaline; abrupt smooth boundary.

Bw—8 to 25 inches; brown (7.5YR 5/4) fine sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable; few fine and medium roots; few fine rounded nodules of calcium carbonate; 2 percent sandstone and limestone pebbles; 1 percent sandstone and limestone cobbles; slightly effervescent; slightly alkaline; gradual smooth boundary.

BC—25 to 30 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable; few fine rounded nodules of calcium carbonate; 5 percent sandstone and limestone pebbles; 2 percent sandstone and limestone cobbles; slightly effervescent; slightly alkaline; abrupt wavy boundary.

R—30 to 50 inches; unweathered, coarsely fractured sandstone bedrock.

The thickness of the solum and the depth to sandstone bedrock range from 20 to 40 inches.

The A horizon has hue of 5YR to 10YR, value of 5 or 6, and chroma of 2 to 4. It is fine sandy loam or loam.

The Bw horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 3 or 4. It is fine sandy loam or loam. The content of clay is less than 18 percent.

The BC horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 3 or 4. It is sandy loam or fine sandy loam. The content of coarse fragments ranges from 5 to 30 percent. Where present, calcium carbonate pendants on the fragments can be thick.

## Mentone Series

The Mentone series consists of very deep, well drained, moderately slowly permeable soils that formed in loamy alluvial materials (fig. 11). These nearly level soils are in slightly depressional playas. Slopes are 0 to 1 percent. These soils are fine-silty, mixed, thermic Torrifluventic Haplustolls.

Typical pedon of Mentone silty clay loam, in an area of Tencee-Mentone complex, gently undulating, in Loving County; from the junction of Texas Highway 302 and County Road 1933 in Mentone, 6.2 miles northwest on County Road 1933, northeast 3.1 miles on a road to Slash Ranch headquarters, 0.9 mile southeast on a dirt ranch road, 200 feet northeast in a playa:

A1—0 to 5 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure parting to moderate fine and medium angular blocky; hard, friable; common very fine and fine roots; common very fine and fine interstitial pores; slightly alkaline; clear smooth boundary.

A2—5 to 13 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse angular and subangular blocky structure; very hard, firm; common very fine and fine roots; common very fine and fine interstitial and tubular pores; faint silt coatings lining pores; neutral; gradual smooth boundary.

Bw1—13 to 27 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse prismatic structure parting to moderate medium and coarse angular blocky; very hard, firm; common very fine and fine roots; common very fine and fine interstitial and tubular pores; faint silt coatings lining pores; slightly alkaline; gradual smooth boundary.

Bw2—27 to 40 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate coarse

prismatic structure parting to moderate medium and coarse angular blocky; very hard, firm; common very fine and fine roots; common very fine and fine interstitial and tubular pores; common faint silt and organic coatings on faces of peds and lining pores; neutral; gradual smooth boundary.

Bw3—40 to 47 inches; yellowish brown (10YR 5/4) loam, dark brown (10YR 4/3) moist; weak medium and coarse subangular blocky structure; slightly hard, firm; common very fine and fine roots; common very fine and fine interstitial and tubular pores; few organic coatings in root channels and on faces of peds; neutral; abrupt smooth boundary.

Bwb1—47 to 64 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium and coarse prismatic structure parting to moderate medium and coarse angular blocky; common very fine and fine roots; common very fine and fine interstitial and tubular pores; common organic coatings in root channels and on faces of peds; slightly alkaline; gradual smooth boundary.

Bwb2—64 to 80 inches; brown (10YR 5/3) silt loam, dark yellowish brown (10YR 3/4) moist; weak coarse prismatic structure; hard, firm; common very fine and fine roots; common very fine and fine interstitial and tubular pores; common organic and silt coatings lining pores; slightly alkaline.

The thickness of the solum ranges from 60 to more than 80 inches. The mollic epipedon ranges from 10 to 20 inches in thickness. The average content of clay in the 10- to 40-inch control section ranges from 18 to 35 percent. The number of masses, films, threads, and concretions of calcium carbonate ranges from none to common below a depth of 30 inches. Reaction ranges from neutral to moderately alkaline.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 1 to 3. It is silt loam, loam, clay loam, or silty clay loam.

The Bw horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 to 4. It is loam, silt loam, clay loam, or silty clay loam.

The Bwb horizon has hue of 5YR to 10YR, value of 3 to 5, and chroma of 2 to 4. It is loam, silt loam, clay loam, or silty clay loam.

In some pedons a lithological discontinuity of contrasting colors or texture occurs at a depth of more than 40 inches.

## Monahans Series

The Monahans series consists of very deep, well drained, moderately permeable soils that formed in alluvium containing significant amounts of gypsum and calcium carbonate. These nearly level to gently sloping soils are on upland plains. Slopes range from 0 to 5 percent.

The soils of the Monahans series are coarse-loamy, mixed, thermic Calcic Gypsiorthids. However, the Monahans soils in this survey area are taxadjuncts to the series because a calcic horizon does not occur above the gypsic horizon. This difference does not significantly affect use and management.

Typical pedon of Monahans fine sandy loam, in an area of Monahans-Pajarito complex, nearly level, in Loving County; from the junction of U.S. Highway 285 and Texas Highway 652 in Orla, 2.7 miles north on U.S. Highway 285, east 2.7 miles to Red Bluff Reservoir, 1.75 miles east across the Red Bluff Reservoir dam, 1.45 miles northeast on a gravel road, 3.9 miles northwest to the junction of a dirt road that leads to a windmill, 1.55 miles east-northeast, 0.65 mile south-southeast on a dirt road, 30 feet west in range:

A1—0 to 4 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; loose, very friable; common fine and medium roots; slightly effervescent; slightly alkaline; clear smooth boundary.

A2—4 to 12 inches; light brown (7.5YR 6/4) fine sandy loam, brown (7.5YR 5/4) moist; weak fine granular structure; loose, very friable; common fine and medium roots; slightly effervescent; slightly alkaline; clear smooth boundary.

Bw—12 to 32 inches; yellowish red (5YR 5/6) sandy clay loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, very friable; common fine and medium roots; 5 percent siliceous pebbles; strongly effervescent; slightly alkaline; abrupt smooth boundary.

Bky1—32 to 40 inches; pinkish white (5YR 8/2) sandy clay loam, pink (5YR 7/4) moist; weak medium and coarse subangular blocky structure; slightly hard, friable; 5 percent gypsum; 10 percent masses and concretions of calcium carbonate; violently effervescent; moderately alkaline; clear smooth boundary.

Bky2—40 to 60 inches; pink (5YR 7/3) sandy clay loam, reddish yellow (5YR 6/6) moist; weak medium and coarse subangular blocky structure; slightly hard, friable; 5 percent gypsum; 10 percent masses and concretions of calcium carbonate; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to soil material that contains more than 5 percent gypsum, by weight, range from 16 to 36 inches. The texture of the 10- to 40-inch control section is fine sandy loam, loam,

or sandy clay loam. The content of clay in the control section ranges from 18 to about 30 percent. Reaction is slightly alkaline or moderately alkaline.

The A horizon has hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 to 4. It is fine sandy loam or loam.

The Bw horizon, where present, has hue of 5YR to 10YR, value of 5 to 7, and chroma of 3 to 6. It is fine sandy loam, loam, or sandy clay loam. It is 0 to 10 percent, by volume, siliceous pebbles.

The Bky horizon has hue of 5YR or 7.5YR, value of 6 to 8, and chroma of 2 to 6. It is loam or sandy clay loam. It contains 10 to 20 percent visible calcium carbonate and 5 to 15 percent visible gypsum crystals. The content of gypsum does not decrease with depth.

## Paisano Series

The Paisano series consists of well drained soils that are very shallow or shallow over a petrocalcic horizon. These soils are moderately rapidly permeable over the very slowly permeable petrocalcic horizon. They formed in gravelly alluvium. They are undulating to hilly and are on upland ridges and footslopes of escarpments. Slopes range from 1 to 12 percent. These soils are loamy-skeletal, carbonatic, thermic, shallow Ustollic Paleorthids.

Typical pedon of Paisano very gravelly fine sandy loam, in an area of Paisano-Rock outcrop association, hilly, in Winkler County; from Notrees, 0.2 mile east on Texas Highway 302, northwest 8.1 miles on a county road, 3.9 miles west-southwest on a ranch road, 0.55 mile south on a ranch road, 30 feet east of the road in range:

A—0 to 4 inches; brown (7.5YR 5/4) very gravelly fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; slightly hard, friable; common fine and medium roots; few fine rounded calcium carbonate concretions; 40 percent limestone and strongly cemented calcium carbonate pebbles; surface covered with 90 percent fragments of calcium carbonate, mostly less than 3/4 inch across, 3 percent up to 3 inches across; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk—4 to 10 inches; brown (7.5YR 5/4) very gravelly fine sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; slightly hard, friable; common very fine and fine roots; common fine rounded calcium carbonate concretions; 30 percent limestone and strongly cemented calcium carbonate pebbles and 10 percent cobbles; violently effervescent; moderately alkaline; abrupt smooth boundary.

Bkm—10 to 26 inches; pink (7.5YR 8/4), indurated calcium carbonate that is laminar in the upper 1/2 to 3/4 inch, pink (7.5YR 7/4) moist; many imbedded limestone pebbles; massive; violently effervescent; abrupt smooth boundary.

BCk—26 to 80 inches; pink (7.5YR 8/4) alternating layers of loamy carbonatic soil material and moderately cemented calcium carbonate plates, pink (7.5YR 7/4) moist; massive; 50 percent fragments of limestone and strongly cemented calcium carbonate; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to a petrocalcic horizon range from 7 to 14 inches. The content of coarse fragments above the petrocalcic horizon ranges from 35 to 60 percent. The coarse fragments are of mixed origin but are mostly limestone and strongly cemented calcium carbonate. The calcium carbonate equivalent in the fine-earth fraction ranges from 15 to 35 percent above the petrocalcic horizon.

The A and Bk horizons have hue of 7.5YR or 10YR, value of 5 to 7, and chroma of 2 to 4. They are very gravelly fine sandy loam or very gravelly loam and are more than 35 percent coarse fragments of limestone and strongly cemented calcium carbonate.

The Bkm horizon has hue of 7.5YR or 10YR, value of 7 or 8, and chroma of 2 to 4. Induration is continuous except for scattered cracks. A 1/4- to 1-inch-thick laminar cap is commonly on the upper surface.

The BCk horizon has hue of 7.5YR or 10YR, value of 6 to 8, and chroma of 2 to 4. The texture of the fine-earth fraction is sandy loam, loam, or sandy clay loam. The content of coarse fragments ranges from 35 to 60 percent.

## Pajarito Series

The Pajarito series consists of very deep, well drained, moderately rapidly permeable soils that formed in sandy alluvial sediments. These nearly level to gently sloping soils are on alluvial fans and upland plains. Slopes range from 0 to 5 percent. These soils are coarse-loamy, mixed, thermic Typic Camborthids.

Typical pedon of Pajarito fine sandy loam, in an area of Monahans-Pajarito complex, nearly level, in Loving County; from the junction of U.S. Highway 285 and Texas Highway 652 in Orla, 2.7 miles north on U.S. Highway 285, east 2.7 miles to Red Bluff Reservoir, 1.75 miles east across the Red Bluff reservoir dam, 1.45 miles northeast on a gravel road, 3.9 miles northwest to the junction of a road that leads to a windmill, 1.55 miles east-northeast, 0.75 mile south-southeast on a dirt road, 30 feet west in range:

**Figure 10.—A profile of Elgee fine sand. This soil has a very thick surface layer of fine sand and has a subsoil of loamy fine sand at a depth of 40 to 75 inches.**

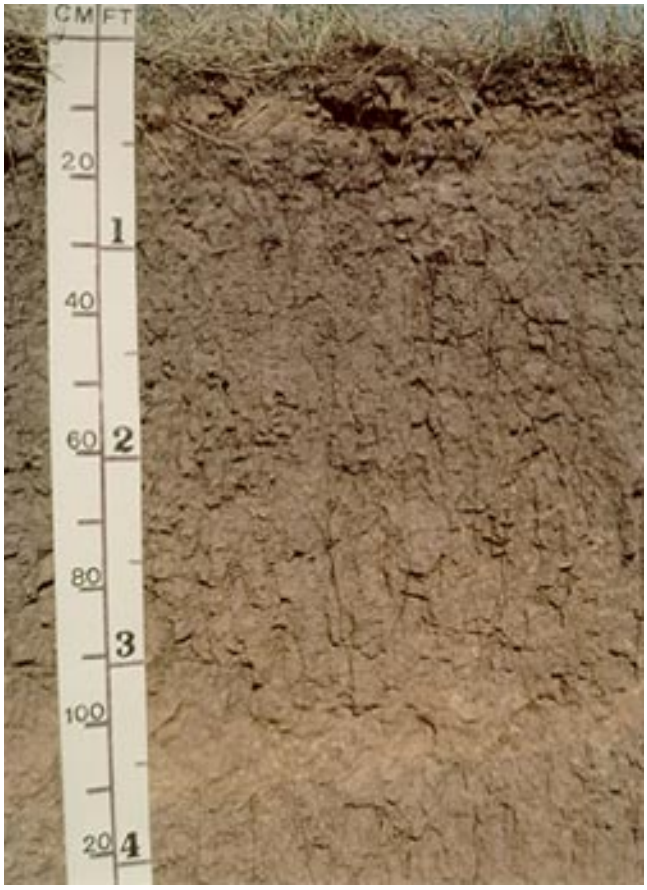


**Figure 11.—A profile of Mentone silty clay loam. This soil is very deep and formed in alluvial sediments in playas.**

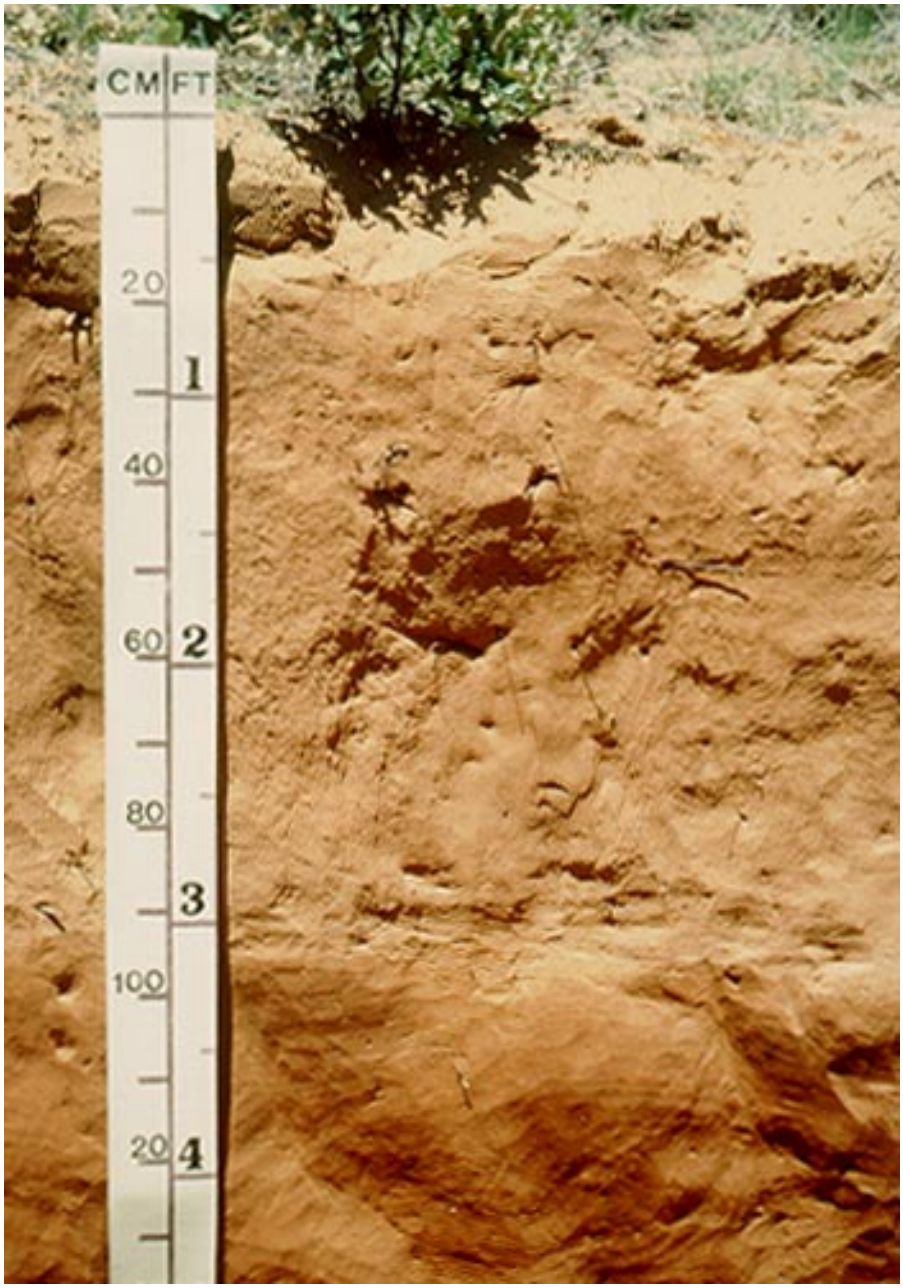


**Figure 12.—A profile of Pyote fine sand. This soil has a thick surface layer of fine sand and has a subsoil of fine sandy loam at a depth of 20 to 40 inches.**

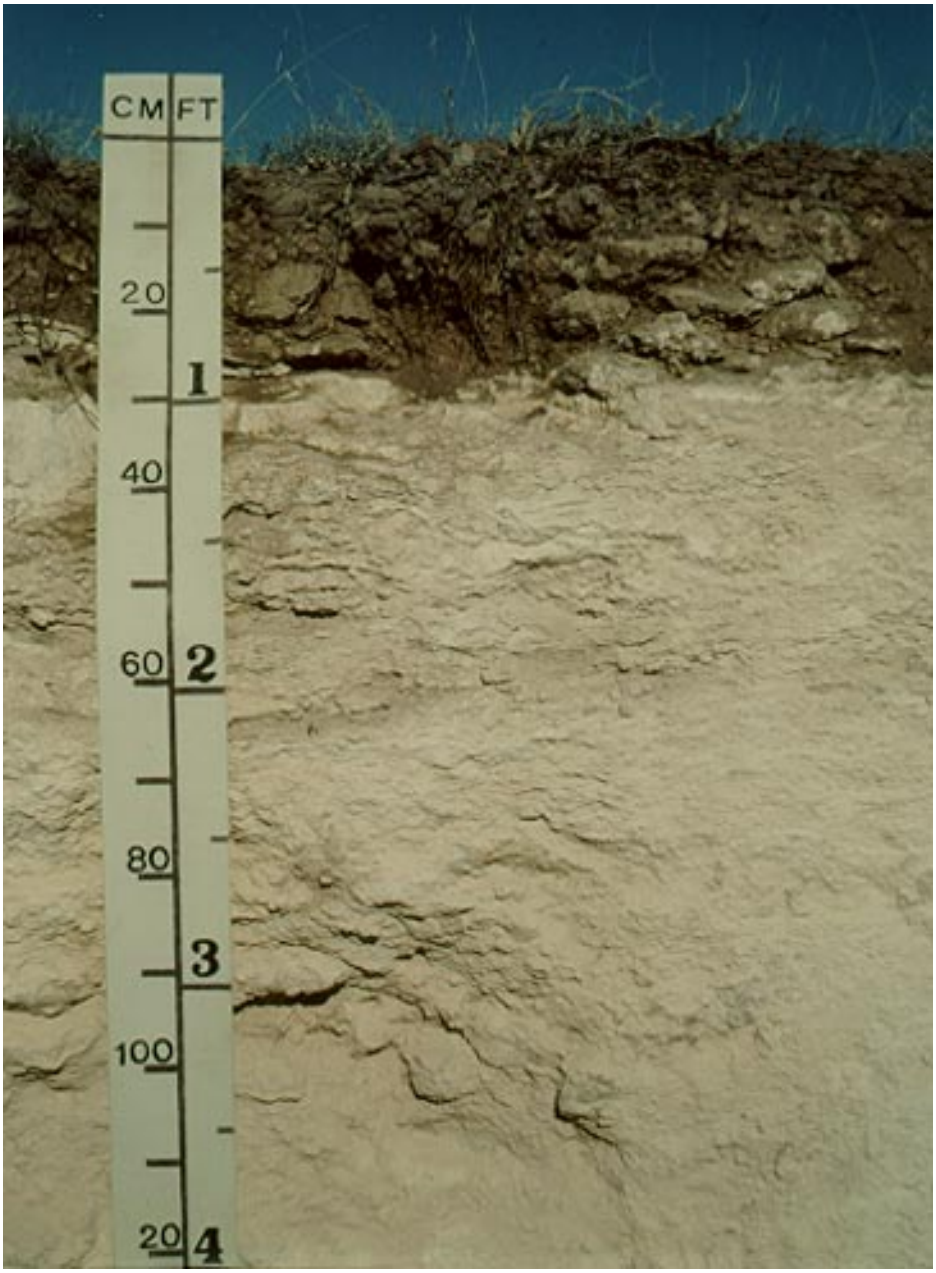


**Figure 13.—A profile of Splotter gravelly fine sandy loam. The surface layer is about 12 inches thick and is underlain by a thick bed of carbonatic soil material that is naturally cemented in the upper part.**

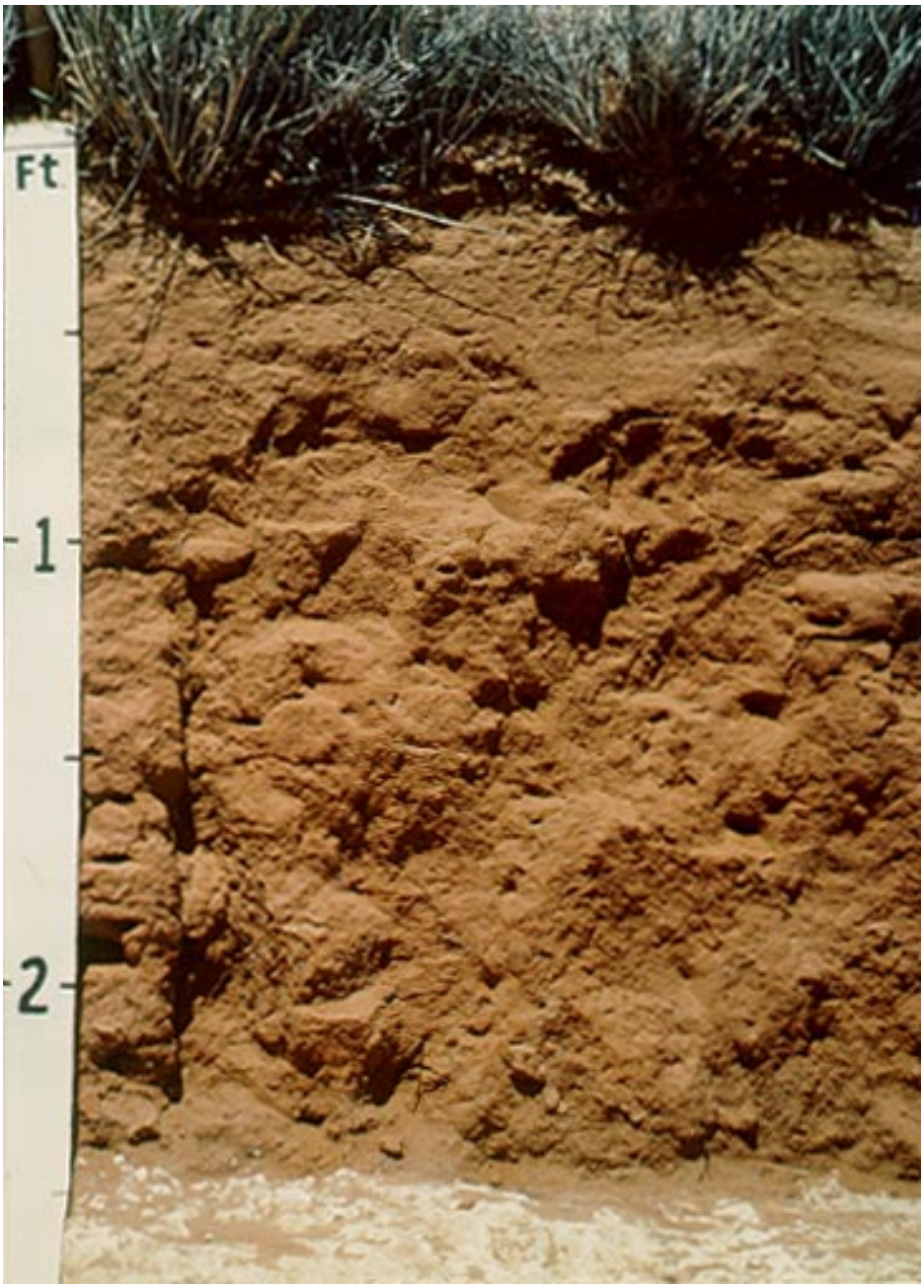


**Figure 14.—A profile of Wickett loamy fine sand. The surface layer is loamy fine sand. The subsoil is fine sandy loam and is underlain by naturally cemented caliche.**

A—0 to 4 inches; light reddish brown (5YR 6/4) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine granular structure; loose, very friable; common fine and medium roots; slightly effervescent; clear smooth boundary.

Bw1—4 to 14 inches; reddish yellow (5YR 6/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak fine granular structure; loose, very friable; common fine and medium roots; strongly effervescent; clear smooth boundary.

Bw2—14 to 30 inches; light red (2.5YR 6/6) fine sandy loam, red (2.5YR 4/6) moist; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; few fine and medium roots; strongly effervescent; clear smooth boundary.

Bw3—30 to 60 inches; light red (2.5YR 6/6) fine sandy loam, red (2.5YR 4/6) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, very friable; few fine roots; 5 percent siliceous pebbles and few calcium carbonate fragments; strongly effervescent.

The solum is more than 60 inches thick. The calcium carbonate equivalent is less than 15 percent within a depth of 40 inches. The content of coarse fragments ranges from 0 to 15 percent.

The A horizon has hue of 2.5YR to 10YR, value of 4 to 6, and chroma of 2 to 6. It is loamy fine sand or fine sandy loam.

The Bw horizon has hue of 2.5YR to 10YR, value of 4 to 6, and chroma of 2 to 6. It is loamy fine sand (more than 15 percent of the soil material is coarser than very fine sand) or fine sandy loam.

The Bk horizon, where present, has hue of 2.5YR to 10YR, value of 4 to 6, and chroma of 2 to 6.

## Patrole Series

The Patrole series consists of very deep, well drained soils that are moderately slowly permeable in the upper 28 inches and are very slowly permeable below this depth. These soils formed in stratified silty over clayey alluvium. They are nearly level and are on the flood plain along the Pecos River. Slopes are 0 to 1 percent. These soils are fine-silty over clayey, mixed (calcareous), thermic Typic Torrifluvents.

Typical pedon of Patrole silty clay loam, in an area of Pecos-Arno-Patrole association, occasionally flooded, in Loving County; from the junction of Texas Highway 302 and County Road 1933 in Mentone, 6.6 miles north on County Road 1933, northwest 2.15 miles on Lindley Ranch headquarters road, 4.0 miles south on a gravel oil-field road to an abandoned oil-well pad, 0.5 mile southwest on a dirt road, 30 feet north of the road, about 100 feet northeast of the junction of two dirt roads:

A—0 to 8 inches; light brown (7.5YR 6/4) silty clay loam, brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; slightly hard, friable; common very fine and fine roots; strongly effervescent; moderately alkaline; abrupt smooth boundary.

BCzy—8 to 28 inches; brown (7.5YR 5/4) silt loam, brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable; common very fine and fine roots; few very fine and fine interstitial and tubular pores; common fine and medium threads of gypsum and other salts; strongly effervescent; moderately alkaline; clear smooth boundary.

2BC1—28 to 50 inches; weak red (2.5YR 4/2) clay, dusky red (2.5YR 3/2) moist; common coarse prominent dark brown (7.5YR 3/2) redoximorphic features; weak coarse prismatic structure parting to weak medium and coarse angular blocky; very hard, firm; few fine and medium roots; few small pieces of charcoal; common fine and medium cylindrical gypsum crystals; strongly effervescent; moderately alkaline; abrupt smooth boundary.

3BC2—50 to 80 inches; stratified brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; weak coarse prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable; few very fine and fine roots; few fine white saline threads; few fine and medium cylindrical gypsum crystals; strongly effervescent; moderately alkaline.

The solum is more than 60 inches thick. The depth to clayey layers ranges from 20 to 36 inches. The upper part of the 10- to 40-inch control section is very fine sandy loam, loam, silt loam, or silty clay loam and has a clay content of 18 to 30 percent. The lower part of the control section is silty clay or clay and has a clay content of 40 to 60 percent.

The A horizon has hue of 5YR to 10YR, value of 4 to 6, and chroma of 2 to 4. It is very fine sandy loam, silt loam, or silty clay loam. Electrical conductivity ranges from 2 to 8 dS/m.

The BC horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 2 to 4. In some pedons it has redoximorphic features in shades of brown, gray, or olive. It is loam, silt loam, or silty clay loam. Electrical conductivity ranges from 4 to 16 dS/m.

The 2BC and 3BC horizons have hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 2 to 4. In some pedons they have redoximorphic features in shades of

brown, gray, or olive. They are clay, silty clay, or sandy clay loam. Electrical conductivity ranges from 4 to 16 dS/m.

## Pecos Series

The Pecos series consists of very deep, moderately well drained, slowly permeable soils that formed in calcareous, clayey alluvium. These nearly level soils are on the flood plain along the Pecos River. Slopes are 0 to 1 percent. These soils are fine, mixed (calcareous), thermic Vertic Torrifluvents.

Typical pedon of Pecos silty clay loam, in an area of Pecos-Arno-Patrole association, occasionally flooded, in Loving County; from the junction of Texas Highway 302 and County Road 1933 in Mentone, 6.6 miles north on County Road 1933, northwest 2.15 miles on Lindley Ranch headquarters road, 2.6 miles south on a gravel road, 2.95 miles west on a gravel road, 1.75 miles west on a ranch road, 0.15 mile south on a ranch road, 60 feet west in range:

A—0 to 4 inches; brown (7.5YR 5/3) silty clay loam, dark brown (7.5YR 3/3) moist; strong very fine subangular blocky structure parting to strong fine and medium subangular blocky; hard, firm; common very fine and fine and few medium and coarse roots between peds; common fine interstitial and tubular pores; few cracks extending through horizon; strongly effervescent; moderately alkaline; clear smooth boundary.

Bzk1—4 to 13 inches; brown (7.5YR 5/3) silty clay, dark brown (7.5YR 3/3) moist; strong medium and coarse subangular blocky structure; very hard, firm; common very fine and fine roots between peds; common fine continuous tubular pores; common fine irregular masses of calcium carbonate and other salts; few cracks extending through horizon; few fine nonintersecting slickensides; strongly effervescent; moderately alkaline; clear smooth boundary.

Bzk2—13 to 22 inches; brown (7.5YR 5/3) clay, dark brown (7.5YR 3/3) moist; strong coarse and very coarse subangular blocky structure; very hard, firm; common very fine and fine roots between peds; common fine continuous tubular pores; peds are longer on horizontal axis than vertical axis; weak bedding planes; common fine irregular masses of calcium carbonate and other salts; few cracks that are less than 1 centimeter wide extending through horizon; few fine nonintersecting slickensides; slightly effervescent; moderately alkaline; gradual smooth boundary.

Bzk3—22 to 36 inches; reddish brown (5YR 5/3) clay, dark reddish brown (5YR 3/3) moist; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; very hard, very firm; common very fine and fine roots between peds; common fine continuous tubular pores; common fine irregular masses of calcium carbonate and other salts; few cracks that are less than 1 centimeter wide extending through horizon; slightly effervescent; slightly alkaline; clear smooth boundary.

Bzk4—36 to 40 inches; reddish brown (5YR 5/3) clay, reddish brown (5YR 4/3) moist; common coarse distinct red (2.5YR 4/6) and very dark gray (10YR 3/1) redoximorphic features; moderate medium and coarse subangular blocky structure; very hard, very firm; common very fine and fine roots between peds; common very fine and fine continuous tubular pores; matrix includes many discontinuous black (10YR 2/1) organic stains and a thin wavy 1/4-inch-thick band of black (10YR 2/1) organic material; common fine irregular masses of calcium carbonate and other salts; few cracks that are less than 1 centimeter wide extending through horizon; slightly effervescent; neutral; clear smooth boundary.

Bzk5—40 to 52 inches; reddish brown (5YR 4/3) silty clay, dark reddish brown (5YR 3/3) moist; common fine distinct strong brown (7.5YR 5/6) redoximorphic features; conchoidal structure parting to moderate medium and coarse subangular blocky structure; very hard, very firm; common very fine and fine roots between peds; common very fine and fine continuous tubular pores; very few distinct continuous pressure faces; common fine and medium irregular salt masses; slightly effervescent; neutral; abrupt smooth boundary.

Bgyz—52 to 62 inches; dark gray (10YR 4/1) clay, very dark gray (10YR 3/1) moist; common coarse distinct strong brown (7.5YR 5/8) redoximorphic features; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; very hard, very firm; common very fine and fine roots between peds; common very fine and fine interstitial and tubular pores; prisms are 2 to 3 inches across on the horizontal axis; common concentrations of very fine and fine gypsum crystals; very few distinct discontinuous pressure faces; common fine and medium irregular salt masses; slightly effervescent; slightly alkaline; abrupt smooth boundary.

2BC—62 to 80 inches; pale brown (10YR 6/3) very fine sandy loam, dark yellowish brown (10YR 4/4) moist; common fine distinct reddish yellow (7.5YR 6/8) redoximorphic features; weak medium and

coarse subangular blocky structure; soft, very friable; common fine and medium continuous tubular pores; common fine irregular salt masses; strongly effervescent; slightly alkaline.

The solum is more than 60 inches thick. The depth to a contrasting textural horizon ranges from 60 to more than 100 inches. The average content of clay in the 10- to 40-inch control section ranges from 45 to 60 percent.

The A horizon has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 2 or 3. It is silty clay loam, silty clay, or clay.

The Bzk horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. It has few to many redoximorphic features in shades of olive, red, and yellow in the upper part and in shades of red, yellow, olive, and gray below a depth of 30 inches. It is silty clay or clay. It has few to many films, masses, threads, and crystals of calcium sulfate and other salts.

The Bgzy horizon, where present, has hue of 7.5YR or 10YR, value of 3 to 5, and chroma of 1 to 3. It is clay or silty clay.

The 2BC horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 8. It is very fine sandy loam, loam, or silt loam.

## Penwell Series

The Penwell series consists of very deep, excessively drained, rapidly permeable soils that formed in sandy eolian materials. These gently undulating and rolling soils are on upland plains. Slopes range from 1 to 15 percent. These soils are siliceous, thermic Ustic Torripsamments.

Typical pedon of Penwell fine sand, in an area of Pyote-Penwell complex, gently undulating, in Winkler County; from the junction of Texas Highways 115 and 18 in Kermit, 4.0 miles northeast on Texas Highway 115, north 45 feet in range:

A—0 to 14 inches; reddish brown (5YR 5/4) fine sand, reddish brown (5YR 4/4) moist; single grain; loose; few fine roots; slightly effervescent; neutral; gradual smooth boundary.

C1—14 to 50 inches; yellowish red (5YR 5/6) fine sand, yellowish red (5YR 4/6) moist; single grain; loose; few fine roots; neutral; gradual smooth boundary.

C2—50 to 80 inches; reddish yellow (5YR 6/6) fine sand, yellowish red (5YR 5/6) moist; single grain; loose; neutral.

The combined thickness of the A and C horizons is more than 80 inches. Reaction is neutral or slightly alkaline throughout.

The A horizon has hue of 5YR to 10YR, value of 5 to 8, and chroma of 3 or 4.

The C horizon has hue of 5YR to 10YR, value of 5 to 7, and chroma of 3 to 6.

## Pyote Series

The Pyote series consists of very deep, well drained, moderately rapidly permeable soils that formed in sandy and loamy sediments that have been modified by wind (fig. 12). These nearly level and gently undulating soils are on upland plains. Slopes range from 0 to 5 percent. These soils are loamy, siliceous, thermic Arenic Ustalfic Haplargids.

Typical pedon of Pyote fine sand, in an area of Pyote fine sand, gently undulating, in Winkler County; from the junction of Texas Highways 115 and 18 in Kermit, 1.25 miles north on Texas Highway 18, west 0.45 mile on an oiled road, 0.5 mile north on a caliche road, 45 feet east in range:

A—0 to 4 inches; yellowish red (5YR 5/6) fine sand, dark reddish brown (5YR 3/4) moist; single grain; loose, very friable; common fine and medium and few coarse roots; neutral; gradual smooth boundary.

E1—4 to 21 inches; yellowish red (5YR 5/6) fine sand, yellowish red (5YR 4/6) moist; single grain; loose, very friable; common fine and medium and few coarse roots; neutral; clear smooth boundary.

E2—21 to 36 inches; yellowish red (5YR 5/6) fine sand, yellowish red (5YR 4/6) moist; single grain; loose, very friable; common fine and medium and few coarse roots; slightly alkaline; abrupt smooth boundary.

Bt1—36 to 44 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure; hard, very friable; few fine and medium roots; common very fine and fine continuous tubular pores; faint patchy clay films between sand grains; slightly alkaline; gradual smooth boundary.

Bt2—44 to 55 inches; yellowish red (5YR 5/8) fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure parting to weak medium and coarse subangular blocky; hard, very friable; few fine and medium roots; common very fine and fine tubular pores; bridging between sand grains; faint patchy clay films; few black (10YR 2/1) manganese stains on surfaces of peds; common fine and medium irregular masses of iron-manganese; slightly alkaline; clear wavy boundary.

Bt3—55 to 63 inches; yellowish red (5YR 5/8) fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure parting to weak

medium and coarse subangular blocky; hard, very friable; few coarse roots; common fine continuous tubular pores; faint patchy clay bridging between sand grains; slightly alkaline; abrupt smooth boundary.

BCt—63 to 74 inches; yellowish red (5YR 5/8) fine sandy loam, yellowish red (5YR 5/6) moist; weak coarse subangular blocky structure parting to weak medium and coarse subangular blocky; hard, very friable; few medium and coarse roots; few medium continuous tubular pores; faint patchy clay bridging between sand grains; neutral; abrupt wavy boundary.

BCk—74 to 80 inches; white (10YR 8/1) gravelly fine sandy loam, light yellowish brown (10YR 6/4) moist; weak coarse subangular blocky structure; hard, friable; 20 percent caliche pebbles that are 1/4 inch to 2 inches across; violently effervescent; moderately alkaline.

The thickness of the solum ranges from 60 to more than 80 inches.

The A horizon has hue of 5YR or 7.5YR, value of 5 or 6, and chroma of 3 to 6. It is fine sand or loamy fine sand. The content of clay ranges from 1 to 12 percent. The horizon ranges from 20 to 40 inches in thickness. Reaction is neutral or slightly alkaline.

The Bt and BCt horizons have hue of 2.5YR to 7.5YR, value of 5 or 6, and chroma of 4 to 8. They are fine sandy loam that has a clay content of 8 to 18 percent. Reaction ranges from neutral to moderately alkaline.

The BCk horizon, where present, has hue of 5YR to 10YR, value of 5 to 8, and chroma of 1 to 8. It is loamy fine sand, fine sandy loam, or the gravelly analogs of those textures. The content of coarse fragments ranges from 0 to 35 percent. In some pedons the horizon is leached of calcium carbonate below a depth of 80 inches. In some pedons the horizon has an indurated layer of caliche at a depth of more than 60 inches. Reaction ranges from neutral to moderately alkaline.

## Ratliff Series

The Ratliff series consists of very deep, well drained, moderately permeable soils that formed in calcareous loamy materials. These nearly level to very gently sloping soils are on upland plains. Slopes range from 0 to 3 percent. These soils are fine-loamy, mixed, thermic Ustollic Calciorthids.

Typical pedon of Ratliff fine sandy loam, in an area of Ratliff fine sandy loam, nearly level, in Winkler County; from the Ector-Winkler County line on Texas Highway 302, west 0.2 mile on Texas Highway 302, southeast 1.60 miles on County Road 307, southwest 0.25 mile on an oil-field road, 50 feet north in range:

A—0 to 9 inches; brown (7.5YR 5/3) fine sandy loam, dark brown (7.5YR 4/3) moist; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, very friable; common fine and medium roots; strongly effervescent; moderately alkaline; clear smooth boundary.

Bw—9 to 22 inches; brown (7.5YR 5/3) sandy clay loam, dark brown (7.5YR 4/3) moist; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, friable; common fine and medium roots; few films and threads of calcium carbonate in the lower part; strongly effervescent; moderately alkaline; clear wavy boundary.

Bk1—22 to 46 inches; pink (7.5YR 7/4) sandy clay loam, light brown (7.5YR 6/4) moist; weak fine and medium subangular blocky structure; hard, firm; few fine and medium roots; 25 percent masses and concretions of calcium carbonate; violently effervescent; moderately alkaline; clear wavy boundary.

Bk2—46 to 60 inches; pink (7.5YR 7/3) sandy clay loam, light brown (7.5YR 6/3) moist; weak fine subangular blocky structure; hard, firm; 10 percent masses and concretions of calcium carbonate; violently effervescent; moderately alkaline.

The solum is more than 60 inches thick. The depth to accumulations of calcium carbonate ranges from 20 to 40 inches. The average content of clay in the 10- to 40-inch control section ranges from 20 to 35 percent.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. It is fine sandy loam or loam.

The Bw horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 3 or 4. It is loam, sandy clay loam, or clay loam.

The Bk horizon has hue of 7.5YR or 10YR, value of 6 to 8, and chroma of 2 to 6. It is loam, sandy clay loam, or clay loam. The calcium carbonate equivalent ranges from 20 to 40 percent.

## Reeves Series

The Reeves series consists of very deep, well drained, moderately permeable soils that formed in calcareous loamy alluvium derived from gypsum deposits. These nearly level to very gently sloping soils are on basin floors. Slopes range from 0 to 3 percent. These soils are fine-loamy, gypsic, thermic Calcic Gypsiorthids.

Typical pedon of Reeves loam, in an area of Holloman-Reeves complex, nearly level, in Loving County; from the junction of Texas Highway 302 and County Road 1933 in Mentone, 18.6 miles north on County Road 1933 to Kyle Ranch headquarters, 0.9 mile southwest on a ranch road, 100 feet southeast of the road in range:

A1—0 to 4 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; many very fine and fine roots; few fine pores; few fine rounded calcium carbonate concretions; strongly effervescent; moderately alkaline; clear smooth boundary.

A2—4 to 14 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; weak fine and medium subangular blocky structure; slightly hard, very friable; common fine and medium roots; few fine pores; few fine rounded calcium carbonate concretions; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk—14 to 23 inches; light yellowish brown (10YR 6/4) silt loam, yellowish brown (10YR 5/4) moist; moderate fine and medium subangular blocky structure; slightly hard, friable; few fine roots; few fine pores; common fine rounded calcium carbonate concretions and threads; violently effervescent; moderately alkaline; clear smooth boundary.

Bky1—23 to 34 inches; very pale brown (10YR 8/3) gypsiferous soil material that has texture of silt loam, very pale brown (10YR 7/4) moist; massive; hard, firm; common fine rounded calcium carbonate concretions; common fine irregular gypsum crystals and few strongly cemented gypsum lenses; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bky2—34 to 60 inches; white (10YR 8/1) gypsiferous soil material that has a texture of silt loam, light gray (10YR 7/2) moist; massive; hard, firm; common fine rounded calcium carbonate concretions; common fine and medium irregular gypsum crystals and strongly cemented lenses; strongly effervescent; moderately alkaline.

The solum is more than 60 inches thick. The depth to a gypsic horizon ranges from 20 to 40 inches.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 7, and chroma of 2 to 4. It is fine sandy loam or loam.

The Bk horizon has hue of 5YR to 10YR, value of 5 to 8, and chroma of 3 to 5. It is loam, silt loam, or clay loam. The content of clay ranges from 18 to 30 percent, by weighted average. The calcium carbonate equivalent ranges from 15 to 25 percent.

The Bky horizon has hue of 7.5YR or 10YR, value of 7 or 8, and chroma of 1 to 3. It is soft gypsiferous soil material that has a texture of silt loam and contains moderately to strongly cemented gypsum lenses.

## Sharvana Series

The Sharvana series consists of well drained soils that are very shallow or shallow over a petrocalcic horizon. These soils are moderately permeable over the very slowly permeable petrocalcic horizon. They formed in calcareous loamy materials over thick beds of caliche. They are nearly level and gently undulating and are on upland plains and ridges. Slopes range from 0 to 5 percent. These soils are loamy, siliceous, thermic, shallow Petrocalcic Ustollic Paleargids.

Typical pedon of Sharvana loamy fine sand, in an area of Wickett-Sharvana complex, gently undulating, in Loving County; from the junction of Texas Highway 302 and County Road 1933 in Mentone, 8.9 miles north on County Road 1933, west 7.65 miles on Lindley Ranch road, 1.75 miles north on an old, gravel oil-field road to an oil-well pad, 0.55 mile southeast on a dirt road, 30 feet west of the road in range:

A—0 to 4 inches; reddish brown (5YR 4/4) loamy fine sand, dark reddish brown (5YR 3/4) moist; weak fine granular structure; soft, very friable; common fine roots; few siliceous pebbles; neutral; abrupt smooth boundary.

Bt—4 to 18 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; moderate medium and coarse subangular blocky structure; slightly hard, friable; common fine and few medium roots; distinct patchy clay bridging between sand grains; clay films on faces of peds and in pores; few siliceous pebbles; slightly alkaline; abrupt wavy boundary.

Bkm—18 to 28 inches; 60 percent pinkish white (7.5YR 8/2) and 40 percent reddish yellow (7.5YR 7/6), indurated calcium carbonate having a $^1/_2$-inch-thick laminar cap; massive; few embedded siliceous pebbles; violently effervescent; abrupt wavy boundary.

BCk—28 to 80 inches; pinkish white (7.5YR 8/2) gravelly fine sandy loam, pinkish gray (7.5YR 7/2) moist; 30 percent moderately to strongly cemented calcium carbonate fragments; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to indurated calcium carbonate range from 8 to 20 inches.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5, and chroma of 3 or 4. It is loamy fine sand or fine

sandy loam. The content of clay ranges from 8 to 18 percent. Reaction ranges from neutral to moderately alkaline.

The Bt horizon has hue of 2.5YR to 7.5YR, value of 4 to 6, and chroma of 3 to 6. It is fine sandy loam or sandy clay loam. The content of clay ranges from 15 to 30 percent. Reaction ranges from neutral to moderately alkaline. In some pedons the lower part of the horizon is calcareous.

The Bkm horizon ranges from indurated to strongly cemented calcium carbonate. In some pedons it is coarsely fractured.

The BCk horizon consists of alternating layers of soft calcium carbonate soil material and strongly cemented fragments of calcium carbonate.

## Splotter Series

The Splotter series consists of well drained soils that are very shallow or shallow over a petrocalcic horizon (fig. 13). These soils are moderately rapidly permeable over the very slowly permeable petrocalcic horizon. They formed in calcareous alluvial sediments over thick beds of caliche. They are nearly level and gently undulating and are on upland plains and ridges. Slopes range from 1 to 5 percent. These soils are loamy-skeletal, mixed, thermic, shallow Typic Paleorthids.

Typical pedon of Splotter gravelly fine sandy loam in an area of Splotter-Mentone complex, gently undulating, in Loving County; from the junction of Texas Highway 302 and County Road 1933 in Mentone, 15.6 miles north on County Road 1933, east 0.15 mile on a caliche road, 60 feet north in range:

A—0 to 3 inches; yellowish brown (10YR 5/4) gravelly fine sandy loam, dark yellowish brown (10YR 3/4) moist; weak fine and medium subangular blocky structure parting to weak fine and medium granular; soft, very friable; common very fine and fine roots; few fine and medium discontinuous tubular pores; 15 percent pebbles of strongly cemented calcium carbonate; slightly effervescent; moderately alkaline; clear smooth boundary.

Bk—3 to 11 inches; yellowish brown (10YR 5/4) very cobbly fine sandy loam, dark yellowish brown (10YR 3/4) moist; weak fine and medium subangular blocky structure parting to weak fine granular; soft, very friable; common very fine and fine roots; few fine and medium discontinuous tubular pores; 15 percent pebbles and 40 percent cobbles of strongly cemented calcium carbonate; fragments are fractured petrocalcic material with a 2-millimeter-thick laminar cap on the upper side and pendants on the lower side; violently effervescent; moderately alkaline; abrupt smooth boundary.

Bkm1—11 to 17 inches; white (10YR 8/1), indurated calcium carbonate having a 1- to 6-millimeter-thick laminar cap; massive; violently effervescent; moderately alkaline; abrupt smooth boundary.

Bkm2—17 to 36 inches; white (10YR 8/1), moderately to strongly cemented calcium carbonate having 5- to 6-inch-thick laminar plates that have 1-millimeter-thick laminar caps on the upper side; massive; violently effervescent; slightly alkaline; abrupt smooth boundary.

BCk—36 to 80 inches; white (10YR 8/1), soft calcium carbonate soil material that has a texture of loam; massive; 15 percent strongly cemented fragments of calcium carbonate and 25 percent moderately cemented fragments of calcium carbonate; most fragments have a 1- to 2-millimeter-thick laminar cap; violently effervescent; slightly alkaline.

The thickness of the solum and the depth to a petrocalcic horizon range from 4 to 20 inches. The average content of clay ranges from 8 to 18 percent. The calcium carbonate equivalent in the fine-earth fraction is less than 15 percent above the petrocalcic horizon.

The A horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 2 to 4. It is fine sandy loam or gravelly fine sandy loam.

The Bk horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4.

The Bkm horizon has hue of 7.5YR or 10YR, value of 7 or 8, and chroma of 1 to 3. It is indurated in the upper part and moderately to strongly cemented in the lower part.

The BCk horizon has hue of 7.5YR or 10YR, value of 7 or 8, and chroma of 1 to 3. It is carbonatic soil material with varying texture. The content of coarse fragments ranges from 25 to 40 percent.

## Stegall Series

The Stegall series consists of well drained soils that are moderately deep over a petrocalcic horizon. These soils are moderately slowly permeable over the very slowly permeable petrocalcic horizon. They formed in calcareous loamy sediments. They are nearly level to very gently sloping and are on upland plains. Slopes range from 0 to 3 percent.

The soils of the Stegall series are fine, mixed, thermic Petrocalcic Paleustolls. However, the Stegall soils in this survey area are taxadjuncts to the series because they are in the fine-loamy particle-size class. This difference does not significantly affect use and management.

Typical pedon of Stegall clay loam, in an area of Kimbrough-Stegall complex, nearly level, in Winkler County; from Notrees, 0.2 mile east on Texas Highway 302, northwest 6.1 miles on a county road, 2.95 miles west-southwest on a ranch road, 50 feet north of the road in range:

A—0 to 7 inches; brown (7.5YR 4/2) clay loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure; hard, firm; common fine and medium roots; slightly alkaline; clear smooth boundary.

Bt1—7 to 15 inches; reddish brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; hard, firm; common fine and medium roots; few distinct discontinuous clay films on faces of peds; moderately alkaline; clear smooth boundary.

Bt2—15 to 26 inches; reddish brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; hard, firm; few very fine and fine roots; few faint discontinuous clay films on faces of peds; few fine calcium carbonate films and threads in the lower part; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bkm—26 to 38 inches; pink (7.5YR 8/4), indurated calcium carbonate that is laminar in the upper 1/2 to 3/4 inches, pink (7.5YR 7/4) moist; violently effervescent; abrupt smooth boundary.

BCk—38 to 60 inches; pink (7.5YR 8/4), soft carbonatic soil material that has imbedded common weakly cemented nodules of calcium carbonate and many caliche pebbles, pink (7.5YR 7/4) moist; massive; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to indurated calcium carbonate range from 20 to 36 inches.

The A horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 or 3. The upper 10 inches of the horizon or 1/3 of the solum has moist value of less than 3.5 and contains more than 1 percent organic matter. The A horizon is loam or clay loam.

The Bt horizon has hue of 5YR to 10YR, value of 4 or 5, and chroma of 2 to 4. The content of clay ranges from 30 to 35 percent. In some pedons the lower part of the horizon has a few films and threads of calcium carbonate.

The Bkm horizon is indurated calcium carbonate that is laminar in the upper 1/2 inch to 3 inches. The Bkm horizon ranges in thickness from 6 inches to several feet.

The BCk horizon is loamy carbonatic soil materials that contain weakly cemented to moderately cemented nodules and fragments of calcium carbonate.

## Tencee Series

The Tencee series consists of well drained soils that are very shallow or shallow over a petrocalcic horizon. These soils are moderately permeable over the very slowly permeable petrocalcic horizon. They formed in gravelly alluvium. They are gently undulating and are on upland plains and ridges. Slopes range from 0 to 5 percent. These soils are loamy-skeletal, carbonatic, thermic, shallow Typic Paleorthids.

Typical pedon of Tencee gravelly loam, in an area of Tencee-Mentone complex, gently undulating, in Loving County; from the junction of U.S. Highway 285 and Texas Highway 652 in Orla, 2.7 miles north on U.S. Highway 285, east 2.7 miles to Red Bluff Reservoir, 1.75 miles east across the Red Bluff Reservoir dam, 1.15 miles north, 0.95 mile northeast on a gravel road, 3.55 miles east, 0.8 mile southwest, 50 feet east of the road in range:

A—0 to 2 inches; grayish brown (10YR 5/2) gravelly loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable; common fine roots; few very fine and fine interstitial and tubular pores; weak crust about 3 millimeters thick on the surface; distinct patchy pendants of calcium carbonate on rock fragments; 25 percent pebbles, mostly limestone with a few siliceous; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk1—2 to 8 inches; grayish brown (10YR 5/2) very gravelly loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable; common fine and medium roots; distinct discontinuous calcium carbonate pendants on rock fragments; 40 percent pebbles, mostly limestone with a few siliceous; violently effervescent; moderately alkaline; abrupt smooth boundary.

Bk2—8 to 12 inches; grayish brown (10YR 5/2) extremely gravelly loam, dark grayish brown (10YR 4/2) moist; weak fine and medium subangular blocky structure; soft, very friable; common fine and medium roots; 65 percent coarse fragments that are mostly indurated calcium carbonate having a laminar cap that is about 10 millimeters thick on one side and a few siliceous pebbles; violently effervescent; moderately alkaline; abrupt smooth boundary.

Bkm—12 to 22 inches; white (10YR 8/2), indurated

calcium carbonate with a laminar cap that is about 15 millimeters thick and embedded common siliceous pebbles, very pale brown (10YR 7/3) moist; violently effervescent; moderately alkaline; abrupt wavy boundary.

BCk—22 to 80 inches; pink (7.5YR 7/4) carbonatic soil material that has a texture of very gravelly loam, light brown (7.5YR 6/4) moist; massive; slightly hard, friable; 15 percent embedded siliceous pebbles and 30 percent fragments of strongly cemented calcium carbonate; violently effervescent; moderately alkaline.

The thickness of the solum and the depth to a petrocalcic horizon range from 7 to 20 inches. In the A and Bk horizons, the fine-earth fraction is fine sandy loam or loam and the content of clay ranges from 15 to 25 percent. The average content of coarse fragments above the petrocalcic horizon ranges from 35 to 65 percent. The average calcium carbonate equivalent from the surface to the petrocalcic horizon ranges from 40 to 60 percent.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. The content of coarse fragments ranges from 25 to 45 percent.

The Bk horizon has hue of 7.5YR or 10YR, value of 5 to 8, and chroma of 2 to 4. The content of coarse fragments ranges from 35 to 65 percent.

The Bkm horizon has hue of 7.5YR or 10YR, value of 7 or 8, and chroma of 1 to 3. It ranges from strongly cemented to indurated and typically has a laminar cap that is less than 1 inch thick.

The BCk horizon has hue of 7.5YR or 10YR, value of 7 or 8, and chroma of 2 to 4. It consists of loamy carbonatic soil materials and has 35 to 70 percent coarse fragments. In some pedons it has embedded siliceous pebbles or strongly cemented calcium carbonate lenses.

## Toyah Series

The Toyah series consists of very deep, well drained, moderately permeable soils that formed in calcareous, loamy alluvium. These nearly level soils are on flood plains along small drainageways. Slopes are 0 to 1 percent. These soils are fine-loamy, mixed, thermic Torrifluventic Haplustolls.

Typical pedon of Toyah clay loam, in an area of Toyah clay loam, occasionally flooded, in Loving County; from the junction of U.S. Highway 285 and Texas Highway 652 in Orla, 2.7 miles north on U.S. Highway 285, east 2.7 miles to Red Bluff Reservoir, 1.75 miles east across the Red Bluff Reservoir dam, 5.5 miles north-northwest on a caliche road, 50 feet west of the road in range, in the middle of a drainage area:

A1—0 to 4 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, friable; common fine and medium roots; about 1 inch of overburden of recently deposited sandy eolian material; strongly effervescent; moderately alkaline; clear smooth boundary.

A2—4 to 18 inches; brown (7.5YR 5/3) clay loam, dark brown (7.5YR 3/3) moist; weak medium subangular blocky structure parting to weak fine and medium granular; slightly hard, friable; common fine and medium roots; strongly effervescent; moderately alkaline; clear smooth boundary.

Bw1—18 to 32 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, firm; common fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.

Bw2—32 to 44 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, firm; few fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.

Bw3—44 to 60 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, firm; strongly effervescent; moderately alkaline.

The solum is more than 60 inches thick. Electrical conductivity is less than 4 dS/m. The 10- to 40-inch control section is loam, sandy clay loam, or clay loam, contains 20 to 35 percent clay, and is more than 15 percent coarser than very fine sand. Some areas have a thin overburden of recent sandy eolian deposits.

The A horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 2 or 3.

The Bw horizon has hue of 5YR to 10YR, value of 5 or 6, and chroma of 2 to 4. It is loam, sandy clay loam, or clay loam. In some pedons it has thin strata and redoximorphic features in shades of gray. In some pedons it also has sandy strata or layers of calcium carbonate below a depth of 40 inches.

## Turney Series

The Turney series consists of very deep, well drained, moderately permeable soils that formed in calcareous loamy alluvial and eolian sediments. These nearly level and very gently sloping soils are on upland plains and basins. Slopes range from 0 to 3 percent. These soils are fine-loamy, mixed, thermic Typic Calciorthids.

Typical pedon of Turney loam, in an area of Turney loam, nearly level, in Loving County; from the junction of Texas Highway 302 and County Road 1933 in

Mentone, 10.7 miles north on County Road 1933, northeast 2.8 miles on a gravel road, 200 feet northwest of the road in range:

A1—0 to 2 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak thin platy structure; soft, very friable; many fine and medium roots; few nodules of calcium carbonate; strongly effervescent; slightly alkaline; abrupt smooth boundary.

A2—2 to 8 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak fine and medium subangular blocky structure; soft, very friable; many fine and medium roots; few fine nodules of calcium carbonate; strongly effervescent; slightly alkaline; clear smooth boundary.

Bw—8 to 25 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak fine and medium subangular blocky structure; soft, very friable; many fine and medium roots; few fine rounded nodules of calcium carbonate; few limestone pebbles; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk1—25 to 36 inches; very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; weak fine and medium subangular blocky structure; soft, very friable; few fine roots; common fine rounded nodules and threads of calcium carbonate; 5 percent limestone pebbles; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk2—36 to 49 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; weak fine and medium subangular blocky structure; soft, very friable; many fine rounded nodules, threads, and masses of calcium carbonate; 10 percent limestone pebbles; violently effervescent; strongly alkaline; abrupt smooth boundary.

Bk3—49 to 60 inches; very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) moist; weak fine and medium subangular blocky structure; soft, very friable; common fine rounded nodules and threads of calcium carbonate; 10 percent limestone pebbles; violently effervescent; strongly alkaline.

The solum is more than 60 inches thick. The depth to a calcic horizon ranges from 20 to 40 inches. The particle-size control section is loam, sandy clay loam, or clay loam and has 18 to 35 percent clay. The average content of gravel throughout the control section is less than 15 percent.

The A horizon has hue of 5YR to 10YR, value of 5 to 7, and chroma of 3 to 5.

The Bw horizon has hue of 5YR to 10YR, value of 5 to 8, and chroma of 3 to 6. It is loam, sandy clay loam, or clay loam.

The Bk horizon has hue of 7.5YR or 10YR, value of 6 to 8, and chroma of 2 to 4. It is fine sandy loam, loam, sandy clay loam, or clay loam. The cementation ranges from none to strong. Parts of the horizon are discontinuously indurated.

## Wickett Series

The Wickett series consists of well drained soils that are moderately deep over a petrocalcic horizon (fig. 14). These soils are moderately rapidly permeable over and below the very slowly permeable petrocalcic horizon. They formed in sandy and loamy eolian materials over thick beds of calcium carbonate. They are nearly level to very gently sloping and are on upland plains. Slopes range from 0 to 3 percent. These soils are coarse-loamy, siliceous, thermic Petrocalcic Ustollic Paleargids.

Typical pedon of Wickett loamy fine sand, in an area of Wickett-Sharvana complex, gently undulating, in Winkler County; from the junction of Texas Highways 115 and 302 southwest of Kermit, 0.95 mile southwest on Texas Highway 115, south 0.5 mile on an oiled road, 0.1 mile west on a caliche road, 30 feet south of the road in range:

A1—0 to 5 inches; brown (7.5YR 4/4) loamy fine sand, dark brown (7.5YR 3/4) moist; weak coarse subangular blocky structure parting to weak fine and medium granular; soft, very friable; common very fine and fine and few medium roots; few very fine and fine discontinuous tubular pores; slightly alkaline; clear smooth boundary.

A2—5 to 15 inches; yellowish red (5YR 4/6) loamy fine sand, reddish brown (5YR 4/4) moist; weak coarse subangular blocky structure parting to fine and medium subangular blocky and granular; slightly hard, very friable; common very fine and fine roots; common very fine and fine continuous tubular pores; slightly alkaline; clear smooth boundary.

Bt1—15 to 29 inches; yellowish red (5YR 5/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure parting to weak fine and medium subangular blocky; hard, very friable; common very fine and fine and few medium roots; common very fine and fine continuous tubular pores; faint patchy clay films on surfaces of peds and lining pores; slightly alkaline; gradual smooth boundary.

Bt2—29 to 36 inches; yellowish red (5YR 4/6) fine sandy loam, yellowish red (5YR 4/6) moist; weak coarse subangular blocky structure parting to weak medium subangular blocky; hard, friable; few very fine, fine, and coarse roots; common very fine and

fine continuous tubular pores; faint discontinuous clay films on surfaces of peds and lining pores; few organic coatings along root channels; few fine irregular organic coatings in lower part of horizon; few fine masses and concretions of calcium carbonate in lower part; slightly alkaline; abrupt smooth boundary.

Bkm—36 to 63 inches; white (10YR 8/1), indurated caliche, laminated in the upper 1/8 to 1/2 inch; strongly cemented below the laminar cap, decreasing in cementation with depth, moderately cemented in the lower part; strongly alkaline; abrupt wavy boundary.

BCk—63 to 80 inches; white (10YR 8/2) gravelly loamy fine sand, white (10YR 8/1) moist; single grain; 20 percent strongly cemented calcium carbonate fragments; 10 to 15 percent discontinuous, moderately to strongly cemented, 1- to 6-inch-thick strata and lenses; moderately alkaline.

The thickness of the solum and the depth to cemented or indurated caliche range from 20 to 40 inches.

The A horizon has hue of 5YR or 7.5YR, value of 3 to 5, and chroma of 3 to 6. Reaction is neutral or slightly alkaline.

The Bt horizon has hue of 2.5YR to 7.5YR, value of 4 or 5, and chroma of 4 to 8. It is fine sandy loam or loam. The content of clay ranges from 8 to 18 percent. Reaction is slightly alkaline or moderately alkaline.

The Bkm horizon ranges from indurated to strongly cemented calcium carbonate in the upper part and from strongly cemented to moderately cemented in the lower part.

The BCk horizon is whitish to pinkish caliche that has a texture of loamy fine sand, fine sandy loam, loam, or the gravelly analogs of those textures. The content of coarse fragments in the form of strongly cemented calcium carbonate ranges from 0 to 35 percent.

## Wink Series

The Wink series consists of very deep, well drained, moderately rapidly permeable soils that formed in calcareous, loamy, eolian or alluvial sediments. These nearly level to very gently sloping soils are on upland plains. Slopes range from 0 to 3 percent. These soils are coarse-loamy, mixed, thermic Typic Calciorthids.

Typical pedon of Wink fine sandy loam, in an area of Wink fine sandy loam, nearly level, in Loving County; from the intersection of Texas Highway 302 and County Road 1933 in Mentone, 6.2 miles on County Road 1933, about 3.5 miles on a ranch road to Slash Ranch headquarters, 1.7 miles northeast on a ranch road, 0.4 mile east on a ranch road, 100 feet north of the road in range:

A—0 to 9 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; weak fine and medium subangular blocky structure parting to weak fine granular; soft, friable; common fine and medium roots; common very fine and fine interstitial and tubular pores; strongly effervescent; moderately alkaline; clear smooth boundary.

Bk1—9 to 22 inches; very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; weak fine subangular blocky structure parting to weak fine granular; soft, friable; common fine roots; common very fine and fine interstitial and tubular pores; few fine irregular concretions and few fine threads and masses of calcium carbonate; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Bk2—22 to 35 inches; white (10YR 8/1) fine sandy loam, white (10YR 8/2) moist; weak thick platy structure; hard, friable; common coarse moderately cemented plates of calcium carbonate; common fine and medium irregular concretions of calcium carbonate; few root channels filled with soil material from the surface layer; violently effervescent; moderately alkaline; abrupt smooth boundary.

BCk—35 to 60 inches; very pale brown (10YR 7/4) fine sandy loam, light yellowish brown (10YR 6/4) moist; single grain; soft, friable; few fine rounded concretions of calcium carbonate; strongly effervescent; moderately alkaline.

The solum is more than 60 inches thick. The depth to a calcic horizon ranges from 20 to 39 inches. Coarse fragments ranges from none in number to about 10 percent of the horizon. The fragments are mostly limestone pebbles coated with calcium carbonate and strongly cemented calcium carbonate. The soil is calcareous throughout. The average content of clay in the 10- to 40-inch control section ranges from 8 to 18 percent.

The A horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 2 to 4. It is loamy fine sand or fine sandy loam.

The Bk horizon has hue of 7.5YR or 10YR, value of 6 to 8, and chroma of 1 to 4. It is loamy fine sand or fine sandy loam. The weakly cemented to moderately cemented plates consist of fragments that range from 1/2 inch to 4 inches in diameter. The content of calcium carbonate ranges from 15 to 30 percent.

The BCk horizon has hue of 7.5YR or 10YR, value of 6 to 8, and chroma of 1 to 4. It is loamy fine sand, fine sandy loam, loam, or gravelly loam.

# Formation of the Soils

In this section the factors of soil formation and the surface geology of the survey area are described and related to the soils in the survey area.

## Factors of Soil Formation

Soils are the product of the interaction of five major factors of soil formation. The characteristics of a soil at any given point depend on the physical and mineralogical composition of the parent material, the climate under which the soil formed, the plant and animal life on and in the soil, the relief or lay of the land, and the length of time the factors of soil formation have acted on the soil material.

### Parent Material

Parent material is the unconsolidated organic and mineral mass from which a soil forms. Parent material determines the chemical and mineralogical composition of the soil. The soils in Loving and Winkler Counties formed in parent materials derived from geologic strata that range in age from Permian "redbeds" to Holocene alluvial and eolian deposits. These strata are limestone, shale, sandstone, and caliche and unconsolidated gravel, sand, silt, and clay sediment.

In Loving and Winkler Counties, the diversity of geologic materials from which parent materials are derived has resulted in numerous soil types and map units. Limestone and shale are overlain by silty and clayey soils. Sandstone is generally overlain by sandy soils. Unconsolidated fluvial and eolian sediment are parent materials for clayey to gravelly soils. An elaboration describing the location of geologic outcrops, the lithologic characteristics of the outcrops, and soils that are related to each outcrop is under the heading "Surface Geology."

### Climate

The semiarid climate of Loving and Winkler Counties has had a definite effect on soil formation. Rainfall, evaporation, temperature, and wind are important climatic elements. The soils in the survey area are seldom wet below the root zone. The average annual rainfall ranges from about 10 inches along the Pecos River to about 13 inches along the caprock escarpment in northeastern Winkler County. The rainfall is too limited to leach bases from the soils. As a result, most of the soils have a layer in which calcium carbonate has accumulated.

Summer temperatures are high, and winter temperatures are moderate. The high temperatures and low rainfall limit the accumulation of organic matter in the soils.

The section "General Nature of the Survey Area" has additional information regarding the climate of the area.

### Plant and Animal Life

Plants, earthworms, insects, microorganisms, animals, and people contribute to the formation of soils. Gains or losses of organic matter, nitrogen, and plant nutrients and changes in soil structure and porosity are all affected by living organisms.

Plants have a major role in soil formation in Loving and Winkler Counties. The fibrous root system of grasses contributes large amounts of organic matter to the soils. Roots of grasses and shrubs decay and leave pores and holes that serve as passageways for water.

Earthworms, insects, rodents, and other animals work and mix the soil layers. Worms hasten the decay of organic matter. Wormcasts improve soil structure and aid in the movement of water and the growth of plant roots. Fungi, bacteria, and other microorganisms help to decay organic matter and release nutrients from minerals, making the nutrients available to plants.

Human activities affect soil formation. Fencing the range and allowing heavy grazing change the composition of vegetation to shorter, thinner, and less palatable grasses that return less organic matter to the soils. Tillage, irrigation with saline water, and other cultural practices affect soil formation. Construction of buildings and roads also alters soils.

### Relief

Relief or topography influences soil formation through its effect on drainage and runoff. The land

surface in most of Loving and Winkler Counties ranges from nearly level to undulating.

If other factors are equal, the degree of soil profile development depends on the amount of moisture and the depth of penetration of the moisture. Nearly level soils on uplands that receive runoff from adjacent areas generally have weak to moderate development as shown by cambic or calcic horizons. Examples are Ratliff, Reeves, and Turney soils. Nearly level to rolling soils on uplands that do not receive runoff have less moisture penetration and are very shallow and shallow to a cemented calcic horizon. Examples are Blakeney, Delnorte, Sharvana, Splotter, and Tencee soils. Nearly level soils on flood plains have the least developed profiles because they are continually built up by sediments washed in and deposited from surrounding areas. Examples are Arno, Harkey, Patrole, and Pecos soils.

### Time

Time is required for the formation of distinct horizons in soils. Differences in the length of time that the parent materials have been in place are generally reflected in the degree of soil profile development.

The soils in Loving and Winkler Counties range from young to old. The young soils have very little profile development, and the older soils have well expressed soil horizons. Coyanosa, Harkey, Holloman, Patrole, Pecos, and Penwell soils are examples of young soils that lack development.

Some older soils are noncalcareous and have an accumulation of clay in the subsoil. Other soils are calcareous and have an accumulation of calcium carbonate in the lower part of the profile. The calcium carbonate can occur as soft masses or concretions, such as in the Kinco, Ratliff, Reeves, and Wink soils, or be cemented or indurated, such as in the Blakeney, Conger, Delnorte, Paisano, Sharvana, Splotter, and Tencee soils. Indurated or petrocalcic horizons probably take millions of years to form.

## Surface Geology

Dr. Emilio Mutis-Duplat, professor and Chairman of the Department of Geology, University of Texas of the Permian Basin, prepared this section.

Loving and Winkler Counties are located within the Great Plains Province of the Interior Plains Physiographic Division. Loving County and southwestern Winkler County are within the Pecos Valley Section of the Great Plains Province; the remaining northeastern portion of Winkler County is in the High Plains Section *(Schoeneberger, 1997)*. The High Plains and Pecos Valley physiographic sections in Loving and Winkler Counties are within the Southern High Plains Major Land Resource Area and the Southern Desertic Basins, Plains, and Mountains Major Land Resource Area, respectively.

Permian, Triassic, and Quaternary sedimentary rocks and deposits crop out in Loving County; Triassic, Cretaceous, Tertiary, and Quaternary age sedimentary rocks and deposits crop out in Winkler County. The older rocks, Permian to late Tertiary age, are exposed as outliers surrounded by younger Quaternary deposits. These rocks and deposits are the source of parent materials for soils in Loving and Winkler Counties. The following sections describe the general locations, lithologies, and associated soils of the outcrops.

### Permian Strata

Permian outcrops, divided into the Rustler Formation and the Dewey Lake Redbeds, are in the northwest corner of Loving County along the banks of Red Bluff Reservoir and the Pecos River.

The Rustler Formation is comprised of limestone, siltstone, sandstone, gypsum, marl, and clay. The upper 50 feet of the formation is limestone and dolomitic limestone. The middle 50 to 70 feet is siltstone and sandstone. The basal 50 feet is fine-grained sandstone and thin- to medium-bedded siltstone. The sandstone and siltstone are interbedded with gypsum, marl, and clay. The Dewey Lake Redbeds outcrop in Loving County is 40 to 50 feet of siltstone, fine-grained sandstone, and thin beds of gypsiferous clay. Holloman soils are representative soils that are mapped over the Rustler Formation and the Dewey Lake Redbeds.

### Triassic Strata

The Triassic age Dockum Group, undivided, is exposed in several small outcrops in Loving County and the northwestern part of Winkler County. The outcrops are mostly thin-bedded to massive, micaceous shale and siltstone. The shale and siltstone are interbedded with fine- to coarse-grained sandstone and with gravel and chert pebbles. The total thickness of the group is about 275 feet. Coyanosa and Los Tanos soils formed over the Dockum Group, undivided, in Loving and Winkler Counties.

### Cretaceous Strata

Outcrops of Lower Cretaceous rocks in the extreme northeastern corner of Winkler County are comprised of the Antlers Sand and the Fredricksburg Group,

undivided. These formations are topographically and stratigraphically below the late Tertiary age Ogallala Formation. An erosion resistant "caprock" crops out in a ridge or escarpment delineating the High Plains and Pecos Valley physiographic sections.

The Antlers Sand is a poorly indurated, commonly crossbedded, fine- to coarse-grained sandstone. The upper part of the formation is calcareous and silty. The total thickness of the formation is about 90 feet. Outcrops of the Fredricksburg Group are comprised of limestone, dolomite, and lesser strata of nodular or thin-layered chert and locally gypsiferous marl. Paisano soils and Rock outcrop are associated with Cretaceous rocks.

## Tertiary Strata

The late Tertiary age (Pliocene) Ogallala Formation underlies the High Plains physiographic section and the Southern High Plains Major Land Resource Area. A portion of the formation's southern outcrop extremity is in the far northwestern part of Winkler County *(Barnes, 1976a)*. The Ogallala Formation is fluvial sand, gravel, silt, and clay capped by a sandy deposit of caliche. Blakeney and Conger soils formed over the Ogallala Formation.

## Quaternary Sediment

Quaternary sediments cover most of Loving and Winkler Counties. These sediments consist of Pleistocene and Holocene deposits laid down in fluvial, eolian, and lacustrine environments. Mapped Quaternary deposits consist of Pleistocene caliche, fluviatile terrace deposits, and playa deposits and Holocene windblown sand and silt and alluvium *(Barnes, 1976 and 1976a)*.

The oldest Quaternary outcrops in the survey area are in the western part of Loving County. The Gatuna Formation is exposed locally above the terraces along the Pecos River. The formation is comprised of fine sand, gypsiferous marl, siliceous conglomerate, laminated to massive gypsum, silt, shale, and limestone. The total thickness of the formation is about 450 feet. Splotter soils are mapped over the Gatuna Formation.

Late Pleistocene fluviatile deposits are substrata for the terraces along the Pecos River. The sediments are mostly gravel, sand, and silt. Pebbles and cobbles of chert, quartzite, igneous rock, metamorphic rock, and caliche are commonly associated with the gravel. Crossbedded to massive, lenticular quartz sand is at the higher levels on the terraces. Arno, Harkey, Patrole, and Pecos soils formed on terraces along the Pecos River.

Other Quaternary deposits are mapped in the northeastern part of Winkler County and the northwestern part of Loving County. These sediments are mostly boulders, cobbles, and pebbles of Cretaceous limestone and chert. Sources of these clasts include sedimentary and igneous formations, alluvium, colluvium, caliche, and gypsite *(Barnes, 1976 and 1976a)*. Paisano and Splotter soils formed in these predominately coarse-grained parent materials.

Outcrops of caliche are mapped throughout Loving County and in the southwestern half and far northeastern part of Winkler County. In Loving and Winkler Counties, the total exposure area of caliche is second only to the area of windblown sand. The caliche has been stripped of its less erosion-resistant overburden of silt and sand by fluvial and eolian processes. The maximum thickness of these deposits, which are dominantly calcium carbonate, is about 35 feet *(Barnes, 1976 and 1976a)*. Blakeney, Conger, Delnorte, Douro, Kimbrough, Sharvana, Splotter, Stegall, Tencee, and Wickett soils are mapped on outcrops of caliche.

Playa deposits are located on the caliche deposits. These sediments are mostly lacustrine clay, silt, and sand in shallow depressions. Older Pleistocene deposits in the depressions are commonly covered by a thin veneer of younger Holocene lacustrine and eolian sediments. Mentone soils formed in these sediments.

Eolian sediment is the most extensive geologic unit in Winkler and Loving counties. Windblown sand sheets, dunes, dune ridges, and cover sand are found throughout the survey area. These deposits are of Pleistocene and Holocene age. Cover sand, the oldest type of deposit, is silty, fine- to medium-grained quartz sand with caliche nodules. Younger sand sheets, dunes, and dune ridges developed on the cover sand *(Barnes, 1976 and 1976a)*. Many of the dunes are active and support little or no vegetation. Other dunes are stabilized by viable vegetation *(Garza, 1959)*. Coarse-grained Elgee, Kinco, Monahans, Pajarito, Penwell, Pyote, Wickett, and Wink soils are mapped in areas of eolian sediment.

Holocene alluvium consists of flood plain and low terrace deposits along ephemeral streams and of sandy silts on pediments that have been locally modified by sheetwash action *(Barnes, 1976 and 1976a)*. Ratliff, Reeves, Toyah, and Turney soils are mapped in areas of these sediments.

# References

American Association of State Highway and Transportation Officials (AASHTO). 1986. Standard specifications for highway materials and methods of sampling and testing. 14th edition, 2 volumes.

American Society for Testing and Materials (ASTM). 1993. Standard classification of soils for engineering purposes. ASTM Standard D 2487.

Barnes, V.E. 1976. Geologic atlas of Texas—Pecos sheet; Johan August Udden Memorial Edition: University of Texas, Austin, Bureau of Economic Geology, scale 1:250,000.

Barnes, V.E. 1976a. Geologic atlas of Texas—Hobbs sheet; William Battle Phillips Memorial Edition: University of Texas, Austin, Bureau of Economic Geology, scale 1:250,000.

Garza, Sergio, and J.B. Wesselman. 1959. Geology and ground-water resources of Winkler County, Texas: Texas Board of Water Engineers Bulletin 5916.

Schoeneberger, P.J., D.A. Wysocki, E.C. Benham, and W.D. Broderson. 1997. Field book for describing and sampling soils. Version 1.0. United States Department of Agriculture, Natural Resources Conservation Service, National Soil Survey Center.

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. USDA Handbook 210.

United States Department of Agriculture, Soil Conservation Service. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. USDA Handbook 436.

United States Department of Agriculture, Soil Conservation Service. 1992. Keys to soil taxonomy. 5th Edition. Soil Survey Staff, Soil Management Support Services, Technical Monograph 19.

United States Department of Agriculture, Soil Conservation Service. 1993. Soil survey manual. Soil Survey Staff, USDA Handbook 18.

United States Department of Agriculture, Natural Resources Conservation Service. 1996. Soil survey laboratory methods manual. Soil Survey Investigations Report 42.

# 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.

**Alluvial fan.** The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

**Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.

**Alpha,alpha-dipyridyl.** A dye that when dissolved in 1N ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction indicates a type of redoximorphic feature.

**Animal unit month (AUM).** The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

**Aquic conditions.** Current soil wetness characterized by saturation, reduction, and redoximorphic features.

**Area reclaim** (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

**Argillic horizon.** A subsoil horizon characterized by an accumulation of illuvial clay.

**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 |
| Low | 3 to 6 |
| Moderate | 6 to 9 |
| High | 9 to 12 |
| Very high | more than 12 |

**Backslope.** The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Backslopes 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.

**Bedding planes.** Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

**Bedding system.** A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Blowout.** A shallow depression from which all or most of the soil material has been removed by the wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

**Bottom land.** The normal flood plain of a stream, subject to flooding.

**Boulders.** Rock fragments larger than 2 feet (60 centimeters) in diameter.

**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 soil.** A soil containing enough calcium carbonate (commonly combined with magnesium

carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

**Caliche.** A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds directly beneath the solum, or it is exposed at the surface by erosion.

**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.

**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 depletions.** Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

**Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

**Claypan.** A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

**Climax plant community.** The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

**Coarse textured soil.** Sand or loamy sand.

**Cobble (or cobblestone).** A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

**Cobbly soil material.** Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

**Colluvium.** Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

**Complex slope.** Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

**Complex, soil.** A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

**Compressible** (in tables). Excessive decrease in volume of soft soil under load.

**Conchoidal structure.** A smoothly curving, seashell-like fracture surface in three-dimensional form. Conchoidal structure can be either concave or convex and is in contrast to planar and angular cleavage.

**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.

**Congeliturbate.** Soil material disturbed by frost action.

**Conservation cropping system.** Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

**Conservation tillage.** A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

**Consistence, soil.** Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes

resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

**Control section.** The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

**Corrosion.** Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

**Cover crop.** A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

**Cropping system.** Growing crops according to a planned system of rotation and management practices.

**Crop residue management.** Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

**Cross-slope farming.** Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

**Crown.** The upper part of a tree or shrub, including the living branches and their foliage.

**Cutbanks cave** (in tables). The walls of excavations tend to cave in or slough.

**Decreasers.** The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

**Deferred grazing.** Postponing grazing or resting grazing land for a prescribed period.

**Depth, 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.

**Drainage class** (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained*. These classes are defined in the "Soil Survey Manual."

**Drainage, surface.** Runoff, or surface flow of water, from an area.

**Draw.** A small stream valley that generally is more open and has broader bottom land than a ravine or gulch.

**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.

**Escarpment.** A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

**Excess fines** (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

**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.

**Fibric soil material (peat).** The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

**Field moisture capacity.** The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

**Fill slope.** A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

**Fine textured soil.** Sandy clay, silty clay, or clay.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

**Fluvial.** Of or pertaining to rivers; produced by river action, as a fluvial plain.

**Footslope.** The inclined surface at the base of a hill.

**Forb.** Any herbaceous plant not a grass or a sedge.

**Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

**Gilgai.** Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.

**Gleyed soil.** Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

**Gravel.** Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

**Gravelly soil material.** Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

**Ground water.** Water filling all the unblocked pores of the material below the water table.

**Hard bedrock.** Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.

**Hemic soil material (mucky peat).** Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

**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.

**Hummocky.** An imprecise, general term for a rounded or conical mound or other small elevation.

**Humus.** The well decomposed, more or less stable part of the organic matter in mineral soils.

**Hydrologic soil groups.** Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope

and the kind of plant cover are not considered but are separate factors in predicting runoff.

**Illuviation.** The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

**Impervious soil.** A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

**Increasers.** Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

**Induration.** Hardening or consolidation of a rock or soil material by cementation.

**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 rate.** The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

**Intake rate.** The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

| | |
|---|---|
| Less than 0.2 | very low |
| 0.2 to 0.4 | low |
| 0.4 to 0.75 | moderately low |
| 0.75 to 1.25 | moderate |
| 1.25 to 1.75 | moderately high |
| 1.75 to 2.5 | high |
| More than 2.5 | very high |

**Intermittent stream.** A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

**Invaders.** On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

**Iron depletions.** Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are:

*Basin.*—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

*Border.*—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

*Controlled flooding.*—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

*Corrugation.*—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

*Drip (or trickle).*—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

*Furrow.*—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

*Sprinkler.*—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

*Subirrigation.*—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

*Wild flooding.*—Water, released at high points, is allowed to flow onto an area without controlled distribution.

**Landslide.** The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

**Large stones** (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**Loess.** Fine grained material, dominantly of silt-sized particles, deposited by wind.

**Low strength.** The soil is not strong enough to support loads.

**Masses.** Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum

or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

**Mechanical treatment.** Use of mechanical equipment for seeding, brush management, and other management practices.

**Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.

**Mesa.** A broad, nearly flat topped and commonly isolated upland mass characterized by summit widths that are more than the heights of bounding erosional scarps.

**Mineral soil.** Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

**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.

**Mohs' scale.** A scale of hardness for minerals in which 1 represents the hardness of talc; 2, gypsum; 3, calcite; 4, fluorite; 5, apatite; 6, orthoclase; 7, quartz; 8, topaz; 9, corundum; and 10, diamond.

**Mollic epipedon.** A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

**Muck.** Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

**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 |

**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.

**Peat.** Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

**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.

**Plateau.** An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

**Playa.** The generally dry and nearly level lake plain that occupies the lowest parts of closed depressional areas, such as those on intermontane basin floors. Temporary flooding occurs primarily in response to precipitation and runoff.

**Plinthite.** The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

**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 |

**Redoximorphic concentrations.** Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

**Redoximorphic depletions.** Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

**Redoximorphic features.** Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

**Reduced matrix.** A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

**Regolith.** The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Residuum (residual soil material).** Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

**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.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sandstone.** Sedimentary rock containing dominantly sand-sized particles.

**Sapric soil material (muck).** The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

**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.

**Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

**Shale.** Sedimentary rock formed by the hardening of a clay deposit.

**Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

**Shrink-swell** (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

**Siltstone.** Sedimentary rock made up of dominantly silt-sized particles.

**Similar soils.** Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

**Sinkhole.** A depression in the landscape where limestone has been dissolved.

**Slickensides.** Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

**Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, classes for simple slopes are as follows:

| | |
|---|---|
| Nearly level | 0 to 1 percent |
| Very gently sloping | 1 to 3 percent |
| Gently sloping | 3 to 5 percent |
| Moderately sloping | 5 to 8 percent |
| Strongly sloping | 8 to 12 percent |
| Moderately steep | 12 to 20 percent |
| Steep | 20 to 45 percent |
| Very steep | 45 percent and higher |

Classes for complex slopes are as follows:

| | |
|---|---|
| Nearly level | 0 to 3 percent |
| Gently undulating | 1 to 5 percent |
| Undulating | 1 to 8 percent |
| Rolling | 5 to 10 percent |
| Hilly | 10 to 30 percent |
| Steep | 20 to 45 percent |
| Very steep | 45 percent and higher |

**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.

**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.

**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.

**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 grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

**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.

**Summer fallow.** The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

**Surface layer.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Surface soil.** The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

**Taxadjuncts.** Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

**Terrace** (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Thin layer** (in tables). Otherwise suitable soil material that is too thin for the specified use.

**Toeslope.** The outermost inclined surface at the base of a hill; part of a footslope.

**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.

**Underlying material.** The part of the soil below the solum.

**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.

# Tables

**Table 1.--Temperature and Precipitation**

**(Recorded in the period 1961-90 at Wink, Texas)**

| Month | Temperature | | | | | | Precipitation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Average daily maximum | Average daily minimum | Average daily | 2 years in 10 will have-- Maximum temperature higher than-- | 2 years in 10 will have-- Minimum temperature lower than-- | Average number of growing degree days* | Average | 2 years in 10 will have-- Less than-- | 2 years in 10 will have-- More than-- | Average number of days with 0.10 inch or more | Average snowfall |
| | °F | °F | °F | °F | °F | Units | In | In | In | | In |
| January----- | 58.6 | 27.5 | 43.1 | 81 | 4 | 31 | 0.33 | 0.07 | 0.63 | 0 | 1.5 |
| February---- | 64.4 | 31.9 | 48.1 | 86 | 11 | 72 | .43 | .12 | .86 | 1 | 0.6 |
| March------- | 72.3 | 39.9 | 56.1 | 92 | 17 | 231 | .41 | .08 | .88 | 1 | 0.4 |
| April------- | 81.7 | 49.5 | 65.6 | 97 | 30 | 471 | .67 | .20 | 1.35 | 1 | 0.1 |
| May--------- | 89.0 | 58.2 | 73.6 | 104 | 40 | 725 | .97 | .38 | 1.47 | 2 | 0.0 |
| June-------- | 95.0 | 66.7 | 80.9 | 108 | 51 | 926 | 1.89 | .45 | 3.15 | 3 | 0.0 |
| July-------- | 95.9 | 69.9 | 82.9 | 106 | 62 | 1,017 | 1.75 | .42 | 2.80 | 12 | 0.0 |
| August------ | 94.5 | 68.4 | 81.5 | 105 | 58 | 954 | 1.36 | .43 | 2.11 | 12 | 0.0 |
| September--- | 87.8 | 61.9 | 74.8 | 101 | 44 | 745 | 2.22 | .58 | 3.53 | 3 | 0.0 |
| October----- | 79.6 | 50.0 | 64.8 | 96 | 31 | 454 | 1.49 | .34 | 2.67 | 2 | 0.0 |
| November---- | 68.4 | 37.6 | 53.0 | 87 | 17 | 156 | .56 | .10 | 1.15 | 1 | 0.5 |
| December---- | 60.4 | 28.9 | 44.7 | 80 | 9 | 40 | .34 | .11 | .63 | 1 | 0.4 |
| Yearly: | | | | | | | | | | | |
| Average--- | 79.0 | 49.2 | 64.1 | --- | --- | --- | --- | --- | --- | --- | --- |
| Extreme--- | --- | --- | --- | 109 | 2 | --- | --- | --- | --- | --- | --- |
| Total----- | --- | --- | --- | --- | --- | 5,822 | 12.40 | 8.85 | 15.09 | 19 | 3.4 |

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

Table 2.--Freeze Dates in Spring and Fall

(Recorded in the period 1961-90 at Wink, Texas)

| Probability | Temperature | | |
|---|---|---|---|
| | 24°F or lower | 28°F or lower | 32°F or lower |
| Last freezing temperature in spring: | | | |
| 1 year in 10 later than-- | Mar. 27 | Apr. 2 | Apr. 15 |
| 2 years in 10 later than-- | Mar. 19 | Mar. 27 | Apr. 10 |
| 5 years in 10 later than-- | Mar. 5 | Mar. 15 | Mar. 31 |
| First freezing temperature in fall: | | | |
| 1 year in 10 earlier than-- | Nov. 9 | Oct. 27 | Oct. 21 |
| 2 years in 10 earlier than-- | Nov. 15 | Nov. 2 | Oct. 26 |
| 5 years in 10 earlier than-- | Nov. 26 | Nov. 14 | Nov. 5 |

Table 3.--Growing Season

(Recorded in the period 1961-90 at Wink, Texas)

| Probability | Daily minimum temperature during growing season | | |
|---|---|---|---|
| | Higher than 24°F | Higher than 28°F | Higher than 32°F |
| | Days | Days | Days |
| 9 years in 10 | 236 | 217 | 195 |
| 8 years in 10 | 246 | 266 | 203 |
| 5 years in 10 | 264 | 243 | 219 |
| 2 years in 10 | 283 | 260 | 234 |
| 1 year in 10 | 292 | 269 | 242 |

Table 4.--Acreage and Proportionate Extent of the Soils

| Map Symbol | Soil Map Unit Name | Loving County | Winkler County | Total Area | Total Extent |
|---|---|---|---|---|---|
| | | Acres | Acres | Acres | Pct |
| BCB | Blakeney-Conger complex, gently undulating | 29,230 | 50,317 | 79,547 | 8.2 |
| CDD | Chamberino-Delnorte association, rolling | 11,074 | 0 | 11,074 | 1.1 |
| CLC | Coyanosa-Los Tanos complex, undulating | 2,505 | 31 | 2,536 | 0.3 |
| DUB | Dune land | 0 | 26,108 | 26,108 | 2.7 |
| EPB | Elgee-Penwell complex, gently undulating | 1,021 | 97,469 | 98,490 | 10.2 |
| FDA | Faskin-Douro complex, nearly level | 0 | 2,640 | 2,640 | 0.3 |
| HAA | Harkey-Patrole association, occasionally flooded | 10,702 | 0 | 10,702 | 1.1 |
| HMB | Holloman-Monahans complex, gently undulating | 7,702 | 7,272 | 14,974 | 1.5 |
| HRA | Holloman-Reeves complex, nearly level | 7,532 | 232 | 7,764 | 0.8 |
| KAA | Kimbrough-Stegall complex, nearly level | 0 | 5,790 | 5,790 | 0.6 |
| KBA | Kinco-Blakeney complex, nearly level | 7,625 | 43,971 | 51,596 | 5.3 |
| MPA | Monahans-Pajarito complex, nearly level | 11,460 | 216 | 11,676 | 1.2 |
| PAC | Paisano very gravelly loam, undulating | 0 | 4,308 | 4,308 | 0.4 |
| PAF | Paisano-Rock outcrop association, hilly | 0 | 1,884 | 1,884 | 0.2 |
| PEA | Pecos-Arno-Patrole association, occasionally flooded | 8,042 | 170 | 8,212 | 0.8 |
| PND | Penwell-Dune land complex, hummocky | 0 | 76,086 | 76,086 | 7.8 |
| POB | Pyote fine sand, gently undulating | 36,113 | 59,843 | 95,956 | 9.9 |
| PPB | Pyote-Penwell complex, gently undulating | 0 | 32,778 | 32,778 | 3.4 |
| RAA | Ratliff fine sandy loam, nearly level | 0 | 6,716 | 6,716 | 0.7 |
| SHA | Sharvana fine sandy loam, nearly level | 28,658 | 16,211 | 44,869 | 4.6 |
| SMB | Splotter-Mentone complex, gently undulating | 57,997 | 0 | 57,997 | 6.0 |
| TMB | Tencee-Mentone complex, gently undulating | 53,883 | 0 | 53,883 | 5.5 |
| TOA | Toyah clay loam, occasionally flooded | 2,614 | 1,065 | 3,679 | 0.4 |
| TUA | Turney loam, nearly level | 6,047 | 1,297 | 7,344 | 0.8 |
| WCB | Wickett-Pyote complex, gently undulating | 31,628 | 44,496 | 76,124 | 7.8 |
| WKA | Wickett-Sharvana complex, gently undulating | 112,884 | 58,809 | 171,693 | 17.7 |
| WNA | Wink fine sandy loam, nearly level | 2,830 | 0 | 2,830 | 0.3 |
| | Water areas larger than 40 acres | 3,650 | 0 | 3,650 | 0.4 |
| | Total | 433,197 | 537,709 | 970,906 | 100.0 |

Table 5.--Rangeland Productivity

(Only the soils that support rangeland vegetation suitable for grazing are listed.)

| Soil name and map symbol | Range site | Potential annual production for kind of growing season | | |
|---|---|---|---|---|
| | | Favorable | Average | Unfavorable |
| | | Lb/acre | Lb/acre | Lb/acre |
| BCB: | | | | |
| Blakeney | Shallow Sandy Loam (desert grassland) | 1,100 | 850 | 600 |
| Conger | Shallow Sandy Loam (desert grassland) | 1,100 | 850 | 600 |
| CDD: | | | | |
| Chamberino | Gravelly (desert grassland) | 900 | 600 | 300 |
| Delnorte | Gravelly (desert grassland) | 800 | 600 | 300 |
| CLC: | | | | |
| Coyanosa | Sandstone Hill and Mountain (desert grassland) | 1,000 | 700 | 500 |
| Los Tanos | Sandy Loam (desert grassland) | 1,200 | 900 | 600 |
| EPB: | | | | |
| Elgee | Sand Hills (desert grassland) | 2,000 | 1,500 | 800 |
| Penwell | Sand Hills (desert grassland) | 2,000 | 1,500 | 800 |
| FDA: | | | | |
| Faskin | Sandy Loam (PE 19-25) | 2,200 | 1,700 | 1,200 |
| Douro | Sandy Loam (PE 19-25) | 2,200 | 1,700 | 1,200 |
| HAA: | | | | |
| Harkey | Salty Bottomland (desert grassland) | 1,500 | 1,000 | 600 |
| Patrole | Salty Bottomland (desert grassland) | 2,000 | 1,500 | 1,000 |
| HMB: | | | | |
| Holloman | Gyp (desert grassland) | 600 | 400 | 250 |
| Monahans | Sandy Loam (desert grassland) | 1,200 | 900 | 600 |
| HRA: | | | | |
| Holloman | Gyp (desert grassland) | 600 | 400 | 250 |
| Reeves | Loamy (desert grassland) | 1,200 | 900 | 650 |
| KAA: | | | | |
| Kimbrough | Very Shallow (PE 19-25) | 700 | 400 | 200 |
| Stegall | Clay Loam (PE 19-25) | 2,100 | 1,600 | 1,200 |
| KBA: | | | | |
| Kinco | Sandy Loam (desert grassland) | 1,500 | 1,200 | 600 |
| Blakeney | Shallow Sandy Loam (desert grassland) | 1,100 | 850 | 600 |
| MPA: | | | | |
| Monahans | Sandy Loam (desert grassland) | 1,200 | 900 | 600 |
| Pajarito | Sandy Loam (desert grassland) | 1,200 | 900 | 600 |
| PAC Paisano | Gravelly (desert grassland) | 900 | 600 | 300 |

Table 5.--Rangeland Productivity--Continued

| Soil name and map symbol | Range site | Potential annual production for kind of growing season | | |
|---|---|---|---|---|
| | | Favorable | Average | Unfavorable |
| | | Lb/acre | Lb/acre | Lb/acre |
| PAF: | | | | |
| Paisano | Gravelly (desert grassland) | 900 | 600 | 300 |
| Rock outcrop. | | | | |
| PEA: | | | | |
| Pecos | Salty Bottomland (desert grassland) | 1,300 | 1,150 | 500 |
| Arno | Salty Bottomland (desert grassland) | 1,500 | 1,200 | 800 |
| Patrole | Salty Bottomland (desert grassland) | 2,000 | 1,500 | 1,000 |
| PND: | | | | |
| Penwell | Sand Hills (desert grassland) | 2,000 | 1,500 | 800 |
| Dune land. | | | | |
| POB | Loamy Sand (desert grassland) | 2,000 | 1,500 | 1,000 |
| Pyote | | | | |
| PPB: | | | | |
| Pyote | Loamy Sand (desert grassland) | 2,000 | 1,500 | 1,000 |
| Penwell | Sand Hills (desert grassland) | 2,000 | 1,500 | 800 |
| RAA | Sandy Loam (desert grassland) | 1,200 | 900 | 600 |
| Ratliff | | | | |
| SHA | Shallow Sandy Loam (desert grassland) | 1,400 | 1,150 | 900 |
| Sharvana | | | | |
| SMB: | | | | |
| Splotter | Shallow Sandy Loam (desert grassland) | 1,200 | 800 | 600 |
| Mentone | Lakebed (desert grassland) | 2,000 | 1,500 | 800 |
| TMB: | | | | |
| Tencee | Gravelly (desert grassland) | 900 | 600 | 300 |
| Mentone | Lakebed (desert grassland) | 2,000 | 1,500 | 800 |
| TOA | Draw (desert grassland) | 2,200 | 1,750 | 1,200 |
| Toyah | | | | |
| TUA | Loamy (desert grassland) | 1,200 | 900 | 600 |
| Turney | | | | |
| WCB: | | | | |
| Wickett | Loamy Sand (desert grassland) | 1,700 | 1,250 | 800 |
| Pyote | Loamy Sand (desert grassland) | 2,000 | 1,500 | 1,000 |
| WKA: | | | | |
| Wickett | Loamy Sand (desert grassland) | 1,700 | 1,250 | 800 |
| Sharvana | Shallow Sandy Loam (desert grassland) | 1,400 | 1,150 | 900 |
| WNA | Sandy Loam (desert grassland) | 900 | 750 | 600 |
| Wink | | | | |

Table 6.--Recreational Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated.)

| Soil name and map symbol | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| BCB: | | | | | |
| Blakeney | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Slight | Severe: cemented pan. |
| Conger | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Slight | Severe: cemented pan. |
| CDD: | | | | | |
| Chamberino | Moderate: slope, small stones. | Moderate: slope, small stones. | Severe: slope, small stones. | Slight | Moderate: small stones, large stones, slope. |
| Delnorte | Severe: small stones, cemented pan. | Severe: small stones, cemented pan. | Severe: small stones, cemented pan. | Moderate: dusty. | Severe: small stones, droughty. |
| CLC: | | | | | |
| Coyanosa | Severe: small stones, depth to rock. | Severe: small stones, depth to rock. | Severe: slope, small stones, depth to rock. | Severe: small stones. | Severe: small stones, depth to rock. |
| Los Tanos | Slight | Slight | Moderate: slope, depth to rock. | Slight | Moderate: depth to rock. |
| EPB: | | | | | |
| Elgee | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Moderate: droughty. |
| Penwell | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Severe: droughty. |
| FDA: | | | | | |
| Faskin | Slight | Slight | Slight | Slight | Slight. |
| Douro | Slight | Slight | Slight | Slight | Moderate: cemented pan. |
| HAA: | | | | | |
| Harkey | Severe: flooding, excess salt. | Severe: excess salt. | Severe: excess salt. | Moderate: dusty. | Severe: excess salt. |
| Patrole | Severe: flooding. | Moderate: excess salt, percs slowly. | Moderate: flooding. | Moderate: dusty. | Severe: droughty. |
| HMB: | | | | | |
| Holloman | Severe: depth to rock, excess salt. | Severe: excess salt, depth to rock. | Severe: depth to rock, excess salt. | Severe: erodes easily. | Severe: excess salt, depth to rock. |
| Monahans | Slight | Slight | Moderate: slope. | Slight | Moderate: droughty. |

Table 6.--Recreational Development--Continued

| Soil name and map symbol | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| HRA: | | | | | |
| Holloman | Severe: depth to rock, excess salt. | Severe: excess salt, depth to rock. | Severe: depth to rock, excess salt. | Severe: erodes easily. | Severe: excess salt, depth to rock. |
| Reeves | Moderate: dusty, excess salt. | Moderate: excess salt, dusty. | Moderate: dusty, excess salt. | Severe: erodes easily. | Moderate: excess salt. |
| KAA: | | | | | |
| Kimbrough | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: erodes easily. | Severe: cemented pan. |
| Stegall | Slight | Slight | Slight | Slight | Moderate: cemented pan. |
| KBA: | | | | | |
| Kinco | Slight | Slight | Slight | Slight | Moderate: droughty. |
| Blakeney | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Slight | Severe: cemented pan. |
| MPA: | | | | | |
| Monahans | Slight | Slight | Slight | Slight | Moderate: droughty. |
| Pajarito | Slight | Slight | Slight | Slight | Slight. |
| PAC | Severe: small stones, cemented pan. | Severe: small stones, cemented pan. | Severe: small stones, cemented pan. | Severe: small stones. | Severe: small stones, cemented pan. |
| PAF: | | | | | |
| Paisano | Severe: small stones, cemented pan. | Severe: small stones, cemented pan. | Severe: slope, small stones, cemented pan. | Severe: small stones. | Severe: small stones, cemented pan. |
| Rock outcrop. | | | | | |
| PEA: | | | | | |
| Pecos | Severe: flooding. | Moderate: excess salt. | Moderate: flooding, excess salt. | Slight | Severe: droughty. |
| Arno | Severe: flooding, excess salt. | Severe: excess salt. | Severe: excess salt. | Moderate: too clayey. | Severe: excess salt, droughty. |
| Patrole | Severe: flooding. | Moderate: excess salt, percs slowly. | Moderate: flooding, percs slowly. | Slight | Severe: droughty. |
| PND: | | | | | |
| Penwell | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Severe: droughty. |
| Dune land. | | | | | |
| POB | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Severe: droughty. |

Table 6.--Recreational Development--Continued

| Soil name and map symbol | Camp areas | Picnic areas | Playgrounds | Paths and trails | Golf fairways |
|---|---|---|---|---|---|
| PPB: | | | | | |
| Pyote | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Severe: droughty. |
| Penwell | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Severe: droughty. |
| RAA Ratliff | Slight | Slight | Slight | Slight | Slight. |
| SHA Sharvana | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Slight | Severe: cemented pan. |
| SMB: | | | | | |
| Splotter | Severe: cemented pan. | Severe: cemented pan. | Severe: small stones, cemented pan. | Slight | Severe: cemented pan. |
| Mentone | Severe: ponding. | Severe: ponding. | Severe: ponding. | Severe: ponding. | Severe: ponding. |
| TMB: | | | | | |
| Tencee | Severe: cemented pan. | Severe: cemented pan. | Severe: small stones, cemented pan. | Slight | Severe: cemented pan. |
| Mentone | Severe: ponding. | Severe: ponding. | Severe: ponding. | Severe: ponding. | Severe: ponding. |
| TOA Toyah | Severe: flooding. | Slight | Moderate: flooding. | Slight | Moderate: flooding. |
| TUA Turney | Moderate: dusty. | Moderate: dusty. | Moderate: dusty. | Moderate: dusty. | Slight. |
| WCB: | | | | | |
| Wickett | Slight | Slight | Moderate: slope. | Slight | Moderate: droughty, cemented pan. |
| Pyote | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Severe: too sandy. | Severe: droughty. |
| WKA: | | | | | |
| Wickett | Slight | Slight | Moderate: slope. | Slight | Moderate: droughty, cemented pan. |
| Sharvana | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Slight | Severe: cemented pan. |
| WNA Wink | Slight | Slight | Moderate: small stones. | Slight | Moderate: droughty. |

Table 7.--Wildlife Habitat

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated.)

| Soil name and map symbol | Potential for habitat elements | | | | | | Potential as habitat for-- | | |
|---|---|---|---|---|---|---|---|---|---|
| | Grain and seed crops | Grasses and legumes | Wild herbaceous plants | Shrubs | Wetland plants | Shallow water areas | Openland wildlife | Wetland wildlife | Rangeland wildlife |
| BCB: | | | | | | | | | |
| Blakeney | Poor | Poor | Fair | Fair | Very poor | Very poor | Poor | Very poor | Fair. |
| Conger | Poor | Poor | Fair | Fair | Very poor | Very poor | Poor | Very poor | Fair. |
| CDD: | | | | | | | | | |
| Chamberino | Very poor | Very poor | Fair | Fair | Very poor | Very poor | Poor | Very poor | Fair. |
| Delnorte | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |
| CLC: | | | | | | | | | |
| Coyanosa | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |
| Los Tanos | Poor | Fair | Fair | Fair | Poor | Very poor | Fair | Very poor | Fair. |
| EPB: | | | | | | | | | |
| Elgee | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| Penwell | Very poor | Very poor | Fair | Poor | Very poor | Very poor | Very poor | Poor | Poor. |
| FDA: | | | | | | | | | |
| Faskin | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| Douro | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| HAA: | | | | | | | | | |
| Harkey | Very poor | Very poor | Poor | Poor | Poor | Very poor | Very poor | Very poor | Poor. |
| Patrole | Very poor | Very poor | Poor | Poor | Poor | Good | Very poor | Poor | Poor. |
| HMB: | | | | | | | | | |
| Holloman | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |
| Monahans | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |
| HRA: | | | | | | | | | |
| Holloman | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |
| Reeves | Very poor | Very poor | Fair | Poor | Very poor | Very poor | Poor | Very poor | Poor. |
| KAA: | | | | | | | | | |
| Kimbrough | Poor | Poor | Fair | Fair | Very poor | Very poor | Poor | Very poor | Fair. |
| Stegall | Fair | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| KBA: | | | | | | | | | |
| Kinco | Poor | Poor | Fair | Fair | Very poor | Very poor | Poor | Very poor | Fair. |
| Blakeney | Poor | Poor | Fair | Fair | Very poor | Very poor | Poor | Very poor | Fair. |
| MPA: | | | | | | | | | |
| Monahans | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |
| Pajarito | Very poor | Very poor | Poor | Poor | Poor | Very poor | Poor | Very poor | Poor. |

Table 7.--Wildlife Habitat--Continued

| Soil name and map symbol | Potential for habitat elements | | | | | | Potential as habitat for-- | | |
|---|---|---|---|---|---|---|---|---|---|
| | Grain and seed crops | Grasses and legumes | Wild herbaceous plants | Shrubs | Wetland plants | Shallow water areas | Openland wildlife | Wetland wildlife | Rangeland wildlife |
| PAC: Paisano | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |
| PAF: | | | | | | | | | |
| Paisano | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |
| Rock outcrop. | | | | | | | | | |
| PEA: | | | | | | | | | |
| Pecos | Very poor | Very poor | Poor | Poor | Poor | Good | Very poor | Fair | Poor. |
| Arno | Very poor | Very poor | Very poor | Poor | Very poor | Poor | Very poor | Very poor | Poor. |
| Patrole | Very poor | Very poor | Poor | Poor | Poor | Good | Very poor | Poor | Poor. |
| PND: | | | | | | | | | |
| Penwell | Very poor | Very poor | Fair | Poor | Very poor | Very poor | Very poor | Poor | Poor. |
| Dune land. | | | | | | | | | |
| POB: Pyote | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| PPB: | | | | | | | | | |
| Pyote | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| Penwell | Very poor | Very poor | Fair | Poor | Very poor | Very poor | Very poor | Poor | Poor. |
| RAA: Ratliff | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| SHA: Sharvana | Poor | Poor | Fair | Fair | Very poor | Very poor | Poor | Very poor | Fair. |
| SMB: | | | | | | | | | |
| Splotter | Very poor | Very poor | Poor | Poor | Poor | Very poor | Very poor | Very poor | Poor. |
| Mentone | Very poor | Poor | Fair | Fair | Poor | Very poor | Poor | Poor | Poor. |
| TMB: | | | | | | | | | |
| Tencee | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |
| Mentone | Very poor | Poor | Fair | Fair | Poor | Very poor | Poor | Poor | Poor. |
| TOA: Toyah | Poor | Poor | Poor | Poor | Very poor | Very poor | Poor | Very poor | Poor. |
| TUA: Turney | Very poor | Very poor | Fair | Fair | Very poor | Very poor | Poor | Very poor | Fair. |
| WCB: | | | | | | | | | |
| Wickett | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| WCB: | | | | | | | | | |
| Pyote | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| WKA: | | | | | | | | | |
| Wickett | Poor | Fair | Fair | Fair | Very poor | Very poor | Fair | Very poor | Fair. |
| Sharvana | Poor | Poor | Fair | Fair | Very poor | Very poor | Poor | Very poor | Fair. |

Table 7.--Wildlife Habitat--Continued

| Soil name and map symbol | Potential for habitat elements | | | | | | Potential as habitat for-- | | |
|---|---|---|---|---|---|---|---|---|---|
| | Grain and seed crops | Grasses and legumes | Wild herbaceous plants | Shrubs | Wetland plants | Shallow water areas | Openland wildlife | Wetland wildlife | Rangeland wildlife |
| WNA---------- Wink | Very poor | Very poor | Poor | Poor | Very poor | Very poor | Very poor | Very poor | Poor. |

Table 8.--Building Site Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

| Soil name and map symbol | Shallow excavations | Dwellings without basements | Dwellings with basements | Small commercial buildings | Local roads and streets | Lawns and landscaping |
|---|---|---|---|---|---|---|
| BCB: | | | | | | |
| Blakeney | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. |
| Conger | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. |
| CDD: | | | | | | |
| Chamberino | Moderate: slope. | Moderate: slope. | Moderate: slope. | Severe: slope. | Moderate: slope. | Moderate: small stones, large stones, slope. |
| Delnorte | Severe: cemented pan, cutbanks cave. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: small stones, droughty, cemented pan. |
| CLC: | | | | | | |
| Coyanosa | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Severe: small stones, depth to rock. |
| Los Tanos | Severe: depth to rock. | Moderate: depth to rock. | Severe: depth to rock. | Moderate: depth to rock. | Moderate: depth to rock. | Moderate: depth to rock. |
| EPB: | | | | | | |
| Elgee | Severe: cutbanks cave. | Slight | Slight | Slight | Slight | Moderate: droughty. |
| Penwell | Severe: cutbanks cave. | Slight | Slight | Slight | Slight | Severe: droughty. |
| FDA: | | | | | | |
| Faskin | Slight | Slight | Slight | Slight | Slight | Slight. |
| Douro | Severe: cemented pan. | Moderate: cemented pan. | Severe: cemented pan. | Moderate: cemented pan. | Moderate: cemented pan. | Moderate: cemented pan. |
| HAA: | | | | | | |
| Harkey | Moderate: wetness, flooding. | Severe: flooding. | Severe: flooding. | Severe: flooding. | Severe: flooding. | Severe: excess salt. |
| Patrole | Moderate: too clayey, flooding. | Severe: flooding. | Severe: flooding, shrink-swell. | Severe: flooding. | Severe: low strength, flooding. | Severe: droughty. |
| HMB: | | | | | | |
| Holloman | Severe: depth to rock. | Moderate: depth to rock. | Severe: depth to rock. | Moderate: depth to rock. | Moderate: depth to rock. | Severe: excess salt, depth to rock. |
| Monahans | Slight | Slight | Slight | Slight | Slight | Moderate: droughty. |

Table 8.--Building Site Development--Continued

| Soil name and map symbol | Shallow excavations | Dwellings without basements | Dwellings with basements | Small commercial buildings | Local roads and streets | Lawns and landscaping |
|---|---|---|---|---|---|---|
| HRA: | | | | | | |
| Holloman | Severe: depth to rock. | Moderate: depth to rock. | Severe: depth to rock. | Moderate: depth to rock. | Moderate: depth to rock. | Severe: excess salt, depth to rock. |
| Reeves | Slight | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell, low strength. | Moderate: excess salt. |
| KAA: | | | | | | |
| Kimbrough | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. |
| Stegall | Severe: cemented pan. | Moderate: shrink-swell, cemented pan. | Severe: cemented pan. | Moderate: shrink-swell, cemented pan. | Severe: low strength. | Moderate: cemented pan. |
| KBA: | | | | | | |
| Kinco | Slight | Slight | Slight | Slight | Slight | Moderate: droughty. |
| Blakeney | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. |
| MPA: | | | | | | |
| Monahans | Slight | Slight | Slight | Slight | Slight | Moderate: droughty. |
| Pajarito | Slight | Slight | Slight | Slight | Slight | Slight. |
| PAC | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: small stones, cemented pan. |
| PAF: | | | | | | |
| Paisano | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: small stones, cemented pan. |
| Rock outcrop. | | | | | | |
| PEA: | | | | | | |
| Pecos | Moderate: too clayey, flooding. | Severe: flooding, shrink-swell. | Severe: flooding, shrink-swell. | Severe: flooding, shrink-swell. | Severe: shrink-swell, low strength, flooding. | Severe: droughty. |
| Arno | Severe: cutbanks cave. | Severe: flooding, shrink-swell. | Severe: flooding, shrink-swell. | Severe: flooding, shrink-swell. | Severe: shrink-swell, low strength, flooding. | Severe: excess salt, droughty. |
| Patrole | Moderate: too clayey, flooding. | Severe: flooding. | Severe: flooding, shrink-swell. | Severe: flooding. | Severe: low strength, flooding. | Severe: droughty. |
| PND: | | | | | | |
| Penwell | Severe: cutbanks cave. | Slight | Slight | Slight | Slight | Severe: droughty. |
| Dune land. | | | | | | |

Table 8.--Building Site Development--Continued

| Soil name and map symbol | Shallow excavations | Dwellings without basements | Dwellings with basements | Small commercial buildings | Local roads and streets | Lawns and landscaping |
|---|---|---|---|---|---|---|
| POB: Pyote | Severe: cutbanks cave. | Slight | Slight | Slight | Slight | Severe: droughty. |
| PPB: | | | | | | |
| Pyote | Severe: cutbanks cave. | Slight | Slight | Slight | Slight | Severe: droughty. |
| Penwell | Severe: cutbanks cave. | Slight | Slight | Slight | Slight | Severe: droughty. |
| RAA: Ratliff | Slight | Slight | Slight | Slight | Moderate: low strength. | Slight. |
| SHA: Sharvana | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. |
| SMB: | | | | | | |
| Splotter | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. |
| Mentone | Severe: ponding. | Severe: ponding. | Severe: ponding. | Severe: ponding. | Severe: low strength, ponding. | Severe: ponding. |
| TMB: | | | | | | |
| Tencee | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. |
| Mentone | Severe: ponding. | Severe: ponding. | Severe: ponding. | Severe: ponding. | Severe: low strength, ponding. | Severe: ponding. |
| TOA: Toyah | Moderate: flooding. | Severe: flooding. | Severe: flooding. | Severe: flooding. | Severe: flooding. | Moderate: flooding. |
| TUA: Turney | Slight | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Moderate: shrink-swell. | Slight. |
| WCB: | | | | | | |
| Wickett | Moderate: cemented pan. | Slight | Moderate: cemented pan. | Slight | Slight | Moderate: droughty, cemented pan. |
| Pyote | Severe: cutbanks cave. | Slight | Slight | Slight | Slight | Severe: droughty. |
| WKA: Wickett | Moderate: cemented pan. | Slight | Moderate: cemented pan. | Slight | Slight | Moderate: droughty, cemented pan. |
| WKA: Sharvana | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. |
| WNA: Wink | Slight | Slight | Slight | Slight | Slight | Moderate: droughty. |

Table 9.--Sanitary Facilities

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

| Soil name and map symbol | Septic tank absorption fields | Sewage lagoon areas | Trench sanitary landfill | Area sanitary landfill | Daily cover for landfill |
|---|---|---|---|---|---|
| BCB: | | | | | |
| Blakeney | Severe: cemented pan. | Severe: seepage, cemented pan. | Severe: cemented pan. | Slight | Poor: cemented pan. |
| Conger | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Slight | Poor: cemented pan. |
| CDD: | | | | | |
| Chamberino | Moderate: depth to rock, percs slowly, slope. | Severe: seepage, slope. | Severe: depth to rock. | Moderate: slope. | Poor: small stones, slope. |
| Delnorte | Severe: cemented pan, poor filter. | Severe: seepage, cemented pan. | Severe: cemented pan. | Slight | Poor: cemented pan, too sandy, small stones. |
| CLC: | | | | | |
| Coyanosa | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Slight | Poor: depth to rock. |
| Los Tanos | Severe: depth to rock. | Severe: seepage, depth to rock. | Severe: depth to rock. | Slight | Poor: depth to rock. |
| EPB: | | | | | |
| Elgee | Severe: poor filter. | Severe: seepage. | Severe: too sandy. | Slight | Poor: seepage, too sandy. |
| Penwell | Severe: poor filter. | Severe: seepage. | Severe: too sandy. | Slight | Poor: seepage, too sandy. |
| FDA: | | | | | |
| Faskin | Moderate: percs slowly. | Moderate: seepage. | Slight | Slight | Good. |
| Douro | Severe: cemented pan. | Severe: seepage, cemented pan. | Severe: cemented pan. | Slight | Poor: cemented pan. |
| HAA: | | | | | |
| Harkey | Severe: flooding. | Severe: flooding. | Severe: flooding, wetness. | Severe: flooding. | Good. |
| Patrole | Severe: flooding, percs slowly. | Severe: flooding. | Severe: flooding. | Severe: flooding. | Poor: hard to pack. |
| HMB: | | | | | |
| Holloman | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Slight | Poor: depth to rock. |

Table 9.--Sanitary Facilities--Continued

| Soil name and map symbol | Septic tank absorption fields | Sewage lagoon areas | Trench sanitary landfill | Area sanitary landfill | Daily cover for landfill |
|---|---|---|---|---|---|
| HMB: | | | | | |
| Monahans | Moderate: percs slowly. | Moderate: seepage, slope. | Slight | Slight | Fair: small stones. |
| HRA: | | | | | |
| Holloman | Severe: depth to rock. | Severe: depth to rock. | Severe: depth to rock. | Slight | Poor: depth to rock. |
| Reeves | Moderate: percs slowly. | Moderate: seepage. | Slight | Slight | Poor: thin layer. |
| KAA: | | | | | |
| Kimbrough | Severe: cemented pan, percs slowly. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Poor: cemented pan, small stones. |
| Stegall | Severe: cemented pan, percs slowly. | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Poor: cemented pan. |
| KBA: | | | | | |
| Kinco | Slight | Severe: seepage. | Slight | Slight | Good. |
| Blakeney | Severe: cemented pan. | Severe: seepage, cemented pan. | Severe: cemented pan. | Slight | Poor: cemented pan. |
| MPA: | | | | | |
| Monahans | Moderate: percs slowly. | Moderate: seepage. | Slight | Slight | Good. |
| Pajarito | Slight | Severe: seepage. | Slight | Slight | Good. |
| PAC | Severe: cemented pan. | Severe: seepage, cemented pan. | Severe: cemented pan. | Slight | Poor: cemented pan, small stones. |
| PAF: | | | | | |
| Paisano | Severe: cemented pan. | Severe: seepage, cemented pan. | Severe: cemented pan. | Slight | Poor: cemented pan, small stones. |
| Rock outcrop. | | | | | |
| PEA: | | | | | |
| Pecos | Severe: flooding, percs slowly. | Severe: flooding. | Severe: flooding. | Severe: flooding. | Poor: hard to pack. |
| Arno | Severe: flooding, percs slowly. | Severe: flooding. | Severe: flooding, too clayey, excess salt. | Severe: flooding. | Poor: too clayey, hard to pack, excess salt. |
| Patrole | Severe: flooding, percs slowly. | Severe: flooding. | Severe: flooding. | Severe: flooding. | Poor: hard to pack. |

Table 9.--Sanitary Facilities--Continued

| Soil name and map symbol | Septic tank absorption fields | Sewage lagoon areas | Trench sanitary landfill | Area sanitary landfill | Daily cover for landfill |
|---|---|---|---|---|---|
| PND: | | | | | |
| Penwell | Severe: poor filter. | Severe: seepage. | Severe: too sandy. | Slight | Poor: seepage, too sandy. |
| Dune land. | | | | | |
| POB | Severe: poor filter. | Severe: seepage. | Severe: too sandy. | Slight | Poor: seepage, too sandy. |
| PPB: | | | | | |
| Pyote | Severe: poor filter. | Severe: seepage. | Severe: too sandy. | Slight | Poor: seepage, too sandy. |
| Penwell | Severe: poor filter. | Severe: seepage. | Severe: too sandy. | Slight | Poor: seepage, too sandy. |
| RAA | Moderate: percs slowly. | Moderate: seepage. | Slight | Slight | Good. |
| SHA | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Slight | Poor: cemented pan, small stones. |
| SMB: | | | | | |
| Splotter | Severe: cemented pan. | Severe: seepage, cemented pan. | Severe: cemented pan. | Slight | Poor: cemented pan, large stones. |
| Mentone | Severe: ponding, percs slowly. | Severe: ponding. | Severe: ponding. | Severe: ponding. | Poor: ponding. |
| TMB: | | | | | |
| Tencee | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Slight | Poor: cemented pan, small stones. |
| Mentone | Severe: ponding, percs slowly. | Severe: ponding. | Severe: ponding. | Severe: ponding. | Poor: ponding. |
| TOA | Severe: flooding. | Severe: flooding. | Severe: flooding. | Severe: flooding. | Fair: too clayey. |
| TUA | Moderate: percs slowly. | Moderate: seepage. | Slight | Slight | Good. |
| WCB: | | | | | |
| Wickett | Severe: cemented pan. | Severe: seepage, cemented pan. | Moderate: cemented pan. | Slight | Poor: cemented pan. |
| Pyote | Severe: poor filter. | Severe: seepage. | Severe: too sandy. | Slight | Poor: seepage, too sandy. |

Table 9.--Sanitary Facilities--Continued

| Soil name and map symbol | Septic tank absorption fields | Sewage lagoon areas | Trench sanitary landfill | Area sanitary landfill | Daily cover for landfill |
|---|---|---|---|---|---|
| WKA: | | | | | |
| Wickett | Severe: cemented pan. | Severe: seepage, cemented pan. | Moderate: cemented pan. | Slight | Poor: cemented pan. |
| Sharvana | Severe: cemented pan. | Severe: cemented pan. | Severe: cemented pan. | Slight | Poor: cemented pan, small stones. |
| WNA Wink | Slight | Severe: seepage. | Slight | Slight | Poor: small stones. |

Table 10.--Construction Materials

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

| Soil name and map symbol | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| BCB: | | | | |
| Blakeney | Poor: cemented pan. | Improbable: excess fines. | Improbable: excess fines. | Poor: cemented pan, small stones. |
| Conger | Poor: cemented pan. | Improbable: excess fines. | Improbable: excess fines. | Poor: cemented pan. |
| CDD: | | | | |
| Chamberino | Fair: depth to rock, thin layer. | Improbable: excess fines. | Improbable: excess fines. | Poor: small stones, area reclaim. |
| Delnorte | Poor: cemented pan. | Improbable: excess fines. | Improbable: excess fines. | Poor: cemented pan, too sandy, small stones. |
| CLC: | | | | |
| Coyanosa | Poor: depth to rock. | Improbable: excess fines. | Improbable: excess fines. | Poor: depth to rock, small stones. |
| Los Tanos | Poor: depth to rock. | Improbable: excess fines. | Improbable: excess fines. | Fair: depth to rock, thin layer. |
| EPB: | | | | |
| Elgee | Good | Probable | Improbable: too sandy. | Poor: too sandy. |
| Penwell | Good | Probable | Improbable: too sandy. | Poor: too sandy. |
| FDA: | | | | |
| Faskin | Good | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| Douro | Poor: cemented pan. | Improbable: excess fines. | Improbable: excess fines. | Poor: area reclaim. |
| HAA: | | | | |
| Harkey | Good | Improbable: excess fines. | Improbable: excess fines. | Poor: excess salt. |
| Patrole | Poor: shrink-swell, low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: excess salt. |
| HMB: | | | | |
| Holloman | Poor: depth to rock. | Improbable: excess fines. | Improbable: excess fines. | Poor: depth to rock, excess salt. |

Table 10.--Construction Materials--Continued

| Soil name and map symbol | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| HMB: | | | | |
| Monahans | Good | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey, small stones, area reclaim. |
| HRA: | | | | |
| Holloman | Poor: depth to rock. | Improbable: excess fines. | Improbable: excess fines. | Poor: depth to rock, excess salt. |
| Reeves | Poor: thin layer. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey, excess salt, thin layer. |
| KAA: | | | | |
| Kimbrough | Poor: cemented pan. | Improbable: excess fines. | Improbable: excess fines. | Poor: cemented pan, small stones, area reclaim. |
| Stegall | Poor: cemented pan. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey. |
| KBA: | | | | |
| Kinco | Good | Improbable: excess fines. | Improbable: excess fines. | Fair: small stones. |
| Blakeney | Poor: cemented pan. | Improbable: excess fines. | Improbable: excess fines. | Poor: cemented pan, small stones. |
| MPA: | | | | |
| Monahans | Good | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey, small stones, area reclaim. |
| Pajarito | Good | Improbable: excess fines. | Improbable: excess fines. | Fair: small stones. |
| PAC | Poor: cemented pan. | Improbable: excess fines. | Improbable: excess fines. | Poor: cemented pan, small stones, area reclaim. |
| PAF: | | | | |
| Paisano | Poor: cemented pan. | Improbable: excess fines. | Improbable: excess fines. | Poor: cemented pan, small stones, area reclaim. |
| Rock outcrop. | | | | |
| PEA: | | | | |
| Pecos | Good | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey, excess salt. |

Table 10.--Construction Materials--Continued

| Soil name and map symbol | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| PEA: | | | | |
| Arno | Poor: shrink-swell, low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: too clayey, excess salt. |
| Patrole | Poor: shrink-swell, low strength. | Improbable: excess fines. | Improbable: excess fines. | Poor: excess salt. |
| PND: | | | | |
| Penwell | Good | Probable | Improbable: too sandy. | Poor: too sandy. |
| Dune land. | | | | |
| POB | Good | Probable | Improbable: too sandy. | Poor: too sandy. |
| Pyote | | | | |
| PPB: | | | | |
| Pyote | Good | Probable | Improbable: too sandy. | Poor: too sandy. |
| Penwell | Good | Probable | Improbable: too sandy. | Poor: too sandy. |
| RAA | Fair: low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| Ratliff | | | | |
| SHA | Poor: cemented pan. | Improbable: excess fines. | Improbable: excess fines. | Poor: cemented pan, small stones, area reclaim. |
| Sharvana | | | | |
| SMB: | | | | |
| Splotter | Poor: cemented pan. | Improbable: excess fines, large stones. | Improbable: excess fines, large stones. | Poor: cemented pan, small stones. |
| Mentone | Poor: low strength, wetness. | Improbable: excess fines. | Improbable: excess fines. | Poor: wetness. |
| TMB: | | | | |
| Tencee | Poor: cemented pan. | Improbable: excess fines. | Improbable: excess fines. | Poor: cemented pan, small stones, area reclaim. |
| Mentone | Poor: low strength, wetness. | Improbable: excess fines. | Improbable: excess fines. | Poor: wetness. |
| TOA | Fair: shrink-swell, low strength. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey. |
| Toyah | | | | |
| TUA | Fair: shrink-swell. | Improbable: excess fines. | Improbable: excess fines. | Fair: too clayey, small stones. |
| Turney | | | | |

Table 10.--Construction Materials--Continued

| Soil name and map symbol | Roadfill | Sand | Gravel | Topsoil |
|---|---|---|---|---|
| WCB: | | | | |
| Wickett | Good | Improbable: excess fines. | Improbable: excess fines. | Fair: cemented pan, thin layer. |
| Pyote | Good | Probable | Improbable: too sandy. | Poor: too sandy. |
| WKA: | | | | |
| Wickett | Good | Improbable: excess fines. | Improbable: excess fines. | Fair: cemented pan, thin layer. |
| Sharvana | Poor: cemented pan. | Improbable: excess fines. | Improbable: excess fines. | Poor: cemented pan, small stones, area reclaim. |
| WNA Wink | Good | Improbable: excess fines. | Improbable: excess fines. | Poor: small stones, area reclaim. |

Table 11.--Water Management

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

| Soil name and map symbol | Limitations for-- Pond reservoir areas | Embankments, dikes, and levees | Features affecting-- Irrigation | Terraces and diversions |
|---|---|---|---|---|
| BCB: | | | | |
| Blakeney | Severe: seepage, cemented pan. | Severe: piping. | Slope, droughty. | Cemented pan. |
| Conger | Severe: cemented pan. | Severe: piping. | Slope, cemented pan. | Cemented pan, erodes easily. |
| CDD: | | | | |
| Chamberino | Severe: seepage, slope. | Severe: seepage. | Slope, droughty. | Slope. |
| Delnorte | Severe: seepage, cemented pan. | Severe: thin layer. | Slope, droughty, cemented pan. | Cemented pan, too sandy. |
| CLC: | | | | |
| Coyanosa | Severe: depth to rock. | Severe: thin layer. | Slope, droughty, depth to rock. | Depth to rock. |
| Los Tanos | Severe: seepage. | Severe: piping. | Slope, soil blowing, depth to rock. | Depth to rock. |
| EPB: | | | | |
| Elgee | Severe: seepage. | Severe: seepage, piping. | Slope, droughty, fast intake. | Too sandy, soil blowing. |
| Penwell | Severe: seepage. | Severe: seepage, piping. | Slope, droughty, fast intake. | Too sandy, soil blowing. |
| FDA: | | | | |
| Faskin | Moderate: seepage. | Severe: piping. | Favorable | Soil blowing. |
| Douro | Severe: seepage. | Severe: piping. | Soil blowing, cemented pan. | Cemented pan, soil blowing. |
| HAA: | | | | |
| Harkey | Moderate: seepage. | Severe: piping. | Droughty, flooding. | Erodes easily. |
| Patrole | Slight | Moderate: thin layer, hard to pack, excess salt. | Droughty, soil blowing, percs slowly. | Erodes easily, soil blowing, percs slowly. |
| HMB: | | | | |
| Holloman | Severe: depth to rock, seepage. | Severe: thin layer. | Droughty | Depth to rock, erodes easily. |

Table 11.--Water Management--Continued

| Soil name and map symbol | Limitations for-- Pond reservoir areas | Embankments, dikes, and levees | Features affecting-- Irrigation | Terraces and diversions |
|---|---|---|---|---|
| HMB: | | | | |
| Monahans | Moderate: seepage. | Severe: piping. | Droughty, soil blowing. | Soil blowing. |
| HRA: | | | | |
| Holloman | Severe: depth to rock, seepage. | Severe: thin layer. | Droughty | Depth to rock, erodes easily. |
| Reeves | Severe: seepage. | Moderate: thin layer, piping. | Excess salt | Erodes easily. |
| KAA: | | | | |
| Kimbrough | Severe: cemented pan. | Slight | Cemented pan | Cemented pan. |
| Stegall | Moderate: cemented pan. | Severe: piping. | Cemented pan | Cemented pan. |
| KBA: | | | | |
| Kinco | Severe: seepage. | Severe: piping. | Droughty, soil blowing. | Soil blowing. |
| Blakeney | Severe: seepage, cemented pan. | Severe: piping. | Droughty | Cemented pan. |
| MPA: | | | | |
| Monahans | Moderate: seepage. | Severe: piping. | Droughty, soil blowing. | Soil blowing. |
| Pajarito | Severe: seepage. | Severe: piping. | Soil blowing | Soil blowing. |
| PAC Paisano | Severe: seepage, cemented pan. | Slight | Slope, droughty, cemented pan. | Cemented pan. |
| PAF: | | | | |
| Paisano | Severe: seepage, cemented pan. | Slight | Slope, droughty, cemented pan. | Cemented pan. |
| Rock outcrop. | | | | |
| PEA: | | | | |
| Pecos | Slight | Moderate: hard to pack, excess salt. | Droughty, percs slowly. | Erodes easily, percs slowly. |
| Arno | Slight | Severe: excess salt. | Droughty, slow intake, percs slowly. | Percs slowly. |
| Patrole | Slight | Moderate: thin layer, hard to pack, excess salt. | Droughty, percs slowly. | Erodes easily, percs slowly. |

Table 11.--Water Management--Continued

| Soil name and map symbol | Limitations for-- Pond reservoir areas | Embankments, dikes, and levees | Features affecting-- Irrigation | Terraces and diversions |
|---|---|---|---|---|
| PND: | | | | |
| Penwell | Severe: seepage. | Severe: seepage, piping. | Droughty, fast intake. | Too sandy, soil blowing. |
| Dune land. | | | | |
| POB Pyote | Severe: seepage. | Severe: seepage, piping. | Droughty, fast intake. | Too sandy, soil blowing. |
| PPB: | | | | |
| Pyote | Severe: seepage. | Severe: seepage, piping. | Slope, droughty, fast intake. | Too sandy, soil blowing. |
| Penwell | Severe: seepage. | Severe: seepage, piping. | Slope, droughty, fast intake. | Too sandy, soil blowing. |
| RAA Ratliff | Moderate: seepage. | Moderate: piping. | Soil blowing | Soil blowing. |
| SHA Sharvana | Severe: cemented pan. | Severe: piping. | Droughty | Cemented pan. |
| SMB: | | | | |
| Splotter | Severe: cemented pan. | Severe: thin layer. | Slope, large stones, droughty. | Large stones, cemented pan, soil blowing. |
| Mentone | Slight | Severe: ponding. | Ponding | Ponding. |
| TMB: | | | | |
| Tencee | Severe: cemented pan. | Slight | Droughty, cemented pan. | Cemented pan. |
| Mentone | Slight | Severe: ponding. | Ponding | Ponding. |
| TOA Toyah | Moderate: seepage. | Severe: piping. | Flooding | Favorable. |
| TUA Turney | Moderate: seepage. | Severe: piping. | Favorable | Favorable. |
| WCB: | | | | |
| Wickett | Severe: seepage. | Severe: seepage, piping. | Droughty, fast intake, soil blowing. | Cemented pan, soil blowing. |
| Pyote | Severe: seepage. | Severe: seepage, piping. | Slope, droughty, fast intake. | Too sandy, soil blowing. |
| WKA: | | | | |
| Wickett | Severe: seepage. | Severe: seepage, piping. | Droughty, fast intake, soil blowing. | Cemented pan, soil blowing. |

Table 11.--Water Management--Continued

| Soil name and map symbol | Limitations for-- Pond reservoir areas | Embankments, dikes, and levees | Features affecting-- Irrigation | Terraces and diversions |
|---|---|---|---|---|
| WKA: | | | | |
| Sharvana | Severe: cemented pan. | Severe: piping. | Slope, droughty, fast intake. | Cemented pan. |
| WNA Wink | Severe: seepage. | Severe: piping. | Droughty | Soil blowing. |

Table 12.--Engineering Index Properties

(Absence of an entry indicates that data were not estimated.)

| Soil name and map symbol | Depth | USDA texture | Classification: Unified | Classification: AASHTO | Frag- ments 3-10 inches | Percentage passing sieve number--: 4 | 10 | 40 | 200 | Liquid limit | Plas- ticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | | | | Pct | | | | | Pct | |
| BCB: | | | | | | | | | | | |
| Blakeney-------- | 0-19 | Fine sandy loam | SC, SC-SM | A-4, A-2-4 | 0-5 | 80-95 | 75-95 | 60-80 | 30-50 | 18-27 | 4-10 |
| | 19-26 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 26-80 | Fine sandy loam, loam, gravelly loam. | SC, SC-SM, CL, CL-ML | A-2, A-4, A-6 | 5-20 | 75-95 | 70-90 | 55-85 | 25-55 | 15-25 | 4-12 |
| Conger---------- | 0-18 | Sandy clay loam | CL, CL-ML, SC, SC-SM | A-4, A-6 | 0-5 | 90-100 | 90-100 | 75-95 | 40-65 | 20-35 | 5-15 |
| | 18-24 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 24-80 | Loam, gravelly loam, gravelly clay loam. | CL, CL-ML, SC, SC-SM | A-4, A-6 | 5-15 | 80-95 | 75-90 | 60-85 | 45-70 | 20-40 | 5-22 |
| CDD: | | | | | | | | | | | |
| Chamberino------ | 0-4 | Gravelly fine sandy loam. | SM, GM | A-1, A-2 | 0-10 | 60-75 | 55-70 | 30-45 | 20-35 | 20-30 | NP-5 |
| | 4-41 | Very gravelly fine sandy loam, very gravelly loam. | GM-GC, GM, GC | A-2, A-1-b | 0-15 | 45-60 | 25-50 | 20-40 | 15-35 | 20-30 | NP-10 |
| | 41-57 | Gravelly loam---- | GM-GC, SC-SM, GC, SC | A-4 | 0-15 | 60-75 | 55-70 | 45-55 | 35-45 | 25-30 | 5-10 |
| | 57-80 | Weathered bedrock | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Delnorte-------- | 0-4 | Very gravelly loam. | GC, GM-GC, SC-SM, SC | A-2, A-4, A-6, A-1-b | 0-10 | 50-85 | 40-85 | 15-55 | 0-45 | 18-40 | 3-20 |
| | 4-8 | Extremely gravelly loam, extremely gravelly sandy loam, very gravelly loam. | GC, GM-GC, GM, GP-GM | A-2, A-1-b, A-1-a | 0-10 | 50-60 | 35-50 | 15-50 | 10-35 | 18-35 | 2-15 |
| | 8-22 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 22-80 | Very gravelly sandy loam, extremely gravelly sandy loam, extremely gravelly fine sand. | GC, GM-GC, SC-SM, SC | A-2, A-1-a, A-1-b | 0-10 | 25-75 | 20-50 | 15-35 | 5-20 | 18-35 | 2-15 |
| CLC: | | | | | | | | | | | |
| Coyanosa-------- | 0-5 | Very gravelly loam. | GC, GM-GC | A-1, A-2, A-4, A-6 | 0-8 | 30-60 | 20-55 | 20-50 | 15-45 | 22-35 | 5-15 |
| | 5-16 | Unweathered bedrock. | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Los Tanos------- | 0-8 | Fine sandy loam | SM | A-4, A-2 | 0 | 100 | 95-100 | 60-80 | 30-50 | 25-35 | NP-10 |
| | 8-30 | Sandy loam, loam, fine sandy loam. | ML, SM | A-4, A-2 | 0 | 100 | 95-100 | 60-85 | 30-65 | 25-35 | NP-10 |
| | 30-50 | Unweathered bedrock. | --- | --- | --- | --- | --- | --- | --- | --- | --- |

Table 12.--Engineering Index Properties--Continued

| Soil name and map symbol | Depth | USDA texture | Classification: Unified | Classification: AASHTO | Frag- ments 3-10 inches | Percentage passing sieve number--: 4 | 10 | 40 | 200 | Liquid limit | Plas- ticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | | | | Pct | | | | | Pct | |
| DUB. | | | | | | | | | | | |
| Dune land | | | | | | | | | | | |
| EPB: | | | | | | | | | | | |
| Elgee---------- | 0-62 | Fine sand-------- | SM, SP-SM | A-2-4, A-3 | 0 | 100 | 100 | 95-100 | 5-20 | <22 | NP-3 |
| | 62-80 | Loamy fine sand, fine sandy loam. | SM, SC-SM | A-2-4, A-4 | 0 | 100 | 100 | 80-98 | 25-50 | <25 | NP-7 |
| Penwell--------- | 0-9 | Fine sand-------- | SM, SP-SM, SP | A-2-4, A-3 | 0 | 100 | 98-100 | 70-100 | 2-25 | 16-22 | NP-3 |
| | 9-84 | Fine sand, loamy fine sand. | SM, SP, SP-SM | A-2-4, A-3 | 0 | 100 | 98-100 | 70-100 | 2-30 | 16-22 | NP-3 |
| FDA: | | | | | | | | | | | |
| Faskin---------- | 0-10 | Fine sandy loam | SM, SC-SM, CL-ML, ML | A-4 | 0 | 100 | 100 | 80-100 | 35-55 | 17-25 | 3-7 |
| | 10-42 | Sandy clay loam, loam, clay loam. | SC, SC-SM, CL, CL-ML | A-4, A-6 | 0 | 100 | 100 | 85-100 | 36-70 | 22-40 | 5-20 |
| | 42-62 | Sandy clay loam, loam, clay loam. | SC, SC-SM, CL, CL-ML | A-4, A-6 | 0 | 90-100 | 90-100 | 80-98 | 36-70 | 22-35 | 5-17 |
| Douro---------- | 0-5 | Fine sandy loam | SC-SM, ML, ML, CL-ML | A-4 | 0 | 100 | 100 | 70-90 | 35-60 | 15-20 | 3-7 |
| | 5-38 | Sandy clay loam, clay loam. | SC, CL, CL-ML, SC-SM | A-4, A-6 | 0 | 95-100 | 90-100 | 90-100 | 36-65 | 20-35 | 5-18 |
| | 38-50 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 50-80 | Gravelly loam, gravelly sandy clay loam, very gravelly sandy clay loam. | SC, SM, SC-SM | A-1-b, A-2-4 | 0-10 | 75-90 | 25-60 | 25-55 | 20-30 | 15-30 | NP-10 |
| HAA: | | | | | | | | | | | |
| Harkey---------- | 0-8 | Loam---------- | ML, CL-ML, CL | A-4 | 0 | 100 | 100 | 90-100 | 65-90 | 20-30 | NP-10 |
| | 8-60 | Very fine sandy loam, loam, silt loam. | CL-ML, ML, CL | A-4 | 0 | 100 | 100 | 95-100 | 75-90 | 20-30 | NP-10 |
| Patrole--------- | 0-10 | Very fine sandy loam. | CL, CL-ML | A-4, A-6 | 0 | 98-100 | 98-100 | 85-95 | 51-70 | 20-30 | 5-12 |
| | 10-24 | Loam, silt loam, silty clay loam. | CL | A-4, A-6 | 0 | 98-100 | 98-100 | 85-100 | 65-95 | 26-40 | 8-20 |
| | 24-50 | Clay, silty clay | CH | A-7 | 0 | 95-100 | 95-100 | 90-100 | 80-95 | 50-65 | 28-40 |
| | 50-80 | Variable--------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| HMB: | | | | | | | | | | | |
| Holloman-------- | 0-2 | Loam---------- | CL | A-6 | 0 | 100 | 95-100 | 70-90 | 55-75 | 25-35 | 10-15 |
| | 2-60 | Gypsiferous material. | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Monahans-------- | 0-8 | Fine sandy loam | SM, SC, SC-SM | A-2-4, A-2-6, A-4 | 0 | 90-100 | 90-100 | 70-98 | 25-50 | 18-30 | 3-12 |
| | 8-30 | Loam, fine sandy loam, sandy clay loam. | SC, CL, SC-SM, CL-ML | A-4, A-6 | 0 | 90-100 | 90-100 | 80-98 | 36-65 | 20-35 | 4-15 |
| | 30-60 | Loam, fine sandy loam, sandy clay loam. | SC, CL, SC-SM, CL-ML | A-2-4, A-2-6, A-4 | 0 | 75-100 | 70-95 | 55-90 | 25-60 | 20-35 | 4-15 |

Table 12.--Engineering Index Properties--Continued

| Soil name and map symbol | Depth | USDA texture | Classification: Unified | Classification: AASHTO | Frag- ments 3-10 inches | Percentage passing sieve number--: 4 | 10 | 40 | 200 | Liquid limit | Plas- ticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | | | | Pct | | | | | Pct | |
| HRA: | | | | | | | | | | | |
| Holloman-------- | 0-5 | Loam---------- | CL | A-6 | 0 | 100 | 95-100 | 70-90 | 55-75 | 25-35 | 10-15 |
| | 5-60 | Gypsiferous material. | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Reeves---------- | 0-14 | Loam---------- | CL | A-6 | 0 | 100 | 100 | 75-90 | 60-80 | 25-35 | 10-15 |
| | 14-23 | Loam, clay loam, silt loam. | CL | A-6 | 0 | 100 | 100 | 75-100 | 65-80 | 25-35 | 10-15 |
| | 23-60 | Gypsiferous material. | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| KAA: | | | | | | | | | | | |
| Kimbrough------- | 0-16 | Fine sandy loam | CL-ML, CL | A-4 | 0 | 80-90 | 75-85 | 65-75 | 50-60 | 20-25 | 5-10 |
| | 16-27 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 27-80 | Very gravelly loam. | GM-GC, GC | A-2 | 10-40 | 45-60 | 45-50 | 35-45 | 25-35 | 20-25 | 5-10 |
| Stegall--------- | 0-7 | Clay loam-------- | CL | A-6 | 0 | 100 | 95-100 | 85-100 | 55-80 | 28-40 | 11-20 |
| | 7-26 | Clay loam, clay | CL, CH | A-6, A-7-6 | 0 | 100 | 95-100 | 90-100 | 60-90 | 35-60 | 17-30 |
| | 26-38 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 38-60 | Variable--------- | SC, CL, CL-ML, SC-SM | A-4, A-6 | 0 | 100 | 95-100 | 80-100 | 36-60 | 20-40 | 7-22 |
| KBA: | | | | | | | | | | | |
| Kinco---------- | 0-8 | Fine sandy loam | SM, SC-SM, CL-ML, ML | A-2-4, A-4 | 0 | 98-100 | 95-100 | 80-98 | 25-55 | 18-25 | 2-7 |
| | 8-30 | Fine sandy loam, loam. | SM, SC-SM, CL-ML, ML | A-2-4, A-4 | 0 | 80-100 | 80-100 | 75-95 | 30-65 | 18-26 | 1-8 |
| | 30-60 | Loam, fine sandy loam. | SM, SC-SM, CL-ML, ML | A-2-4, A-4 | 0 | 90-100 | 90-100 | 80-98 | 30-65 | 18-28 | 1-9 |
| Blakeney-------- | 0-19 | Fine sandy loam | SC, SC-SM | A-4, A-2-4 | 0-5 | 80-95 | 75-95 | 60-80 | 30-50 | 18-27 | 4-10 |
| | 19-26 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 26-80 | Fine sandy loam, loam, gravelly loam. | SC, SC-SM, CL, CL-ML | A-2, A-4, A-6 | 5-20 | 75-95 | 70-90 | 55-85 | 25-55 | 15-25 | 4-12 |
| MPA: | | | | | | | | | | | |
| Monahans-------- | 0-12 | Fine sandy loam | SM, SC, SC-SM | A-2-4, A-2-6, A-4 | 0 | 90-100 | 90-100 | 70-98 | 25-50 | 18-30 | 3-12 |
| | 12-32 | Loam, fine sandy loam, sandy clay loam. | SC, CL, SC-SM, CL-ML | A-4, A-6 | 0 | 90-100 | 90-100 | 80-98 | 36-65 | 20-35 | 4-15 |
| | 32-60 | Loam, fine sandy loam, sandy clay loam. | SC, CL, SC-SM, CL-ML | A-2-4, A-2-6, A-4 | 0 | 75-100 | 70-95 | 55-90 | 25-60 | 20-35 | 4-15 |
| Pajarito-------- | 0-4 | Fine sandy loam | SM | A-2, A-4 | 0 | 100 | 100 | 85-100 | 30-45 | 15-20 | NP-5 |
| | 4-30 | Fine sandy loam, sandy loam. | SM | A-2, A-4 | 0 | 90-100 | 85-100 | 60-100 | 25-45 | 15-20 | NP-5 |
| | 30-60 | Fine sandy loam, sandy loam, loam. | SC-SM | A-4, A-2 | 0 | 90-100 | 85-100 | 60-95 | 20-50 | 15-25 | 5-10 |

Table 12.--Engineering Index Properties--Continued

| Soil name and map symbol | Depth | USDA texture | Classification: Unified | Classification: AASHTO | Frag- ments 3-10 inches | Percentage passing sieve number--: 4 | 10 | 40 | 200 | Liquid limit | Plas- ticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | | | | Pct | | | | | Pct | |
| PAC---------- Paisano | 0-3 | Very gravelly loam. | SM, SP-SM | A-1-a, A-1-b | 0-7 | 60-80 | 25-50 | 20-35 | 10-20 | 20-27 | NP-5 |
| | 3-8 | Very gravelly loam, very gravelly sandy clay loam. | GM-GC, GC, SC, GP-GC | A-1-a, A-1-b, A-2-4 | 0-7 | 60-80 | 25-50 | 20-45 | 10-35 | 20-27 | 5-10 |
| | 8-16 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 16-60 | Very gravelly sandy loam, very gravelly loam, very gravelly sandy clay loam. | GM-GC, GC, SC, GP-GC | A-1-a, A-1-b, A-2 | 0-7 | 50-75 | 25-50 | 25-45 | 10-35 | 20-27 | 5-10 |
| PAF: | | | | | | | | | | | |
| Paisano--------- | 0-4 | Very gravelly fine sandy loam. | SM, SP-SM | A-1-a, A-1-b | 0-7 | 60-80 | 25-50 | 20-35 | 10-20 | 20-27 | NP-5 |
| | 4-10 | Very gravelly loam, very gravelly sandy clay loam. | GM-GC, GC, SC, GP-GC | A-1-a, A-1-b, A-2-4 | 0-7 | 60-80 | 25-50 | 20-45 | 10-35 | 20-27 | 5-10 |
| | 10-26 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 26-80 | Very gravelly sandy loam, very gravelly loam, very gravelly sandy clay loam. | GM-GC, GC, SC, GP-GC | A-1-a, A-1-b, A-2 | 0-7 | 50-75 | 25-50 | 25-45 | 10-35 | 20-27 | 5-10 |
| Rock outcrop. | | | | | | | | | | | |
| PEA: | | | | | | | | | | | |
| Pecos---------- | 0-4 | Silty clay loam | CH, CL | A-7, A-6 | 0 | 100 | 95-100 | 90-100 | 80-95 | 30-55 | 15-35 |
| | 4-62 | Clay, silty clay, silty clay loam. | CL, CH | A-6, A-7 | 0 | 100 | 95-100 | 90-100 | 80-95 | 36-65 | 18-40 |
| | 62-80 | Loam, very fine sandy loam, silt loam. | SC-SM, CL-ML, SC | A-4 | 0 | 100 | 95-100 | 70-90 | 40-80 | 25-30 | 5-10 |
| Arno---------- | 0-6 | Clay---------- | CL, CH | A-7-6 | 0 | 98-100 | 95-100 | 95-100 | 80-95 | 40-65 | 21-40 |
| | 6-80 | Clay, silty clay, silty clay loam. | CL, CH | A-7-6 | 0 | 98-100 | 95-100 | 90-100 | 80-95 | 40-65 | 21-40 |
| Patrole--------- | 0-8 | Silty clay loam | CL | A-4, A-6 | 0 | 98-100 | 98-100 | 85-100 | 65-95 | 26-40 | 8-20 |
| | 8-28 | Loam, silt loam, silty clay loam. | CL | A-4, A-6 | 0 | 98-100 | 98-100 | 85-100 | 65-95 | 26-40 | 8-20 |
| | 28-50 | Clay, silty clay | CH | A-7 | 0 | 95-100 | 95-100 | 90-100 | 80-95 | 50-65 | 28-40 |
| | 50-80 | Variable--------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PND: | | | | | | | | | | | |
| Penwell--------- | 0-14 | Fine sand-------- | SM, SP-SM, SP | A-2-4, A-3 | 0 | 100 | 98-100 | 70-100 | 2-25 | 16-22 | NP-3 |
| | 14-80 | Fine sand, loamy fine sand. | SM, SP, SP-SM | A-2-4, A-3 | 0 | 100 | 98-100 | 70-100 | 2-30 | 16-22 | NP-3 |
| Dune land. | | | | | | | | | | | |

Table 12.--Engineering Index Properties--Continued

| Soil name and map symbol | Depth | USDA texture | Classification: Unified | Classification: AASHTO | Frag- ments 3-10 inches | Percentage passing sieve number--: 4 | 10 | 40 | 200 | Liquid limit | Plas- ticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | | | | Pct | | | | | Pct | |
| POB---------- Pyote | 0-36 | Fine sand-------- | SM, SP-SM | A-2-4, A-3 | 0 | 100 | 100 | 95-100 | 5-20 | 16-22 | NP-3 |
| | 36-74 | Fine sandy loam | SM, SC-SM, SP-SM | A-2-4 | 0 | 100 | 100 | 95-100 | 10-30 | 16-25 | NP-7 |
| | 74-80 | Loamy fine sand, fine sandy loam, gravelly fine sandy loam. | SM, SP-SM, SP-SM | A-2, A-1-b | 0 | 75-100 | 50-95 | 40-90 | 10-30 | 15-25 | NP-7 |
| PPB: | | | | | | | | | | | |
| Pyote---------- | 0-36 | Fine sand-------- | SM, SP-SM | A-2-4, A-3 | 0 | 100 | 100 | 95-100 | 5-20 | 16-22 | NP-3 |
| | 36-70 | Fine sandy loam | SM, SC-SM, SP-SM | A-2-4 | 0 | 100 | 100 | 95-100 | 10-30 | 16-25 | NP-7 |
| | 70-80 | Loamy fine sand, fine sandy loam, gravelly fine sandy loam. | SM, SP-SM, SP-SM | A-2, A-1-b | 0 | 75-100 | 50-95 | 40-90 | 10-30 | 15-25 | NP-7 |
| Penwell--------- | 0-14 | Fine sand-------- | SM, SP-SM, SP | A-2-4, A-3 | 0 | 100 | 98-100 | 70-100 | 2-25 | 16-22 | NP-3 |
| | 14-80 | Fine sand, loamy fine sand. | SM, SP, SP-SM | A-2-4, A-3 | 0 | 100 | 98-100 | 70-100 | 2-30 | 16-22 | NP-3 |
| RAA---------- Ratliff | 0-9 | Fine sandy loam | SC, SC-SM, CL, CL-ML | A-4 | 0 | 95-100 | 95-100 | 75-98 | 35-55 | 17-27 | 4-9 |
| | 9-22 | Clay loam, sandy clay loam, loam. | CL, SC | A-6, A-4 | 0 | 95-100 | 95-100 | 85-100 | 45-80 | 25-40 | 8-20 |
| | 22-60 | Clay loam, sandy clay loam, loam. | CL, SC | A-6, A-4 | 0 | 95-100 | 95-100 | 80-100 | 45-80 | 25-40 | 8-20 |
| SHA---------- Sharvana | 0-4 | Fine sandy loam | SM, SC-SM, ML, CL-ML | A-2-4, A-4 | 0 | 100 | 95-100 | 80-100 | 30-55 | 17-23 | 3-7 |
| | 4-18 | Sandy clay loam, fine sandy loam. | SC, CL, CL-ML, SC-SM | A-4, A-6 | 0 | 100 | 90-100 | 70-95 | 36-65 | 20-40 | 5-20 |
| | 18-26 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 26-60 | Variable--------- | SC, GC, CL-ML, SC-SM | A-4, A-6 | 0-5 | 70-100 | 50-100 | 45-90 | 35-65 | 20-40 | 7-22 |
| SMB: | | | | | | | | | | | |
| Splotter-------- | 0-3 | Gravelly fine sandy loam. | SC-SM, GM-GC, SC, GC | A-4 | 10-15 | 70-85 | 60-75 | 50-70 | 35-45 | 15-25 | 5-10 |
| | 3-11 | Very cobbly fine sandy loam, very cobbly loam. | SC-SM, SC, GM-GC, GC | A-4 | 45-55 | 65-85 | 60-80 | 50-70 | 35-45 | 15-25 | 5-10 |
| | 11-36 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 36-80 | Variable--------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Mentone--------- | 0-13 | Silty clay loam | CL | A-7-6, A-6 | 0 | 98-100 | 95-100 | 90-100 | 70-90 | 28-45 | 10-25 |
| | 13-41 | Loam, silt loam, silty clay loam. | CL | A-7-6, A-6 | 0 | 98-100 | 95-100 | 90-100 | 70-90 | 28-45 | 10-25 |
| | 41-60 | Loam, silt loam, silty clay loam. | CL | A-7-6, A-6 | 0 | 98-100 | 95-100 | 90-100 | 65-80 | 28-45 | 10-25 |

Table 12.--Engineering Index Properties--Continued

| Soil name and map symbol | Depth | USDA texture | Classification: Unified | Classification: AASHTO | Frag-ments 3-10 inches | Percentage passing sieve number--: 4 | 10 | 40 | 200 | Liquid limit | Plas-ticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | | | | Pct | | | | | Pct | |
| TMB: | | | | | | | | | | | |
| Tencee---------- | 0-2 | Gravelly loam---- | GM-GC, SC-SM, CL-ML | A-4 | 0-10 | 60-80 | 55-75 | 50-65 | 40-55 | 25-30 | 5-10 |
| | 2-12 | Very gravelly loam, extremely gravelly loam, very gravelly sandy loam. | GM-GC, GC, GP-GC | A-2, A-1-a, A-1-b | 10-15 | 25-50 | 20-45 | 15-35 | 10-25 | 25-30 | 5-10 |
| | 12-22 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 22-80 | Very gravelly sandy clay loam. | GM-GC, GC, GP-GC | A-2, A-1-a, A-1-b | 10-15 | 35-55 | 25-50 | 25-45 | 10-25 | 25-30 | 5-10 |
| Mentone--------- | 0-13 | Silty clay loam | CL | A-7-6, A-6 | 0 | 98-100 | 95-100 | 90-100 | 70-90 | 28-45 | 10-25 |
| | 13-47 | Loam, silt loam, silty clay loam. | CL | A-7-6, A-6 | 0 | 98-100 | 95-100 | 90-100 | 70-90 | 28-45 | 10-25 |
| | 47-80 | Loam, silt loam, silty clay loam. | CL | A-7-6, A-6 | 0 | 98-100 | 95-100 | 90-100 | 65-80 | 28-45 | 10-25 |
| TOA---------- Toyah | 0-18 | Clay loam-------- | CL, CL-ML | A-4, A-6 | 0 | 100 | 98-100 | 85-98 | 51-85 | 22-40 | 7-20 |
| | 18-60 | Loam, clay loam, sandy clay loam. | CL, SC, CL-ML, SC-SM | A-4, A-6 | 0 | 100 | 95-100 | 80-98 | 36-80 | 22-40 | 7-20 |
| TUA---------- Turney | 0-8 | Loam---------- | CL, SC | A-6 | 0 | 95-100 | 90-100 | 75-90 | 35-65 | 25-30 | 10-15 |
| | 8-25 | Sandy clay loam, clay loam, loam. | CL-ML, CL, SC, SC-SM | A-4, A-6 | 0 | 95-100 | 90-100 | 75-90 | 35-65 | 25-35 | 5-15 |
| | 25-60 | Sandy clay loam, clay loam, loam. | CL-ML, CL, SC, SC-SM | A-4, A-6 | 0 | 95-100 | 90-100 | 75-90 | 35-65 | 25-35 | 5-15 |
| WCB: | | | | | | | | | | | |
| Wickett--------- | 0-9 | Loamy fine sand | SM, SP-SM | A-2-4 | 0 | 100 | 98-100 | 75-98 | 10-25 | <22 | NP-4 |
| | 9-34 | Fine sandy loam, loam. | SM, SC-SM | A-2-4, A-4 | 0 | 100 | 98-100 | 80-98 | 13-40 | 15-22 | 2-7 |
| | 34-42 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 42-80 | Loamy fine sand, fine sandy loam, gravelly loam. | SM, SC-SM, GM, GM-GC | A-4 | 0-5 | 70-100 | 50-100 | 45-90 | 35-65 | 15-22 | 2-7 |
| Pyote---------- | 0-36 | Fine sand-------- | SM, SP-SM | A-2-4, A-3 | 0 | 100 | 100 | 95-100 | 5-20 | 16-22 | NP-3 |
| | 36-57 | Fine sandy loam | SM, SC-SM, SP-SM | A-2-4 | 0 | 100 | 100 | 95-100 | 10-30 | 16-25 | NP-7 |
| | 57-65 | Loamy fine sand, fine sandy loam, gravelly fine sandy loam. | SM, SP-SM, SP-SM | A-2, A-1-b | 0 | 75-100 | 50-95 | 40-90 | 10-30 | 15-25 | NP-7 |
| WKA: | | | | | | | | | | | |
| Wickett--------- | 0-15 | Loamy fine sand | SM, SP-SM | A-2-4 | 0 | 100 | 98-100 | 75-98 | 10-25 | <22 | NP-4 |
| | 15-36 | Fine sandy loam, loam. | SM, SC-SM | A-2-4, A-4 | 0 | 100 | 98-100 | 80-98 | 13-40 | 15-22 | 2-7 |
| | 36-63 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 63-80 | Loamy fine sand, fine sandy loam, gravelly loam. | SM, SC-SM, GM, GM-GC | A-4 | 0-5 | 70-100 | 50-100 | 45-90 | 35-65 | 15-22 | 2-7 |

Table 12.--Engineering Index Properties--Continued

| Soil name and map symbol | Depth | USDA texture | Classification: Unified | Classification: AASHTO | Frag- ments 3-10 inches | Percentage passing sieve number--: 4 | 10 | 40 | 200 | Liquid limit | Plas- ticity index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | | | | Pct | | | | | Pct | |
| WKA: | | | | | | | | | | | |
| Sharvana-------- | 0-4 | Loamy fine sand | SM, SC-SM | A-2-4 | 0 | 100 | 95-100 | 80-100 | 15-35 | <22 | NP-4 |
| | 4-18 | Sandy clay loam, fine sandy loam. | SC, CL, CL-ML, SC-SM | A-4, A-6 | 0 | 100 | 90-100 | 70-95 | 36-65 | 20-40 | 5-20 |
| | 18-28 | Indurated-------- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | 28-80 | Variable--------- | SC, GC, CL-ML, SC-SM | A-4, A-6 | 0-5 | 70-100 | 50-100 | 45-90 | 35-65 | 20-40 | 7-22 |
| WNA---------- Wink | 0-9 | Fine sandy loam | SM, SC-SM | A-2-4, A-4 | 0-5 | 95-100 | 90-100 | 80-100 | 25-45 | 17-25 | 3-7 |
| | 9-22 | Fine sandy loam, loam, sandy loam. | SM, SC-SM | A-2-4, A-4 | 0-5 | 90-100 | 85-100 | 80-100 | 25-45 | 17-25 | 3-7 |
| | 22-35 | Variable--------- | SC, GC, CL-ML, SC-SM | A-4 | 0-5 | 70-100 | 50-100 | 45-90 | 35-65 | <22 | NP-10 |
| | 35-60 | Gravelly loamy fine sand, gravelly fine sandy loam, very gravelly loam. | SM, SC-SM, GM | A-2-4, A-4, A-1-b | 0-5 | 40-80 | 25-75 | 20-50 | 15-45 | 17-25 | 3-7 |

Table 13.--Physical and Chemical Properties of the Soils

(Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated.)

| Soil name and map symbol | Depth | Clay | Moist bulk density | Permea- bility | Available water capacity | Soil reaction | Salinity | Shrink- swell potential | Erosion factors K | Erosion factors T | Wind erodi- bility group | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | Pct | g/cc | In/hr | In/in | pH | dS/m | | | | | Pct |
| BCB: | | | | | | | | | | | | |
| Blakeney-------- | 0-19 | 8-18 | 1.35-1.55 | 2.0-6.0 | 0.08-0.14 | 7.9-8.4 | 0-2 | Low------- | 0.24 | 1 | 3 | .5-2 |
| | 19-26 | --- | --- | 0.01-0.6 | --- | --- | --- | ---------- | ---- | | | |
| | 26-80 | 8-18 | 1.45-1.65 | 2.0-6.0 | 0.05-0.12 | 7.9-8.4 | 0-2 | Low------- | 0.15 | | | |
| Conger---------- | 0-18 | 18-27 | 1.30-1.50 | 0.6-2.0 | 0.14-0.20 | 7.9-8.4 | 0-2 | Low------- | 0.37 | 1 | 4L | 1-2 |
| | 18-24 | --- | --- | 0.01-0.6 | --- | --- | --- | ---------- | ---- | | | |
| | 24-80 | 20-35 | 1.35-1.55 | 0.6-2.0 | 0.06-0.10 | 7.9-8.4 | 0-2 | Low------- | 0.20 | | | |
| CDD: | | | | | | | | | | | | |
| Chamberino------ | 0-4 | 17-25 | 1.40-1.55 | 0.6-2.0 | 0.10-0.12 | 7.9-8.4 | 2-4 | Low------- | 0.20 | 4 | 5 | .5-1 |
| | 4-41 | 15-25 | 1.40-1.55 | 2.0-6.0 | 0.08-0.10 | 7.9-8.4 | 2-4 | Low------- | 0.15 | | | |
| | 41-57 | 17-27 | 1.40-1.55 | 0.6-2.0 | 0.10-0.12 | 7.9-8.4 | 2-4 | Low------- | 0.15 | | | |
| | 57-80 | --- | --- | 0.2-2.0 | --- | --- | --- | ---------- | ---- | | | |
| Delnorte-------- | 0-4 | 5-18 | 1.40-1.55 | 2.0-6.0 | 0.06-0.12 | 7.9-8.4 | 0-2 | Low------- | 0.10 | 1 | 8 | .5-1 |
| | 4-8 | 5-25 | 1.45-1.60 | 6.0-20 | 0.04-0.08 | 7.9-8.4 | 0-2 | Low------- | 0.02 | | | |
| | 8-22 | --- | --- | 0.01-0.6 | --- | --- | --- | Low------- | ---- | | | |
| | 22-80 | 5-18 | 1.45-1.60 | 6.0-20 | 0.01-0.06 | 7.9-8.4 | 0-2 | Low------- | 0.02 | | | |
| CLC: | | | | | | | | | | | | |
| Coyanosa-------- | 0-5 | 15-25 | 1.40-1.55 | 0.6-2.0 | 0.05-0.12 | 6.6-8.4 | <2 | Low------- | 0.10 | 1 | 8 | <1 |
| | 5-16 | --- | --- | 0.2-2.0 | --- | --- | --- | ---------- | ---- | | | |
| Los Tanos------- | 0-8 | 8-17 | 1.45-1.55 | 2.0-6.0 | 0.12-0.14 | 7.4-8.4 | 0-2 | Low------- | 0.28 | 2 | 3 | .3-.5 |
| | 8-30 | 8-18 | 1.45-1.55 | 2.0-6.0 | 0.13-0.15 | 7.4-8.4 | 0-2 | Low------- | 0.32 | | | |
| | 30-50 | --- | --- | 0.00-0.6 | --- | --- | --- | ---------- | ---- | | | |
| DUB. | | | | | | | | | | | | |
| Dune land | | | | | | | | | | | | |
| EPB: | | | | | | | | | | | | |
| Elgee---------- | 0-62 | 1-7 | 1.50-1.70 | 6.0-20 | 0.05-0.09 | 6.6-7.8 | 0-2 | Low------- | 0.10 | 5 | 1 | .1-.5 |
| | 62-80 | 8-15 | 1.45-1.65 | 2.0-6.0 | 0.09-0.13 | 6.6-7.8 | 0-2 | Low------- | 0.17 | | | |
| Penwell--------- | 0-9 | 3-10 | 1.50-1.65 | 6.0-20 | 0.03-0.08 | 6.6-7.8 | 0-2 | Low------- | 0.15 | 5 | 1 | .1-.5 |
| | 9-84 | 3-12 | 1.50-1.65 | 6.0-20 | 0.03-0.09 | 6.6-7.8 | 0-2 | Low------- | 0.15 | | | |
| FDA: | | | | | | | | | | | | |
| Faskin---------- | 0-10 | 8-20 | 1.35-1.55 | 2.0-6.0 | 0.10-0.15 | 6.6-7.8 | 0-2 | Low------- | 0.24 | 4 | 3 | .5-1 |
| | 10-42 | 20-35 | 1.30-1.50 | 0.6-2.0 | 0.12-0.18 | 7.4-8.4 | 0-2 | Low------- | 0.32 | | | |
| | 42-62 | 20-35 | 1.30-1.50 | 0.6-2.0 | 0.10-0.15 | 7.9-8.4 | 0-2 | Low------- | 0.32 | | | |
| Douro---------- | 0-5 | 10-18 | 1.45-1.60 | 2.0-6.0 | 0.10-0.15 | 6.6-7.8 | 0-2 | Low------- | 0.24 | 2 | 3 | .7-1 |
| | 5-38 | 18-35 | 1.45-1.60 | 0.6-2.0 | 0.12-0.18 | 6.6-8.4 | 0-2 | Low------- | 0.32 | | | |
| | 38-50 | --- | --- | 0.01-0.6 | --- | --- | --- | ---------- | ---- | | | |
| | 50-80 | 10-25 | 1.45-1.60 | 2.0-6.0 | 0.06-0.10 | 7.9-8.4 | 0-2 | Low------- | 0.24 | | | |
| HAA: | | | | | | | | | | | | |
| Harkey---------- | 0-8 | 15-27 | 1.40-1.50 | 0.6-2.0 | 0.07-0.13 | 8.5-9.0 | 2-16 | Low------- | 0.55 | 5 | 4L | .7-1 |
| | 8-60 | 15-18 | 1.40-1.50 | 0.6-2.0 | 0.07-0.13 | 8.5-9.0 | 4-16 | Low------- | 0.43 | | | |
| Patrole--------- | 0-10 | 15-20 | 1.40-1.55 | 0.6-2.0 | 0.04-0.15 | 7.9-8.4 | 2-8 | Low------- | 0.43 | 3 | 3 | .5-1 |
| | 10-24 | 18-30 | 1.25-1.40 | 0.2-0.6 | 0.04-0.15 | 7.9-8.4 | 2-16 | Low------- | 0.43 | | | |
| | 24-50 | 40-60 | 1.25-1.40 | <0.06 | 0.04-0.15 | 7.9-8.4 | 4-16 | High------ | 0.28 | | | |
| | 50-80 | --- | --- | 0.06-2.0 | --- | --- | --- | ---------- | ---- | | | |

Table 13.--Physical and Chemical Properties of the Soils--Continued

| Soil name and map symbol | Depth | Clay | Moist bulk density | Permea- bility | Available water capacity | Soil reaction | Salinity | Shrink- swell potential | Erosion factors K | Erosion factors T | Wind erodi- bility group | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | Pct | g/cc | In/hr | In/in | pH | dS/m | | | | | Pct |
| HMB: | | | | | | | | | | | | |
| Holloman-------- | 0-2 | 18-27 | 1.20-1.30 | 0.6-2.0 | 0.08-0.10 | 7.4-8.4 | 4-16 | Low------- | 0.37 | 2 | 4L | 0-.6 |
| | 2-60 | --- | --- | 0.2-0.6 | --- | --- | --- | ---------- | ---- | | | |
| Monahans-------- | 0-8 | 15-20 | 1.35-1.55 | 2.0-6.0 | 0.09-0.15 | 7.4-8.4 | 0-2 | Low------- | 0.24 | 5 | 3 | .5-1 |
| | 8-30 | 18-30 | 1.30-1.50 | 0.6-2.0 | 0.10-0.16 | 7.4-8.4 | 0-4 | Low------- | 0.28 | | | |
| | 30-60 | 18-30 | 1.35-1.55 | 0.6-2.0 | 0.07-0.14 | 7.4-8.4 | 0-4 | Low------- | 0.28 | | | |
| HRA: | | | | | | | | | | | | |
| Holloman-------- | 0-5 | 18-27 | 1.20-1.30 | 0.6-2.0 | 0.08-0.10 | 7.4-8.4 | 4-16 | Low------- | 0.37 | 2 | 4L | 0-.6 |
| | 5-60 | --- | --- | 0.2-0.6 | --- | --- | --- | ---------- | ---- | | | |
| Reeves---------- | 0-14 | 18-27 | 1.35-1.45 | 0.6-2.0 | 0.14-0.16 | 7.9-9.0 | 2-8 | Low------- | 0.37 | 3 | 4L | .4-.6 |
| | 14-23 | 18-35 | 1.40-1.50 | 0.6-2.0 | 0.09-0.17 | 7.9-9.0 | 2-8 | Moderate | 0.37 | | | |
| | 23-60 | --- | --- | 0.2-6.0 | --- | --- | --- | ---------- | ---- | | | |
| KAA: | | | | | | | | | | | | |
| Kimbrough------- | 0-16 | 15-20 | 1.35-1.45 | 0.6-2.0 | 0.14-0.16 | 7.4-8.4 | 0-2 | Low------- | 0.37 | 1 | 4L | 1-2 |
| | 16-27 | --- | --- | 0.01-0.6 | --- | --- | --- | ---------- | ---- | | | |
| | 27-80 | 15-25 | 1.35-1.45 | 0.2-2.0 | 0.05-0.10 | 7.4-8.4 | 0-2 | Low------- | 0.10 | | | |
| Stegall--------- | 0-7 | 20-35 | 1.25-1.45 | 0.6-2.0 | 0.15-0.20 | 6.6-8.4 | 0-2 | Moderate | 0.32 | 2 | 6 | 1-3 |
| | 7-26 | 35-45 | 1.30-1.55 | 0.2-0.6 | 0.14-0.19 | 7.4-8.4 | 0-2 | Moderate | 0.32 | | | |
| | 26-38 | --- | --- | 0.01-0.6 | --- | --- | --- | ---------- | ---- | | | |
| | 38-60 | 15-30 | 1.30-1.50 | 0.6-2.0 | 0.05-0.12 | 7.4-8.4 | 0-2 | Low------- | 0.32 | | | |
| KBA: | | | | | | | | | | | | |
| Kinco---------- | 0-8 | 10-18 | 1.25-1.45 | 2.0-6.0 | 0.10-0.14 | 7.9-8.4 | 0-0 | Low------- | 0.24 | 5 | 3 | .5-1 |
| | 8-30 | 10-18 | 1.25-1.45 | 2.0-6.0 | 0.08-0.12 | 7.9-8.4 | 0-0 | Low------- | 0.28 | | | |
| | 30-60 | 10-18 | 1.25-1.45 | 2.0-6.0 | 0.08-0.14 | 7.9-8.4 | 0-0 | Low------- | 0.28 | | | |
| Blakeney-------- | 0-19 | 8-18 | 1.35-1.55 | 2.0-6.0 | 0.08-0.14 | 7.9-8.4 | 0-2 | Low------- | 0.24 | 1 | 3 | .5-2 |
| | 19-26 | --- | --- | 0.01-0.6 | --- | --- | --- | ---------- | ---- | | | |
| | 26-80 | 8-18 | 1.45-1.65 | 2.0-6.0 | 0.05-0.12 | 7.9-8.4 | 0-2 | Low------- | 0.15 | | | |
| MPA: | | | | | | | | | | | | |
| Monahans-------- | 0-12 | 15-20 | 1.35-1.55 | 2.0-6.0 | 0.09-0.15 | 7.4-8.4 | 0-2 | Low------- | 0.24 | 5 | 3 | .5-1 |
| | 12-32 | 18-30 | 1.30-1.50 | 0.6-2.0 | 0.10-0.16 | 7.4-8.4 | 0-4 | Low------- | 0.28 | | | |
| | 32-60 | 18-30 | 1.35-1.55 | 0.6-2.0 | 0.07-0.14 | 7.4-8.4 | 0-4 | Low------- | 0.28 | | | |
| Pajarito-------- | 0-4 | 15-20 | 1.45-1.55 | 2.0-6.0 | 0.13-0.15 | 7.4-8.4 | 0-2 | Low------- | 0.24 | 5 | 3 | .5-.8 |
| | 4-30 | 15-20 | 1.45-1.55 | 2.0-6.0 | 0.13-0.15 | 7.9-8.4 | 0-2 | Low------- | 0.24 | | | |
| | 30-60 | 15-20 | 1.45-1.55 | 2.0-6.0 | 0.13-0.15 | 7.9-8.4 | 0-2 | Low------- | 0.24 | | | |
| PAC---------- | 0-3 | 12-20 | 1.45-1.60 | 2.0-6.0 | 0.05-0.11 | 7.9-8.4 | 0-2 | Low------- | 0.10 | 1 | 8 | 1-3 |
| Paisano | 3-8 | 12-20 | 1.45-1.60 | 2.0-6.0 | 0.05-0.11 | 7.9-8.4 | 0-2 | Low------- | 0.10 | | | |
| | 8-16 | --- | --- | 0.01-0.6 | --- | --- | --- | ---------- | ---- | | | |
| | 16-60 | 12-25 | 1.45-1.60 | 2.0-6.0 | 0.05-0.11 | 7.9-8.4 | 0-2 | Low------- | 0.10 | | | |
| PAF: | | | | | | | | | | | | |
| Paisano--------- | 0-4 | 12-20 | 1.45-1.60 | 2.0-6.0 | 0.05-0.11 | 7.9-8.4 | 0-2 | Low------- | 0.10 | 1 | 8 | 1-3 |
| | 4-10 | 12-20 | 1.45-1.60 | 2.0-6.0 | 0.05-0.11 | 7.9-8.4 | 0-2 | Low------- | 0.10 | | | |
| | 10-26 | --- | --- | 0.01-0.6 | --- | --- | --- | ---------- | ---- | | | |
| | 26-80 | 12-25 | 1.45-1.60 | 2.0-6.0 | 0.05-0.11 | 7.9-8.4 | 0-2 | Low------- | 0.10 | | | |
| Rock outcrop. | | | | | | | | | | | | |
| PEA: | | | | | | | | | | | | |
| Pecos---------- | 0-4 | 30-40 | 1.30-1.50 | 0.06-0.2 | 0.01-0.15 | 7.9-8.4 | 0-8 | High------ | 0.43 | 5 | 4 | 1-3 |
| | 4-62 | 35-60 | 1.40-1.50 | 0.06-0.2 | 0.01-0.15 | 6.6-8.4 | 2-16 | High------ | 0.37 | | | |
| | 62-80 | 15-27 | 1.35-1.50 | 0.6-2.0 | 0.03-0.10 | 7.4-8.4 | 2-16 | Low------- | 0.49 | | | |

Table 13.--Physical and Chemical Properties of the Soils--Continued

| Soil name and map symbol | Depth | Clay | Moist bulk density | Permea-bility | Available water capacity | Soil reaction | Salinity | Shrink-swell potential | Erosion factors K | Erosion factors T | Wind erodi-bility group | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | Pct | g/cc | In/hr | In/in | pH | dS/m | | | | | Pct |
| PEA: | | | | | | | | | | | | |
| Arno---------- | 0-6 | 40-60 | 1.20-1.40 | <0.06 | 0.08-0.15 | 7.9-8.4 | 2-16 | High------ | 0.32 | 5 | 4 | .1-2 |
| | 6-80 | 35-60 | 1.40-1.60 | <0.06 | 0.01-0.05 | 7.9-8.4 | 16-32 | High------ | 0.32 | | | |
| Patrole--------- | 0-8 | 18-30 | 1.25-1.40 | 0.2-0.6 | 0.04-0.15 | 7.9-8.4 | 2-8 | Low------- | 0.43 | 3 | 4L | .5-1 |
| | 8-28 | 18-30 | 1.25-1.40 | 0.2-0.6 | 0.04-0.15 | 7.9-8.4 | 2-16 | Low------- | 0.43 | | | |
| | 28-50 | 40-60 | 1.25-1.40 | <0.06 | 0.04-0.15 | 7.9-8.4 | 4-16 | High------ | 0.28 | | | |
| | 50-80 | --- | --- | 0.06-2.0 | --- | --- | --- | ---------- | ---- | | | |
| PND: | | | | | | | | | | | | |
| Penwell--------- | 0-14 | 3-10 | 1.50-1.65 | 6.0-20 | 0.03-0.08 | 6.6-7.8 | 0-2 | Low------- | 0.15 | 5 | 1 | .1-.5 |
| | 14-80 | 3-12 | 1.50-1.65 | 6.0-20 | 0.03-0.09 | 6.6-7.8 | 0-2 | Low------- | 0.15 | | | |
| Dune land. | | | | | | | | | | | | |
| POB---------- | 0-36 | 1-10 | 1.40-1.60 | 6.0-20 | 0.03-0.09 | 6.6-7.8 | 0-2 | Low------- | 0.15 | 5 | 1 | .1-.5 |
| Pyote | 36-74 | 8-18 | 1.35-1.55 | 2.0-6.0 | 0.08-0.14 | 6.6-8.4 | 0-2 | Low------- | 0.17 | | | |
| | 74-80 | 3-18 | 1.35-1.60 | 6.0-20 | 0.09-0.13 | 6.6-8.4 | 0-2 | Low------- | 0.17 | | | |
| PPB: | | | | | | | | | | | | |
| Pyote---------- | 0-36 | 1-10 | 1.40-1.60 | 6.0-20 | 0.03-0.09 | 6.6-7.8 | 0-2 | Low------- | 0.15 | 5 | 1 | .1-.5 |
| | 36-70 | 8-18 | 1.35-1.55 | 2.0-6.0 | 0.08-0.14 | 6.6-8.4 | 0-2 | Low------- | 0.17 | | | |
| | 70-80 | 3-18 | 1.35-1.60 | 6.0-20 | 0.09-0.13 | 6.6-8.4 | 0-2 | Low------- | 0.17 | | | |
| Penwell--------- | 0-14 | 3-10 | 1.50-1.65 | 6.0-20 | 0.03-0.08 | 6.6-7.8 | 0-2 | Low------- | 0.15 | 5 | 1 | .1-.5 |
| | 14-80 | 3-12 | 1.50-1.65 | 6.0-20 | 0.03-0.09 | 6.6-7.8 | 0-2 | Low------- | 0.15 | | | |
| RAA---------- | 0-9 | 12-20 | 1.35-1.55 | 2.0-6.0 | 0.10-0.15 | 7.9-8.4 | 0-2 | Low------- | 0.24 | 3 | 3 | .7-2 |
| Ratliff | 9-22 | 20-35 | 1.35-1.55 | 0.6-2.0 | 0.12-0.18 | 7.9-8.4 | 0-2 | Low------- | 0.32 | | | |
| | 22-60 | 20-35 | 1.35-1.55 | 0.6-2.0 | 0.10-0.16 | 7.9-8.4 | 0-2 | Low------- | 0.32 | | | |
| SHA---------- | 0-4 | 10-20 | 1.35-1.55 | 2.0-6.0 | 0.11-0.15 | 6.6-8.4 | 0-2 | Low------- | 0.24 | 1 | 3 | .7-2 |
| Sharvana | 4-18 | 15-30 | 1.30-1.60 | 0.6-2.0 | 0.12-0.17 | 7.4-8.4 | 0-2 | Low------- | 0.32 | | | |
| | 18-26 | --- | --- | 0.01-0.6 | --- | --- | --- | ---------- | ---- | | | |
| | 26-60 | 15-30 | 1.30-1.50 | 0.6-2.0 | 0.05-0.12 | 7.4-8.4 | 0-2 | Low------- | ---- | | | |
| SMB: | | | | | | | | | | | | |
| Splotter-------- | 0-3 | 7-18 | 1.50-1.60 | 2.0-6.0 | 0.09-0.11 | 7.4-8.4 | 0-2 | Low------- | 0.20 | 1 | 3 | .2-.6 |
| | 3-11 | 5-18 | 1.50-1.60 | 6.0-20 | 0.07-0.10 | 7.4-8.4 | 0-2 | Low------- | 0.10 | | | |
| | 11-36 | --- | --- | --- | --- | --- | --- | ---------- | ---- | | | |
| | 36-80 | --- | --- | --- | --- | --- | --- | ---------- | ---- | | | |
| Mentone--------- | 0-13 | 18-35 | 1.30-1.45 | 0.2-0.6 | 0.14-0.20 | 6.6-8.4 | 0-2 | Moderate | 0.32 | 5 | 4 | 1-5 |
| | 13-41 | 18-35 | 1.25-1.40 | 0.2-0.6 | 0.14-0.20 | 6.6-8.4 | 0-2 | Moderate | 0.32 | | | |
| | 41-60 | 18-35 | 1.30-1.45 | 0.2-0.6 | 0.14-0.20 | 6.6-8.4 | 0-2 | Moderate | 0.32 | | | |
| TMB: | | | | | | | | | | | | |
| Tencee---------- | 0-2 | 18-27 | 1.35-1.55 | 0.6-2.0 | 0.12-0.14 | 7.9-8.4 | 0-2 | Low------- | 0.20 | 1 | 8 | .3-.6 |
| | 2-12 | 18-27 | 1.35-1.55 | 0.6-2.0 | 0.08-0.10 | 7.9-8.4 | 0-2 | Low------- | 0.10 | | | |
| | 12-22 | --- | --- | 0.01-0.6 | --- | --- | --- | ---------- | ---- | | | |
| | 22-80 | 18-27 | 1.35-1.55 | 0.6-2.0 | 0.08-0.10 | 7.9-8.4 | 0-2 | Low------- | 0.10 | | | |
| Mentone--------- | 0-13 | 18-35 | 1.30-1.45 | 0.2-0.6 | 0.14-0.20 | 6.6-8.4 | 0-2 | Moderate | 0.32 | 5 | 4 | 1-5 |
| | 13-47 | 18-35 | 1.25-1.40 | 0.2-0.6 | 0.14-0.20 | 6.6-8.4 | 0-2 | Moderate | 0.32 | | | |
| | 47-80 | 18-35 | 1.30-1.45 | 0.2-0.6 | 0.14-0.20 | 6.6-8.4 | 0-2 | Moderate | 0.32 | | | |
| TOA---------- | 0-18 | 20-35 | 1.15-1.35 | 0.6-2.0 | 0.14-0.20 | 7.9-8.4 | 0-4 | Moderate | 0.28 | 5 | 4L | 1-3 |
| Toyah | 18-60 | 20-35 | 1.20-1.40 | 0.6-2.0 | 0.12-0.18 | 7.9-8.4 | 0-4 | Moderate | 0.28 | | | |

Table 13.--Physical and Chemical Properties of the Soils--Continued

| Soil name and map symbol | Depth | Clay | Moist bulk density | Permea- bility | Available water capacity | Soil reaction | Salinity | Shrink- swell potential | Erosion factors K | Erosion factors T | Wind erodi- bility group | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | Pct | g/cc | In/hr | In/in | pH | dS/m | | | | | Pct |
| TUA---------- | 0-8 | 18-27 | 1.20-1.30 | 0.6-2.0 | 0.15-0.17 | 7.4-8.4 | 0-2 | Moderate | 0.32 | 3 | 4L | .4-.6 |
| Turney | 8-25 | 18-35 | 1.45-1.55 | 0.6-2.0 | 0.15-0.18 | 7.9-9.0 | 2-4 | Moderate | 0.32 | | | |
| | 25-60 | 18-35 | 1.45-1.60 | 0.6-2.0 | 0.15-0.18 | 7.9-9.0 | 2-4 | Moderate | 0.32 | | | |
| WCB: | | | | | | | | | | | | |
| Wickett--------- | 0-9 | 5-12 | 1.40-1.60 | 6.0-20 | 0.06-0.10 | 6.6-7.8 | 0-2 | Low------- | 0.17 | 2 | 2 | 0-1 |
| | 9-34 | 8-18 | 1.35-1.65 | 2.0-6.0 | 0.10-0.15 | 7.4-8.4 | 0-2 | Low------- | 0.20 | | | |
| | 34-42 | --- | --- | 0.01-0.6 | --- | --- | --- | ---------- | ---- | | | |
| | 42-80 | 5-18 | 1.40-1.80 | 2.0-6.0 | 0.02-0.05 | 7.9-8.4 | 0-2 | Low------- | 0.20 | | | |
| Pyote---------- | 0-36 | 1-10 | 1.40-1.60 | 6.0-20 | 0.03-0.09 | 6.6-7.8 | 0-2 | Low------- | 0.15 | 5 | 1 | .1-.5 |
| | 36-57 | 8-18 | 1.35-1.55 | 2.0-6.0 | 0.08-0.14 | 6.6-8.4 | 0-2 | Low------- | 0.17 | | | |
| | 57-65 | 3-18 | 1.35-1.60 | 6.0-20 | 0.09-0.13 | 6.6-8.4 | 0-2 | Low------- | 0.17 | | | |
| WKA: | | | | | | | | | | | | |
| Wickett--------- | 0-15 | 5-12 | 1.40-1.60 | 6.0-20 | 0.06-0.10 | 6.6-7.8 | 0-2 | Low------- | 0.17 | 2 | 2 | 0-1 |
| | 15-36 | 8-18 | 1.35-1.65 | 2.0-6.0 | 0.10-0.15 | 7.4-8.4 | 0-2 | Low------- | 0.20 | | | |
| | 36-63 | --- | --- | 0.01-0.6 | --- | --- | --- | ---------- | ---- | | | |
| | 63-80 | 5-18 | 1.40-1.80 | 2.0-6.0 | 0.02-0.05 | 7.9-8.4 | 0-2 | Low------- | 0.20 | | | |
| Sharvana-------- | 0-4 | 3-12 | 1.40-1.60 | 2.0-6.0 | 0.06-0.10 | 6.6-8.4 | 0-2 | Low------- | 0.17 | 1 | 2 | .5-2 |
| | 4-18 | 15-30 | 1.30-1.60 | 0.6-2.0 | 0.12-0.17 | 7.4-8.4 | 0-2 | Low------- | 0.32 | | | |
| | 18-28 | --- | --- | 0.01-0.6 | --- | --- | --- | ---------- | ---- | | | |
| | 28-80 | 15-30 | 1.30-1.50 | 0.6-2.0 | 0.05-0.12 | 7.4-8.4 | 0-2 | Low------- | ---- | | | |
| WNA---------- | 0-9 | 8-18 | 1.35-1.55 | 2.0-6.0 | 0.10-0.14 | 7.9-8.4 | 0-2 | Low------- | 0.20 | 3 | 3 | .1-.5 |
| Wink | 9-22 | 8-18 | 1.35-1.55 | 2.0-6.0 | 0.10-0.15 | 7.9-8.4 | 0-2 | Low------- | 0.20 | | | |
| | 22-35 | 8-18 | 1.55-1.70 | 2.0-6.0 | 0.02-0.08 | 7.9-8.4 | 0-2 | Low------- | 0.20 | | | |
| | 35-60 | 6-20 | 1.50-1.65 | 2.0-6.0 | 0.04-0.08 | 7.9-8.4 | 0-2 | Low------- | 0.20 | | | |

Table 14.--Soil and Water Features

("Flooding" and "water table" and terms such as "brief," "apparent," and "perched" are explained in the text. Absence of an entry indicates that the feature is not a concern or that data were not estimated.)

| Soil name and map symbol | Hydrologic group | Flooding | | | High water table | | | Bedrock | | Cemented pan | | Risk of corrosion | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Frequency | Duration | Months | Depth | Kind | Months | Depth | Hardness | Depth | Thickness | Uncoated steel | Concrete |
| | | | | | Ft | | | In | | In | | | |
| BCB: | | | | | | | | | | | | | |
| Blakeney | C | None | --- | --- | >6.0 | --- | --- | >60 | --- | 7-20 | Thick | Moderate | Low. |
| Conger | D | None | --- | --- | >6.0 | --- | --- | >60 | --- | 8-20 | Thick | Moderate | Low. |
| CDD: | | | | | | | | | | | | | |
| Chamberino | C | None | --- | --- | >6.0 | --- | --- | 40-60 | Soft | --- | --- | High | Low. |
| Delnorte | D | None | --- | --- | >6.0 | --- | --- | >60 | --- | 7-20 | Thick | High | Low. |
| CLC: | | | | | | | | | | | | | |
| Coyanosa | D | None | --- | --- | >6.0 | --- | --- | 3-14 | Hard | --- | --- | Moderate | Low. |
| Los Tanos | C | None | --- | --- | >6.0 | --- | --- | 20-40 | Hard | --- | --- | Moderate | Low. |
| DUB. | | | | | | | | | | | | | |
| Dune land | | | | | | | | | | | | | |
| EPB: | | | | | | | | | | | | | |
| Elgee | A | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | Low | Low. |
| Penwell | A | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | Low | Low. |
| FDA: | | | | | | | | | | | | | |
| Faskin | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | Moderate | Low. |
| Douro | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | 20-40 | Thick | Moderate | Low. |
| HAA: | | | | | | | | | | | | | |
| Harkey | B | Occasional | Very brief | Jul-Aug | 4.0-6.0 | Apparent | Apr-Nov | >60 | --- | --- | --- | High | Moderate. |
| Patrole | C | Occasional | Brief | Jul-Oct | >6.0 | --- | --- | >60 | --- | --- | --- | High | Low. |
| HMB: | | | | | | | | | | | | | |
| Holloman | D | None | --- | --- | >6.0 | --- | --- | 2-20 | Soft | --- | --- | High | High. |
| Monahans | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | High | Moderate. |
| HRA: | | | | | | | | | | | | | |
| Holloman | D | None | --- | --- | >6.0 | --- | --- | 2-20 | Soft | --- | --- | High | High. |
| Reeves | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | High | High. |
| KAA: | | | | | | | | | | | | | |
| Kimbrough | D | None | --- | --- | >6.0 | --- | --- | >60 | --- | 4-20 | Thick | Moderate | Low. |
| Stegall | C | None | --- | --- | >6.0 | --- | --- | >60 | --- | 20-40 | Thick | Moderate | Low. |
| KBA: | | | | | | | | | | | | | |
| Kinco | A | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | Moderate | Low. |
| Blakeney | C | None | --- | --- | >6.0 | --- | --- | >60 | --- | 7-20 | Thick | Moderate | Low. |
| MPA: | | | | | | | | | | | | | |
| Monahans | B | None | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | High | Moderate. |

Table 14.--Soil and Water Features--Continued

| Soil name and map symbol | Hydro-logic group | Flooding: Frequency | Flooding: Duration | Flooding: Months | High water table: Depth | High water table: Kind | High water table: Months | Bedrock: Depth | Bedrock: Hard-ness | Cemented pan: Depth | Cemented pan: Thick-ness | Risk of corrosion: Uncoated steel | Risk of corrosion: Concrete |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Ft | | | In | | In | | | |
| MPA: | | | | | | | | | | | | | |
| Pajarito--------- | B | None------ | --- | --- | >6.0 | --- | --- | >80 | --- | --- | --- | High----- | Low. |
| PAC---------- Paisano | D | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | 8-14 | Thick | Moderate | Low. |
| PAF: | | | | | | | | | | | | | |
| Paisano---------- | D | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | 8-14 | Thick | Moderate | Low. |
| Rock outcrop. | | | | | | | | | | | | | |
| PEA: | | | | | | | | | | | | | |
| Pecos---------- | D | Occasional | Brief----- | Jul-Oct | >6.0 | --- | --- | >60 | --- | --- | --- | High----- | Moderate. |
| Arno---------- | D | Occasional | Brief----- | Jul-Oct | >6.0 | --- | --- | >60 | --- | --- | --- | High----- | High. |
| Patrole---------- | C | Occasional | Brief----- | Jul-Oct | >6.0 | --- | --- | >60 | --- | --- | --- | High----- | Low. |
| PND: | | | | | | | | | | | | | |
| Penwell---------- | A | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | Low------ | Low. |
| Dune land. | | | | | | | | | | | | | |
| POB---------- Pyote | A | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | Moderate | Low. |
| PPB: | | | | | | | | | | | | | |
| Pyote---------- | A | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | Moderate | Low. |
| Penwell---------- | A | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | Low------ | Low. |
| RAA---------- Ratliff | B | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | Moderate | Low. |
| SHA---------- Sharvana | C | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | 7-20 | Thick | Low------ | Low. |
| SMB: | | | | | | | | | | | | | |
| Splotter--------- | D | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | 10-20 | Thick | Low------ | Low. |
| Mentone---------- | C | None------ | --- | --- | +.5-0.5 | Perched | Jul-Sep | >60 | --- | --- | --- | High----- | Low. |
| TMB: | | | | | | | | | | | | | |
| Tencee---------- | D | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | 7-20 | Thick | Moderate | Low. |
| Mentone---------- | C | None------ | --- | --- | +.5-0.5 | Perched | Jul-Sep | >60 | --- | --- | --- | High----- | Low. |
| TOA---------- Toyah | B | Occasional | Very brief | Apr-Oct | >6.0 | --- | --- | >60 | --- | --- | --- | High----- | Low. |
| TUA---------- Turney | B | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | High----- | Low. |
| WCB: | | | | | | | | | | | | | |
| Wickett---------- | C | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | 20-40 | Thin | Low------ | Low. |
| Pyote---------- | A | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | Moderate | Low. |

Table 14.--Soil And Water Features--Continued

| Soil name and map symbol | Hydro-logic group | Flooding | | | High water table | | | Bedrock | | Cemented pan | | Risk of corrosion | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Frequency | Duration | Months | Depth | Kind | Months | Depth | Hard-ness | Depth | Thick-ness | Uncoated steel | Concrete |
| | | | | | Ft | | | In | | In | | | |
| WKA: | | | | | | | | | | | | | |
| Wickett---------- | C | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | 20-40 | Thin | Low------ | Low. |
| Sharvana--------- | C | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | 7-20 | Thick | Low------ | Low. |
| WNA---------- Wink | B | None------ | --- | --- | >6.0 | --- | --- | >60 | --- | --- | --- | High----- | Low. |

Table 15.--Physical Properties of Selected Soils

(Analyses by the National Soil Survey Laboratory, Lincoln, Nebraska. Dashes indicate data were not available. The location of each pedon sampled is the same as that of the typical pedon in the section "Soil Series and Their Morphology." TR means trace.)

| Soil Series and Sample Numbers | Depth | Horizon | Particle size distribution (Percent less than 2 mm): Sand: Very coarse (2.0-1.0) | Coarse (1.0-0.5) | Medium (0.5-0.25) | Fine (0.25-0.1) | Very fine (0.1-0.05) | Total (2.0-0.05) | Silt (0.05-0.002) | Clay 0.002 | Bulk Density: 1/3-bar | Oven dry | COLE whole soil | Water Content Pct of <2mm: 1/3-bar | 15-bar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | | | | | | | | | | g/cc | g/cc | cm/cm | | |
| Elgee | 0-19 | A | 0.1 | 0.6 | 22.4 | 63.8 | 9.8 | 96.7 | 1.3 | 2.0 | 1.66 | 1.66 | --- | 2.9 | 0.9 |
| S91TX-495-39 | 19-52 | E1 | --- | 0.5 | 20.1 | 62.2 | 12.1 | 94.9 | 3.5 | 1.6 | 1.79 | 1.82 | 0.006 | 4.9 | 1.3 |
| | 52-62 | E2 | --- | 0.4 | 17.0 | 62.5 | 13.4 | 93.3 | 4.1 | 2.6 | 1.65 | 1.66 | | 7.8 | 1.6 |
| | 62-72 | Bt1 | TR | 0.5 | 17.5 | 56.9 | 10.5 | 85.4 | 3.2 | 11.4 | 1.69 | 1.77 | 0.016 | 11.9 | 6.2 |
| | 72-80 | Bt2 | --- | 0.4 | 21.6 | 57.2 | 8.2 | 87.4 | 3.0 | 9.6 | 1.72 | 1.72 | --- | 10.2 | 4.5 |
| Mentone | 0-5 | A1 | 0.1 | 0.2 | 0.4 | 1.6 | 13.6 | 15.9 | 55.0 | 29.1 | --- | --- | --- | --- | 13.8 |
| S91TX-301-34 | 5-13 | A2 | TR | 0.1 | 0.4 | 1.9 | 15.0 | 17.4 | 49.9 | 32.7 | 1.31 | 1.53 | 0.053 | 30.5 | 15.4 |
| | 13-27 | Bw1 | TR | 0.1 | 0.6 | 4.5 | 14.3 | 19.5 | 46.3 | 34.2 | 1.55 | 1.77 | 0.045 | 22.2 | 15.1 |
| | 27-40 | Bw2 | TR | 0.1 | 0.7 | 6.7 | 18.3 | 25.8 | 45.3 | 28.9 | 1.17 | 1.70 | 0.133 | 25.1 | 13.1 |
| | 40-47 | Bw3 | 0.1 | 0.2 | 2.9 | 17.1 | 23.8 | 44.1 | 38.1 | 17.8 | 1.60 | 1.68 | 0.016 | 16.8 | 7.8 |
| | 47-64 | Bwb1 | --- | 0.1 | 0.7 | 5.8 | 19.0 | 25.6 | 48.9 | 25.5 | 1.61 | 1.75 | 0.028 | 18.5 | 12.2 |
| | 64-80 | Bwb2 | --- | 0.1 | 1.0 | 5.4 | 14.5 | 21.0 | 54.6 | 24.4 | 1.45 | 1.64 | 0.042 | 25.0 | 12.4 |
| Pecos | 0-4 | A | 0.1 | 0.1 | 0.2 | 0.4 | 3.4 | 4.2 | 67.3 | 28.5 | 1.18 | 1.27 | 0.025 | 32.8 | 14.1 |
| S91TX-301-35 | 4-13 | Bzk1 | --- | 0.1 | 0.1 | 0.2 | 2.4 | 2.8 | 44.1 | 53.1 | 1.27 | 1.75 | 0.113 | 32.1 | 19.5 |
| | 13-22 | Bzk2 | --- | TR | 0.1 | 0.2 | 1.2 | 1.5 | 38.4 | 60.1 | 1.29 | 1.69 | 0.094 | 32.8 | 20.9 |
| | 22-36 | Bzk3 | --- | --- | --- | 0.1 | 0.4 | 0.5 | 37.2 | 62.3 | 1.29 | 1.91 | 0.140 | 33.5 | 22.0 |
| | 36-40 | Bzk4 | --- | 0.1 | 0.1 | 0.2 | 0.4 | 0.8 | 31.8 | 67.4 | 1.16 | 1.63 | 0.120 | 39.0 | 24.5 |
| | 40-52 | Bzk5 | 0.2 | 0.2 | 0.1 | 0.1 | 0.2 | 0.8 | 43.7 | 55.5 | 1.33 | 1.74 | 0.094 | 31.0 | 23.1 |
| | 52-62 | Bg | 0.1 | 0.1 | 0.2 | 0.5 | 1.0 | 1.9 | 34.4 | 63.7 | 1.16 | 1.80 | 0.158 | 39.2 | 25.3 |
| | 62-80 | 2BC | 0.3 | 1.7 | 5.8 | 22.3 | 36.4 | 66.5 | 20.5 | 13.0 | 1.44 | 1.48 | 0.009 | 12.8 | 5.9 |
| Pyote | 0-4 | A | 0.1 | 0.5 | 21.6 | 61.3 | 11.6 | 95.1 | 3.2 | 1.7 | --- | --- | --- | --- | 1.0 |
| S91TX-495-38 | 4-21 | E1 | --- | 0.6 | 22.7 | 60.6 | 11.4 | 95.3 | 2.6 | 2.1 | --- | --- | --- | --- | 1.0 |
| | 21-36 | E2 | 0.2 | 0.9 | 18.6 | 60.5 | 14.3 | 94.5 | 2.6 | 2.9 | 1.65 | 1.72 | 0.014 | 5.8 | 1.5 |
| | 36-44 | Bt1 | --- | 0.4 | 17.3 | 53.4 | 10.2 | 81.3 | 2.8 | 15.9 | 1.72 | 1.86 | 0.026 | 12.2 | 6.5 |
| | 44-55 | Bt2 | --- | 0.3 | 14.9 | 54.0 | 14.1 | 83.3 | 3.1 | 13.6 | 1.69 | 1.84 | 0.029 | 10.3 | 5.6 |
| | 55-63 | Bt3 | 0.1 | 0.3 | 17.1 | 55.6 | 15.2 | 88.3 | 3.1 | 8.6 | 1.69 | 1.72 | 0.006 | 6.8 | 4.0 |
| | 63-74 | BCt | TR | 0.3 | 17.9 | 51.6 | 12.9 | 82.7 | 2.4 | 14.9 | 1.66 | 1.72 | 0.012 | 13.3 | 6.4 |
| | 74-80 | BCk | 1.1 | 1.8 | 10.8 | 36.6 | 15.9 | 66.2 | 20.5 | 13.3 | 1.50 | 1.52 | 0.002 | 21.6 | 5.2 |
| Splotter | 0-4 | A | 0.2 | 0.4 | 9.6 | 37.9 | 27.2 | 75.3 | 17.7 | 7.0 | --- | --- | --- | --- | 3.6 |
| S91TX-301-36 | 4-11 | Bk | 0.6 | 0.5 | 11.7 | 36.7 | 22.6 | 72.1 | 16.6 | 11.3 | --- | --- | --- | --- | 5.4 |
| | 11-17 | Bkm1 | 18.3 | 17.7 | 14.1 | 17.8 | 9.9 | 77.8 | 15.3 | 6.9 | --- | --- | --- | --- | 4.4 |
| | 17-36 | Bkm2 | 11.5 | 14.8 | 15.5 | 20.6 | 11.7 | 74.1 | 21.2 | 4.7 | --- | --- | --- | --- | 4.8 |
| | 36-80 | BCk | 3.1 | 5.5 | 11.1 | 32.5 | 22.8 | 75.0 | 23.2 | 1.8 | --- | --- | --- | --- | 6.1 |
| Wickett | 0-5 | A1 | TR | 0.4 | 21.3 | 51.3 | 15.7 | 88.7 | 6.0 | 5.3 | 1.67 | 1.67 | --- | 7.0 | 2.5 |
| S91TX-495-37 | 5-15 | A2 | --- | 0.4 | 18.0 | 53.3 | 15.0 | 86.7 | 5.4 | 7.9 | 1.56 | 1.60 | --- | 6.8 | 2.9 |
| | 15-29 | Bt1 | --- | 0.4 | 14.4 | 51.3 | 16.3 | 82.4 | 5.3 | 12.3 | 1.65 | 1.70 | 0.010 | 9.5 | 5.0 |
| | 29-36 | Bt2 | --- | 0.4 | 17.5 | 47.4 | 13.7 | 79.0 | 2.8 | 18.2 | 1.64 | 1.71 | 0.014 | 12.8 | 7.0 |
| | 36-63 | Bkm | 22.3 | 18.5 | 14.6 | 16.6 | 9.1 | 81.1 | 13.2 | 5.7 | --- | --- | --- | --- | 4.6 |
| | 63-80 | BCk | 10.2 | 11.8 | 16.1 | 24.5 | 13.2 | 75.8 | 17.8 | 6.4 | --- | --- | --- | --- | 3.1 |

Table 16.--Chemical Properties of Selected Soils

(Analyses by the National Soil Survey Laboratory, Lincoln, Nebraska. Dashes indicate data were not available. The location of each pedon sampled is the same as that of the typical pedon in the section "Soil Series and Their Morphology." TR means trace.)

| Soil Series and Sample Numbers | Depth | Horizon | $NH_4OAc$ Extractable Bases Ca | Mg | Na | K | SUM | $NH_4OAc$ CEC | <2mm $CaCO_3$ | Electrical Conductivity | SAR | pH $H_2O$ (1:1) | pH $CaCl_2$ .01M (1:2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In | | meq/100g | | | | | | Pct | dS/m | | | |
| Elgee | 0-19 | A | 1.8 | 0.1 | TR | --- | 1.9 | 1.7 | --- | 0.06 | --- | 7.3 | 6.6 |
| S91TX-495-39 | 19-52 | E1 | 1.5 | 0.4 | 0.1 | --- | 2.0 | 1.8 | TR | 0.06 | --- | 7.4 | 6.7 |
| | 52-62 | E2 | 1.7 | 0.3 | --- | 0.1 | 2.1 | 1.9 | --- | 0.06 | --- | 7.3 | 6.7 |
| | 62-72 | Bt1 | 6.3 | 2.3 | TR | 0.3 | 8.9 | 7.5 | --- | 0.07 | --- | 7.2 | 6.7 |
| | 72-80 | Bt2 | 4.4 | 1.4 | TR | 0.2 | 6.0 | 5.9 | TR | 0.05 | --- | 7.3 | 6.6 |
| Mentone | 0-5 | A1 | 31.9 | 4.0 | TR | 2.5 | 38.4 | 30.0 | TR | 1.24 | TR | 7.4 | 7.0 |
| S91TX-301-34 | 5-13 | A2 | 24.5 | 1.9 | --- | 1.5 | 27.9 | 27.7 | --- | 0.14 | --- | 7.2 | 6.7 |
| | 13-27 | Bw1 | 24.5 | 3.4 | TR | 1.3 | 29.2 | 26.4 | --- | 0.06 | --- | 7.5 | 6.8 |
| | 27-40 | Bw2 | 19.1 | 3.4 | TR | 1.0 | 23.5 | 22.4 | --- | 0.09 | --- | 7.1 | 6.6 |
| | 40-47 | Bw3 | 13.2 | 2.9 | TR | 0.8 | 16.9 | 15.6 | --- | 0.06 | --- | 7.1 | 6.5 |
| | 47-64 | Bwb1 | 18.1 | 3.5 | 0.2 | 1.1 | 22.9 | 21.7 | TR | 0.07 | --- | 7.5 | 6.8 |
| | 64-80 | Bwb2 | 18.1 | 3.7 | --- | 1.2 | 23.0 | 21.8 | --- | 0.08 | --- | 7.5 | 6.8 |
| Pecos | 0-4 | A | --- | 5.1 | 0.2 | 2.1 | --- | 25.3 | 18 | 0.93 | 1 | 8.2 | 7.7 |
| S91TX-301-35 | 4-13 | Bzk1 | --- | 6.4 | 1.4 | 1.6 | --- | 32.8 | 15 | 2.26 | 2 | 7.9 | 7.7 |
| | 13-22 | Bzk2 | --- | 13.0 | 9.0 | 0.9 | --- | 35.4 | 15 | 9.16 | 11 | 8.4 | 7.7 |
| | 22-36 | Bzk3 | --- | 8.0 | 11.2 | 0.8 | --- | 38.5 | 12 | 22.70 | 12 | 7.6 | 7.6 |
| | 36-40 | Bzk4 | --- | 11.9 | 13.2 | 0.7 | --- | 42.2 | 10 | 12.00 | 13 | 7.2 | 7.4 |
| | 40-52 | Bzk5 | --- | 11.5 | 14.7 | 0.7 | --- | 36.0 | 13 | 12.90 | 13 | 7.3 | 7.5 |
| | 52-62 | Bg | --- | 13.4 | 16.2 | 0.8 | --- | 40.2 | 10 | 13.90 | 13 | 7.4 | 7.5 |
| | 62-80 | 2BC | --- | 3.2 | 3.6 | 0.1 | --- | 7.5 | 10 | 13.70 | 14 | 7.6 | 7.7 |
| Pyote | 0-4 | A | 1.9 | 0.3 | TR | 0.1 | 2.3 | 2.2 | --- | 0.12 | --- | 7.0 | 6.5 |
| S91TX-495-38 | 4-21 | E1 | 1.8 | 0.3 | --- | 0.1 | 2.2 | 1.9 | --- | 0.06 | --- | 7.2 | 6.5 |
| | 21-36 | E2 | 2.1 | 0.4 | --- | --- | 2.5 | 2.3 | --- | 0.06 | --- | 7.5 | 6.9 |
| | 36-44 | Bt1 | 6.4 | 1.6 | 0.1 | 0.3 | 8.4 | 8.9 | --- | 0.08 | --- | 7.7 | 7.0 |
| | 44-55 | Bt2 | 6.4 | 1.6 | TR | 0.3 | 8.3 | 8.0 | --- | 0.06 | --- | 7.4 | 6.8 |
| | 55-63 | Bt3 | 4.4 | 1.3 | TR | 0.1 | 5.8 | 5.3 | --- | 0.05 | --- | 7.4 | 6.7 |
| | 63-74 | BCt | 6.5 | 1.3 | TR | 0.2 | 8.0 | 8.3 | --- | 0.04 | --- | 7.2 | 6.7 |
| | 74-80 | BCk | --- | 1.5 | 0.1 | 0.2 | --- | 4.3 | 25 | 0.13 | --- | 8.1 | 7.5 |
| Splotter | 0-4 | A | --- | 0.7 | TR | 0.3 | --- | 8.1 | 1 | 1.79 | TR | 7.9 | 7.4 |
| S91TX-301-36 | 4-11 | Bk | --- | 1.2 | TR | 0.3 | --- | 9.6 | 5 | 0.77 | TR | 8.2 | 7.6 |
| | 11-17 | Bkm1 | --- | 1.1 | 0.6 | --- | --- | 1.8 | 74 | 3.64 | 4 | 8.0 | 8.0 |
| | 17-36 | Bkm2 | --- | 1.1 | 0.3 | --- | --- | 1.9 | 62 | 2.63 | 1 | 7.8 | 7.7 |
| | 36-80 | BCk | --- | 1.3 | 1.1 | --- | --- | 4.9 | 21 | 3.67 | 4 | 7.8 | 7.6 |
| Wickett | 0-5 | A1 | 6.1 | 0.7 | --- | 0.3 | 7.1 | --- | --- | 0.23 | --- | 7.6 | 7.0 |
| S91TX-495-37 | 5-15 | A2 | 4.8 | 0.6 | --- | 0.2 | 5.6 | 5.3 | TR | 0.07 | --- | 7.5 | 6.8 |
| | 15-29 | Bt1 | 6.6 | 1.9 | --- | 0.2 | 8.7 | 8.5 | --- | 0.08 | --- | 7.6 | 6.9 |
| | 29-36 | Bt2 | 8.8 | 2.9 | 0.1 | 0.2 | 12.0 | 11.2 | TR | 0.12 | --- | 7.7 | 7.0 |
| | 36-63 | Bkm | --- | 1.3 | 0.1 | --- | --- | 2.1 | 81 | 0.64 | TR | 8.5 | 7.9 |
| | 63-80 | BCk | --- | 0.9 | 0.1 | --- | --- | 1.6 | 84 | 2.16 | 2 | 8.0 | 7.7 |

Table 17.--Classification of the Soils

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.)

| Soil name | Family or higher taxonomic class |
|---|---|
| Arno | Fine, montmorillonitic, thermic Halic Haplotorrerts |
| Blakeney | Loamy, mixed, thermic, shallow Ustollic Paleorthids |
| Chamberino | Loamy-skeletal, mixed, thermic Typic Calciorthids |
| Conger | Loamy, mixed, thermic, shallow Ustollic Paleorthids |
| *Coyanosa | Loamy-skeletal, mixed, nonacid, thermic Lithic Ustic Torriorthents |
| Delnorte | Loamy-skeletal, mixed, thermic, shallow Typic Paleorthids |
| Douro | Fine-loamy, siliceous, thermic Petrocalcic Ustollic Paleargids |
| Elgee | Sandy, siliceous, thermic Arenic Ustalfic Haplargids |
| Faskin | Fine-loamy, siliceous, thermic Ustollic Haplargids |
| Harkey | Coarse-silty, mixed (calcareous), thermic Typic Torrifluvents |
| Holloman | Loamy, gypsic, thermic, shallow Typic Torriorthents |
| Kimbrough | Loamy, mixed, thermic, shallow Petrocalcic Calciustolls |
| Kinco | Coarse-loamy, mixed, thermic Ustochreptic Calciorthids |
| Los Tanos | Coarse-loamy, mixed, thermic Ustollic Camborthids |
| Mentone | Fine-silty, mixed, thermic Torrifluventic Haplustolls |
| *Monahans | Coarse-loamy, mixed, thermic Calcic Gypsiorthids |
| Paisano | Loamy-skeletal, carbonatic, thermic, shallow Ustollic Paleorthids |
| Pajarito | Coarse-loamy, mixed, thermic Typic Camborthids |
| Patrole | Fine-silty over clayey, mixed (calcareous), thermic Typic Torrifluvents |
| Pecos | Fine, mixed (calcareous), thermic Vertic Torrifluvents |
| Penwell | Siliceous, thermic Ustic Torripsamments |
| Pyote | Loamy, siliceous, thermic Arenic Ustalfic Haplargids |
| Ratliff | Fine-loamy, mixed, thermic Ustollic Calciorthids |
| Reeves | Fine-loamy, gypsic, thermic Calcic Gypsiorthids |
| Sharvana | Loamy, siliceous, thermic, shallow Petrocalcic Ustollic Paleargids |
| Splotter | Loamy-skeletal, mixed, thermic, shallow Typic Paleorthids |
| *Stegall | Fine, mixed, thermic Petrocalcic Paleustolls |
| Tencee | Loamy-skeletal, carbonatic, thermic, shallow Typic Paleorthids |
| Toyah | Fine-loamy, mixed, thermic Torrifluventic Haplustolls |
| Turney | Fine-loamy, mixed, thermic Typic Calciorthids |
| Wickett | Coarse-loamy, siliceous, thermic Petrocalcic Ustollic Paleargids |
| Wink | Coarse-loamy, mixed, thermic Typic Calciorthids |